Masterarbeit im Studiengang

„Environmental Management“ - Management natürlicher Ressourcen

Introduction and Implementation of the LEEN Energy Management System for network oriented companies

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Abstract

The finite availability of natural resources (oil, gas, charcoal, etc) and its influences in products from production and consumption point new challenges for the energy management in organisations. The decision to write the present work was taken based on the need to impulse activities towards the configuration of a sustainable resource use within companies and consequently their contribution to the global environmental protection.

Therefore this master thesis aims to investigate which contribution the energy networks based on the LEEN management system standard (management system in development phase) offer to any participating organisation in attaining a more efficient energy usage.

For that purpose three different methods will be applied: comparison between the LEEN management system and the DIN EN 16001 (energy management standard), interviews with network participants and one case study.

In conclusion the current and future aspects offered by the LEEN management system to help the companies by the compliance with the DIN EN 16001 (as identification of energy potential and definition of energy potentials and the monitoring of energy consumption), the tools offered by the systems by supporting the practical implementation of energy efficiency measures and the help provided to the organisational structuring toward energy efficiency implementation will be showed.

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1. Introduction

1.1 Background

The current energy supply situation, the future expectations in worldwide oil and gas exploitation and the continued intensification of climate change have been leading the world towards a fundamental rethinking concerning energy issues. In the first instance the growth in energy demand over the last few years, especially in those rapidly developing countries such as China and India have been causing a significant increase in both energy costs and gas emissions, both of which, following the existing peak oil[1] predictions will almost certainly continue to rise in future years.

As a consequence, the competitive ability of some countries will be negatively affected, particularly those who are dependent on international energy imports. Germany for example depends on gas and oil imports from Russia, Norway and Great Britain (about one third of the German gas and oil import in 2008 came from Russia) (Focus, 2009). Higher costs of fuel and foodstuffs, conflicts over critical water supplies and dwindling mineral resources are just some examples of the issues of a potential oil crisis.

In the European Union the ambitious 20-20-20 goal (greenhouse gases reduction by 20%, energy consumption reduction by 20% and increase of renewable energies share in energy consumption by 20%) by 2020 is an example of impulses towards the enhancement of energy efficiency. Furthermore business recognises the importance of fighting climate change and the opportunities deriving from energy efficiency. Unfortunately some disturbances as the economic and financial crisis, lack of awareness and information, lack of effective policies and lack of time are found by the implementation of energy efficiency measures influencing the amount of exploited potential.

Because of the limited resources availability (personal and financial) there is in the companies, particularly in the small ones a lack of energy expertise. The organisations do not know exactly how to identify their energy potential and monitor their energy consumption. The result of this is no insight into energy losses because of the inexistence of properly investigation and measurement from the real energy consumption and monitoring of the impacts of measures implementation. Furthermore the financial situation and the fact that the energy efficiency needs to be more encouraged by the government limits the implementation of energy saving measures. High investments, long payback period, no availability to get a loan influence directly in the number of companies, which really implement energy measures (Change, 2010).

[1] Peak Oil is the point in time when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline. Peak of Oil: Die Zeitenwende. Abgerufen am 03.06.2010 (www.peakofoil.de). Peak of Oil: Die Zeitenwende. Abgerufen am 03.06.2010 (www.peakofoil.de).

In searching for an alternative to increase the energy efficiency in Germany, multifarious impulses have been implemented in Germany in recent years. One example is the LEEN management system for networks, which support companies within networks particularly by energy system structuring. The system provides guidelines for planning, organisation, assessment, potential identification, measures implementation, energy monitoring and continuous improvement in practice and enables the companies all sizes to account for the organisational cost saving by reduction of primary energy consumption, decrease in gas emission and climate protection.

1.2 Statement of the problem

This master thesis aims to set an overview of the degree to which network activity based on the LEEN management system may provide assistance to business organisations in their handling of economic energy issues, the improvement of their energy efficiency, configuration of working processes and the optimization of their energy potentials.

The current energy supply situation, the potential problems concerning increasing future demand coupled with dwindling resources and the undeniable process of climate change, are all fundamental grounds for an increase in energy efficiency.

Considering this situation, the following question is posed: which form of initiative might be successfully applied in order to cope with the mentioned problems? Fundamentally there are two major possibilities; increasing the use of renewable energy resources, and the further enhancement of energy efficiency.

Unfortunately acceptable conditions must first be created, using either legal and/or economic pressure, in order to encourage both suppliers and consumers to apply both practices wherever possible. One clear example of this being the current financial support by government for the use of renewable energy resources through the feed-in tariffs for “green” electricity. With regard to energy efficiency, the supportive approaches are even more versatile. Besides providing any financial support this issue is being strongly reinforced politically by different directives and standards (for example the DIN EN 16001) at various political levels (for example the Energy Service Directive).

One particular approach is the so called energy efficiency network, in which organisations exchange experiences with one another over an extended period of combined team work. This approach supports the identification of energy efficiency potentials and also the implementation (at an acceptable cost) of the correlated efficiency measures. Specifically for this purpose, the Management System “Learning Energy Efficiency Networks” (LEEN-MS - currently still under development) is used

as a basis for the formation of a business[2] network which also takes into account the relevant issues concerning the compliance with the DIN EN 16001 Norm.

This paper aims to investigate just how the LEEN-MS process encourages compliance with the DIN EN 16001 requirements, and which contribution the energy networks thereby offer to any participating organisation in attaining a more efficient energy usage.

In particular, this matter leads to a discussion of the following major questions:

1) Which aspects of the DIN EN 16001 standard specifically encourages the LEEN-MS process, and which factors have to be additionally taken into account?
2) How is the acceptance and approval for the LEEN-MS process by the network participants (organization, consultant engineer and moderator)?
3) In which manner can the LEEN-MS process provide support to the participating organisations in a practical sense?
4) How does LEEN-MS contribute to an improvement in energy efficiency?

Taking into account that the LEEN-MS has been in a phase of continual development for several years (continuing until the end of 2012), the conclusions drawn in the present work essentially describes the situation for the current system use. Important is that the work generates results which might provide useful references for further LEEN-MS development.

1.3 Outline

Chapters 2 and 3 outline the project framework.

In chapter 2 the requirements of the DIN EN 16001 standard for the participating organizations as well as it's correlation to the DIN ISO 14001 standard are described. This section is followed by a discussion of the LEEN-MS development and a description of its elements. Finally, both requirement catalogs are compared in order to identify where the similarities and differences between the management system and the standards exist.

Chapter 3 describes and analyses the current situation concerning the practical implementation of typical energy efficiency measures in organisations. Initially the background of both the current situation and the future energetic challenges will be

[2] E.g. mainly companies, sometimes public authorities.

discussed, in order to demonstrate clearly the increasing awareness and importance of energy efficiency in business organisations over the past few years.

With particular emphasis on modern company organisations, the existing constraints with regard to the implementation of energy efficiency measures will be comprehensively investigated and discussed.

Based on interviews and one case-study, chapter 4 highlights the current state of LEEN-MS implementation within existing energy networks. Here will be analyzed to what extent the existent LEEN-MS specifications may be applied, where the problems and discrepancies have been observed and what impressions the network participants have concerning LEEN–MS as a whole. For that purpose the interview candidates have been separately grouped, dependant on their fields of activity within an energy network (i.e. moderator, consultant engineer and company organisations).

In chapter 5 the results obtained in the chapters 2, 3 and 4 will be summarized, to be followed by an evaluation of LEEN-MS concerning the compliance with the DIN requirements and the implementation of energy efficiency measures. Individual applications of LEEN-MS will be considered individually, demonstrating the various positive achievements attainable by an improvement in energy efficiency.

Chapter 6 provides a short critical acclaim of the whole work, followed by an overview of other possible researches. This overview is of particular interest, because the LEEN-MS is a central element of the pilot project “30 Pilot Networks” from the BMU (see description in chapter 2), currently in development, to run until 2012.

Chapter 7 concludes the work and comprises a summary of the collected results.

1.4 Methodology overview

In the present work three different methods will be applied. The first one, in chapter 2 depicts a tabular comparison between the LEEN-MS and the DIN EN 16001 standard, aiming to provide an overview of the differences and similarities between both systems, and the consequences of the energy efficiency implementations within organisations. For that purpose the literature used was based mainly on the LEEN management system central document and the DIN EN 16001 norm. Additionally, the experience exchanges taking place in workshops, meetings and other correlated events were taken into account.

The second method in chapter 4 consists of interviews with current system users in an attempt to illustrate how effective the LEEN-MS is in its current form in supporting the participating organisations in their task - improvement of energy efficiency. In addition, which other aspects of the system should be addressed in order to provide improved support to its users. To this end, moderators and engineers, who are

certified by LEEN-MS, together with corporative representatives, who participate actively in networks, were interviewed with the help of questionnaires.

The third method is a case study presented at the end of chapter 4 as a complement to these interviews. A senior company representative presents his practical experience concerning the support offered by the LEEN-MS process for the implementation of energy measures in his company, and the respective results obtained.

2. DIN EN 16001 Standard and LEEN management system for networks

2.1 DIN EN 16001 Standard requirements

The DIN EN 16001 norm was written and published by the European Committee for Standardization (French abbr. CEN) and then transferred by the German Standards Institute (DIN) into a national standard (BMU, 2010) with the aim of the support for a system, and process development towards energy efficiency improvement in business organisations. Reduction of energy costs and also greenhouse gas emissions through the implementation of an energy management system is the main goal of the norm. This norm describes in detail the corporative requirements for an energy management system implementation, which prepares and encourages the companies to develop and apply energy efficiency strategies taking into account the laws and other regulatory requirements concerning all aspects of energy consumption (Deutsches Institut für Norm, 2009).

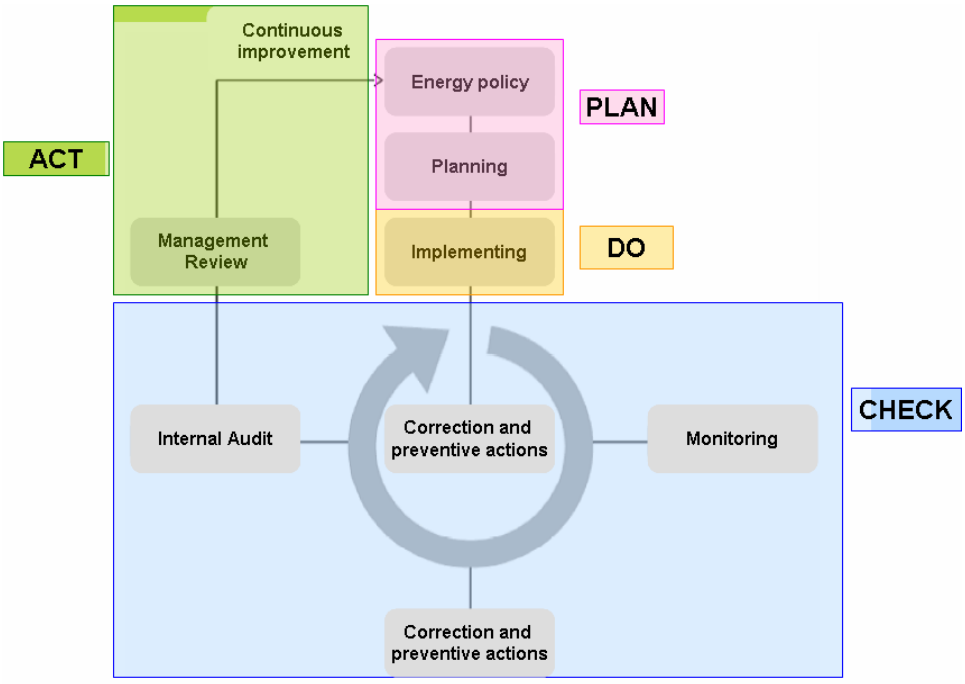
The DIN EN 16001, as the prefix already shows, is a European Norm, which may be applied to all enterprises regardless of size, political concern and sector (services, small trade, industries, etc.). It is possible to combine the norm with existing management systems (e.g. DIN EN 14001) or to implement it in an independent manner.

The guide lines of the norm is the PDCA cycle[3] (Fig.1) with a continuous, iterative improvement process being applied to an efficient and sustainable energy consumption, independent of the energy form. These guide lines provide the recurring theme for the implementation of an energy management system (EMS), which clearly defines individual elements such as communication, organisational structure, responsibilities, methods, processes, resources etc. One of the absolute major pre-conditions to the success of the norm is the full engagement of all hierarchical levels of an organisation during the implementation of an EMS, in particular the top management, (model function – the management system must be exemplified through the top management). The observed current situation must be

[3] PDCA cycle means continuous process (Plan-Do-Check-Act): P establishment of objectives and processes necessary to deliver results in accordance with the expected output, D process implementation, C measurement of new processes and comparison of the results against the expected results to ascertain any differences and A analyse the differences to determine their cause (DIN EN 16001, 2009).

continuously compared with the targeted state within the PDCA cycle, and the identified deviations should be corrected through the follow-up measures implementation. In the case where the indicated value exceeds or undercuts the required value, correction measures should be initiated (Gastl, R, 2005).

Figure 1: PDCA cycle (DIN EN 16001, 2009).



2.1.1 Planning and implementation

In the planning phase (*Plan*) the top management must establish an energy policy for the whole company, and in the next phase implement and maintain the measures defined in it (*Do*). Important during the energy policy definition phase is to consider the following general conditions (Deutsches Institut für Normung, 2009):

- Cover all energy aspects related to the sources and amplitude of the energy consumption;
- Identification of all possible influences leading to energy consumption variations;
- Contain the obligation towards continuous improvement of energy efficiency;
- Contain the obligation to assure the full availability of relevant information as well as providing adequate resources, both meterial and financial, to attain the defined strategic and operative objectives;
- Construct a framework for the tasks of definition and monitoring of the resulting changes in energy consumption;

- Contain an obligation towards compliance of all exigencies concerning the energy aspects, independent of whether these are of a legal or corporative nature;
- Fully documented, attentively introduced, conscientiously maintained and well communicated to all the associated personal involved with the implementation of the energy strategy;
- Periodic monitoring and actualisation of documents;
- To be accessible to the public.

This energy policy guideline may form part of a general corporative policy (for example as part of an environmental policy) or be independently established, ensuring that any legal and/or other obligations of the company are taken into account by the implementation of an energy management system (Deutsches Institut für Normung, 2009). It is followed by a phase concerned with the rough planning of the relevant work packages. (i.e. their determination and eventual implementation).

The definition of individual responsibilities, tasks, authorities, costs, expiration dates as well as the availability of those resources required for the accomplishment of the objectives must be defined in the planning phase. Within the implementation plan, the strategic targets should be realistically specified, then subsequently transformed into an operative plan, which should be measurable and documented with a pre-defined expiration date. Creative instruments such as action plans, check lists, tie tables, flux diagrams etc. may also be employed as auxiliary material to encourage success in reaching the energy management goals.

In the practical implementation of the program, the involvement of the organisational team through specific training and instruction in preparation for their new areas of duties and responsibilities should follow as a natural course, as should the announcement of the available support for the implementation of the program for the whole involved staff. The primary goal of the energy management system is to increase the energy efficiency through a continuous learning process, where all the company staff are sensitized towards, and thus individually involved in the whole process.

2.1.2 Review and improvements

In this phase the results are precisely measured and controlled (*Check*). This naturally includes an analysis of the implemented energy efficiency measures, their impact on the whole efficiency process, and an assessment of the conformity of the

energy politic relative to all other obligations, both legal and general. Furthermore the dimension of the strategic objectives in the form of operative measures, the status of corrective measures and preventive actions are closely observed (*Act*).

Overall energy consumption considering the environmental and other conditions (e.g. temperature fluctuation and capacity utilization of machines) is employed as a main indicator in order to evaluate reasonably the whole energy program. Energy sources (electricity, oil, gas, water, steam, etc.), mode of utilization (drying, pumping, air conditioning, illumination, etc.) and their performance variation provide an indication towards the assessment of the target achievement. Nonconformities must be identified, examined, and rectified accordingly in a reasonable manner within the allotted deadline.

The monitoring process is achieved through internal audits[4]. Here the control and assessment of decisions aimed towards target achievement is carried out. In addition, the top management has here the obligation to continually review the entire system. All results are evaluated during the Management-Reviews[5], where feasible measures concerning the improvement of energy efficiency, changes in the energy politic, modifications in the strategic and operative objectives as well as other related elements of the energy management system, in agreement with the obligation to continuous improvements and resources allocation, are discussed and defined.

Documentation is in all phases of the energy management program one of the most important instruments employed in the process of review and control, and in all cases must be compliant to the requirements in a commensurate and detailed manner in order to adequately cover the processes and activities described. In particular, by the process of integration with other existent management systems it is essential when establishing the application of existing operations and documentation schemes in order to configure a transparent workflow and thus avoiding unnecessary workflow.

[4] Audits are performed to ascertain the validity and reliability of information; also provide an assessment of a system's international control. The goal of an audit is to express an opinion on the system in question under evaluation based on a work done on a test basis (Wikipedia, 2010) (03.06.2010).
[5] Management-Review is a management study into a project's status and allocation of resources in regard to continuous improvement of processes. (Wikipedia, 2010) (03.06.2010).

2.2 Correlation between the DIN EN 16001 and the DIN EN ISO 14001

The DIN EN ISO 14001 standard concentrates primarily on developing and upgrading a functioning environmental management system within an business organisation, thus assisting those companies attempting to improve their environmental activities. In Germany approvimately 5.000 companies and organisations have implemented the requirements for environmental management according to this standard (BMU, 2010).

The structure of the DIN EN ISO 14001 and the DIN EN 16001 are very similar. Both systems are based on the PDCA Cycle, which provides a framework for the continuous improvement of processes or systems (Table 1).

Table 1: Structure of a management system (BMU, 2010).

PLAN	- Establishment of targets - Determination of strategy - Identification of measures and responsibilities - Providence of necessary resources - Preparation of the action plan
DO	- Establishment of management structures to maintain a continuous process - Measures implementation
CHECK	- Review of the level of target achievement and system effectiveness
ACT	- Consolidation of the current data - Audit results - Evaluation of the progress

This basic structure enables the integration of both systems adapting the energy requirements to the environmental ones and vice versa. For the companies who are

certified in ISO 14001 it is possible to incorporate energy as an environmental aspect within their management system and report their energy activities and achievements in their environmental statements to the public by applying just a few modifications regarding the energy efficiency and energy consumption terminologies (UGA, 2009).

Besides the fact that implementation is far easier for companies who have already put a management model into practice, it is also more logical from the point of view of efficiency to integrate the requirements of various management systems instead of introducing them concurrently to one another.

2.3 Origin and development of LEEN-MS in Germany

The LEEN-Management System is a method to provide assistance in the formation of energy efficiency networks, thus supporting the management in the identification, implementation and monitoring of energy efficiency measures. Therefore LEEN-MS serves of operational basis for the required energy strategy of the company. The system is characterized by the use of standardised tools for energy efficiency networks, and has been applied in Germany since 2002 in a demonstration project called *EnergieEffizienz-Initiativ Hohenlohe* based on the Swiss energy model[6].

Members of the Model Hohenlohe e.V. (a non-profit association), based in the Heilbronn-Franken region of Baden-Württemberg and consisting of seventeen companies with work-forces ranging from 3 to 2.000 workers each, composed the energy efficiency network Hohenlohe (*EnergieEffizienz-Initiativ Hohenlohe*) in 2002. The areas of activity of the companies were as follows:

- Services
- Automobile
- Ventilator production
- Nursing home
- Printing
- Injection molding
- Steel production
- Musical instrument production
- Components for tool manufacturing
- Printer circuit boarder production
- Transmission systems
- Die-Casting of components
- Sanitary products
- Restaurants
- Waste management
- Castings (Weissenbach, 2003).

[6] Swiss Energy Modell is a scheme developed in Swizerland after the introduction of the CO_2 law with an extensive proliferation. It provides tax concessions for companies participating in energy efficiency networks (EBWK: on-line Service: Fachbeiträge: Energieeffizienz-Tisch, 2007. S.2).

The implementation of the project *EnergieEffizienz-Initiativ Hohenlohe* was financed by the regional government of Baden-Württemberg and was characterised by the partnership between Modell Hohenlohe e.V. (a non-profit association) and the Fraunhofer Institut für System- und Innovationsforschung Karlsruhe (a research institute).

In the beginning the Modell Hohenlohe – Netzwerk betrieblicher Umweltschutz und Nachhaltiges Wirtschaften e.V. (corporative environmental protection and sustainable economy) founded in 1991 in Waldenburg[7] was composed of twenty seven firms from different sectors in the region Hohenlohe. At its peak the association consisted of more than two hundred regional companies, engaged in the implementation and support of sustainable strategies. The main objective of the association is to connect the regional resourcefulness, encourage the sustainable economy, the environmental consciousness and corporative responsibility toward enhancement of environmental protection. The association aims in addition to provide information to, and raising the sensitivity of, resident businesses and consumers, to encourage the self implementation of future solutions within the corporative praxis and to strongly support regional cooperation. (Burschel, C. et al., 2004). With these basic thoughts the association has developed as a major influence of energy efficiency issues in the region.

Fraunhofer Institut für System- und Innovationsforschung Karlsruhe (ISI) is an Institute which analyses the fundamental frameworks for innovations, researches innovation processes and the consequences of new technologies and services to society in both the short and long terms. Based on this knowledge, the Fraunhofer Institut offers suggestions on how to manage the new challenges in their institutions to their clients from the economic, political and scientific groups (Fraunhofer ISI, 2010).

The Modell Hohenlohe e.V. through its regional engagement towards sustainability, coupled with the wide variety of individual industrial activities of its members, and the resulting spread of interest groups with their extensive experience, provided the necessary depth and numerical scale essential for putting together the *Energie Initiativ Hohenlohe* and developing the communication structure for the required networks. Combined with the scientific contribution from the Fraunhofer Institut and

[7] Model Hohenlohe is currently located in Pfedelbach.

the financial support from the Environmental Agency Baden-Württemberg the first steps to the system development were taken. In this initial period the project was based on the successful Swiss energy model (see footnote 5).

At the conclusion of the primary financial support for the development of the system in 2006, the project continued unabated: the remaining companies (five in 2010) provided the financial resources themselves. The participants have retained the meetings and the experience exchanges in the form of a network and continue to achieve significant positive energy-saving and CO_2 emission reduction results.

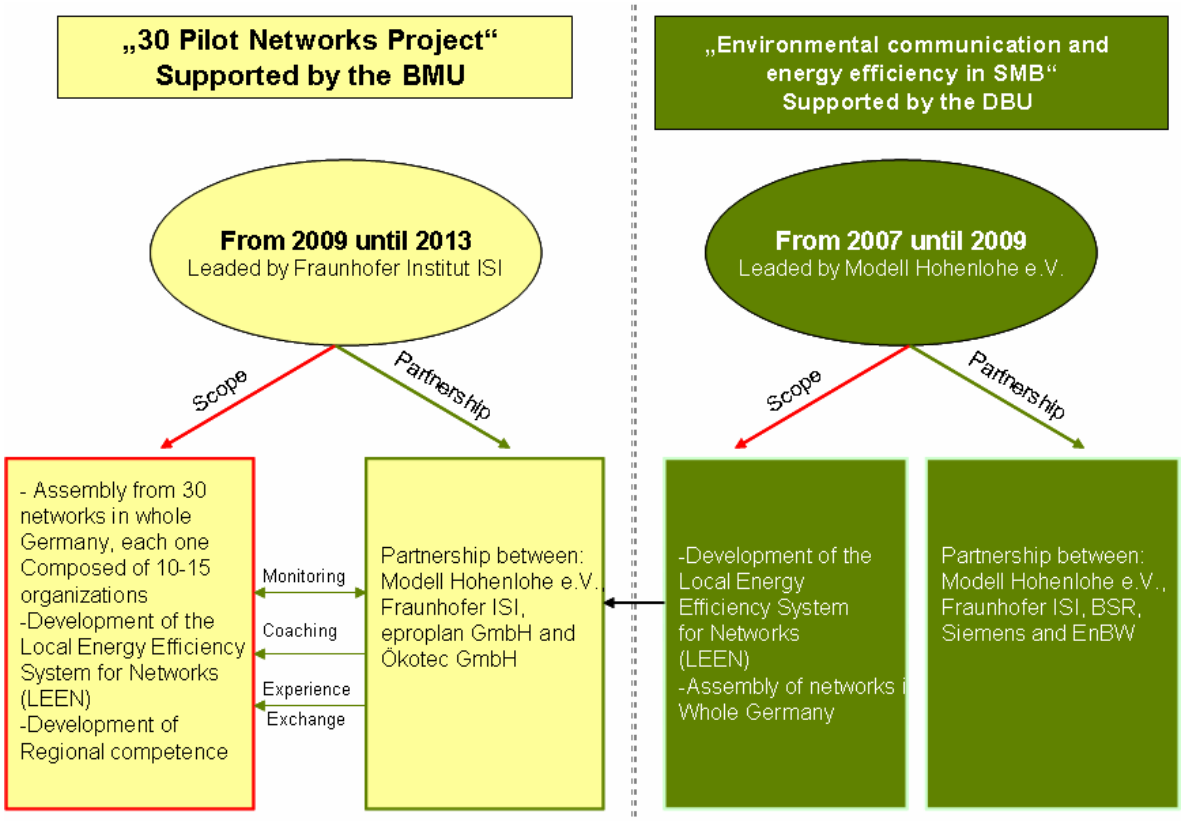
In the year 2006 the company members have been able to increase their energy efficiency in comparison with the year 2001 by a total of eighteen point three percent (18,3%) and have achieved a reduction of fifteen thousand tons (15.000t) CO_2 emission (LEEN GmbH, 2008). During the following year the net results increased even further: based on the year of 2001 the amount of CO_2 emissions in 2007 have been reduced by seventeen thousand tons and the energy efficiency increased to twenty point one percent (20,1%). The average reduction in energy consumption of the participant companies for the same production volume thus corresponded to about one fifth of the year 2001.

The energy efficiency project from Hohenlohe demonstrated in 2007 the success of the project over a long term and the end is not in sight, the project continues to exist and the energy efficiency persists in improving. The demand in energy consumption from the network company members has been reduced since 2001 by an average of three point five percent per year (3,5%/annum) compared to an average value of just one percent (1%/annum) in the industrial sector generally. In absolute terms, compared to 2001, 36,2 GW.h of energy consumption has been avoided, which represents the typical annual demand for about 3.600 residences. Similarly, over the same period the CO_2 emission has been reduced in the same proportion. This corresponds to an energy saving in 2007 of circa one hundred and twenty thousand euros for each participating company. (see the development of the energy demand of the network *Energie Initiativ Hohenlohe* from 2001 until 2005 in fig. 2) (Modell Hohenlohe, 2010).

After the initial pilot project *Energie Initiative Hohenlohe,* the system philosophy has been further applied within various other projects (Fig. 2) and ultimately developed into a Network Management System. This development process has taken place

primarily within the project “Environmental communication and energy efficiency for small and medium sized companies” (KMU-Project - from 2007 until 2009) financed partially by the German Environmental Institute (DBU), and co-financed by EnBW Energie Baden-Württemberg AG, Siemens AG, Hessian Agency for economy, transport and regional development and the Environmental Agency from Baden-Württemberg. The Network Management System was developed with the specific objective of providing a methodology exposure over-all in Germany (multiplication concept) and together with the LEEN-MS elements they were successfully tested in several reference networks.

Figure 2: Partnership schema of the LEEN-MS development (modified from Weissenbach, 2009).

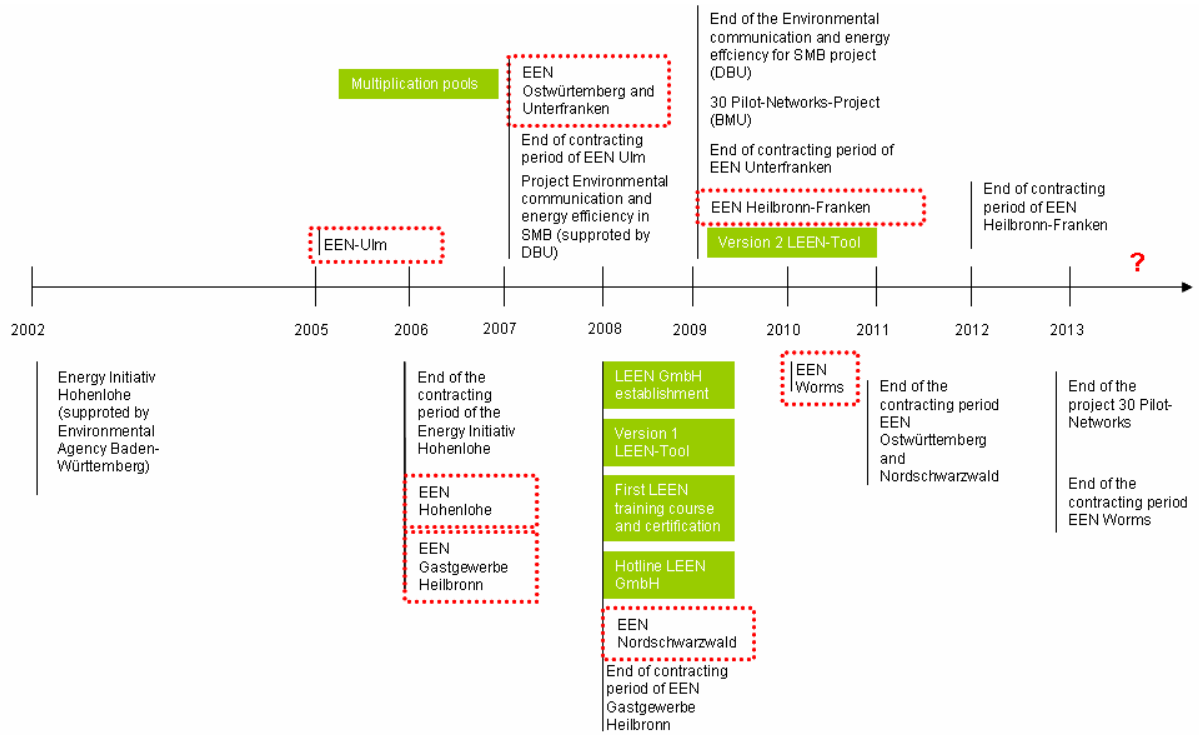


Subsequently, the next logical step to be taken was the selection of the 30-Pilot-Networks (from 2009 until 2013) supported by the German ministry for the environment, nature and reactor safety (BMU), who have accepted one third of the correlated costs towards network-formation. Here once again the overall aim being the further multiplication of the LEEN-MS philosophy within the whole of Germany. The concept seeks to establish at least 30 energy efficiency networks in different regions of Germany as a whole before the end of 2013, consisting of a total of

between three and four hundred companies. The basic requirements specified for the financial support being the successful bringing together of groups of between ten and fifteen companies with individual annual energy costs ranging from between 150.000 to 50 million euros per company, each group to form an energy management network to encourage collective application of the LEEN standards in conjunction with certified LEEN moderators and engineers. The financial support is distributed regionally, allowing the opportunity for all German districts to participate in the project (Modell Hohenlohe, 2009). The network expansion process will be scientifically evaluated, thus aiding the process of management system tool improvement on the basis of the practical experiences obtained within each network activity.

This continuing process should produce a significant increase in the number of active project participants, project supporters and consultants employing the quality standards of the Energy Efficiency Networks throughout Germany. The continuing development of the Energy Efficiency Networks and the demand on participation are all evidence that, even without the benefit of financial subsidies, the philosophy is capable of providing future positive results for the participating companies providing energy saving, gas emission reduction (for example the network Black Forest) and climate protection.

Figure 3: Development of the LEEN-MS (Rocha, Marcia, 2010).

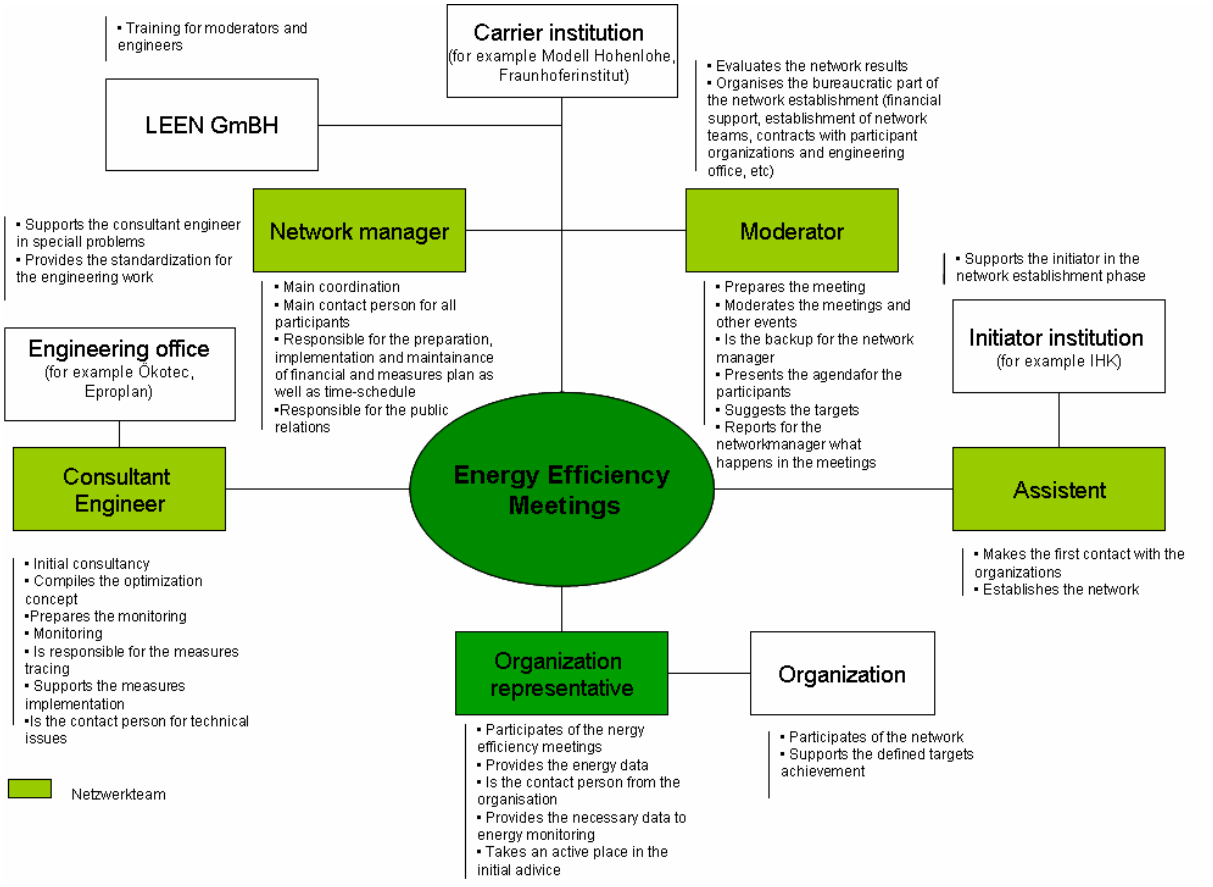


2.4 Concept of the LEEN-MS

The fundamental elements of the Energy Efficiency Networks should consist of the following: the regular, moderated exchange of experience; support from competent energy consultants, initial consultancy assisting the members in identifying the major elements of energy consumption; mutual acceptance of target definitions; independent decision by the participating companies regarding which measures, when and how they should be implemented; regular, periodic evaluation of the project results; concomitant public relations; confidential control of each company's individual results (EBWK, 2007).

Characteristic of the LEEN-MS processes are the cost-effectiveness of implementation, the outstanding communication between the companies' members, an intensive experience exchange process, and the additional support provided by the system elements for those companies who might wish to integrate their existent management system with an energy management system. The process of implementation and its progress is accomplished solely dependant on the individual corporative requirements and is supported at each phase by the network team which consists basically of a network manager, a moderator and a consultant engineer (Fig. 4). The various activities need not necessarily be carried out by different individuals, but may be shared as a function between, for example, the moderator and the consultant engineer e.g. Initiating a network (*Plan*); Energy Efficiency meetings (*Do*); Initial adivice and tasks definition (*Plan*); Monitoring (*Check*) and of course public relations.

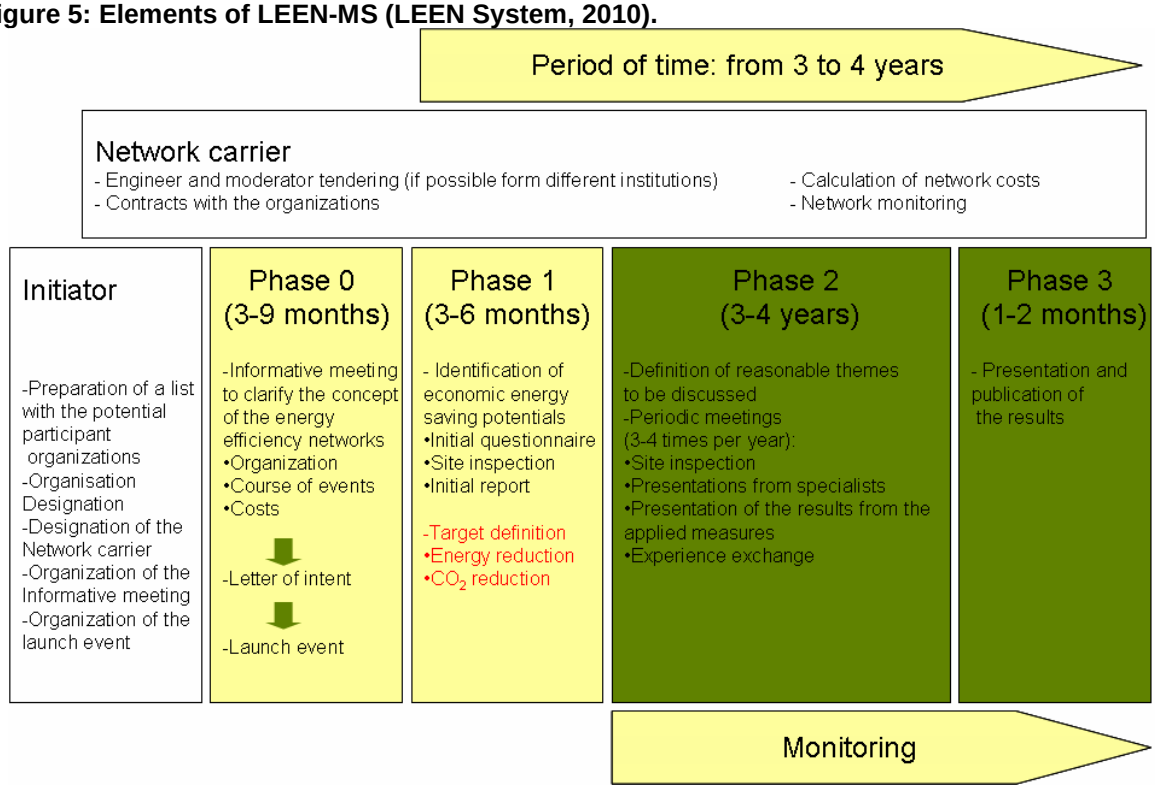
Figure 4: Network components (Rocha, Marcia 2010).



2.4.1 Phase 0 - Initiating a network

The network formation begins formally with the acquisition of companies and the creation of a pertinent network structure. This phase does not belong itself to the network, but as it is an important step to the network foundation it is a part of the LEEN-MS. In this phase the network initiator (responsible for structuring and funding the network) play a decisive role by establishing contacts to the potential participants of the network. Convenient for these roles are those institutions who have already made contact with different sectors, for example Chambers of commerce, industrial associations and local business clusters. There is no fixed rule for this step in the process.

Figure 5: Elements of LEEN-MS (LEEN System, 2010).



To initiate a network the Initiator must enjoy a comfortable relationship with regional companies and have sufficient time and freedom to establish the necessary contacts. This person should demonstrate sensitivity, diplomacy, broad technical knowledge, social competence, and ability in handling discrete confidential information.

During the process of identifying prospective companies several factors need to be carefully considered. The success of an energy efficiency network demands from each participant a significant degree of intensive team work, similarly the perspective of corporative profits must be firmly established. This selection process dictates a minimum operating magnitude i.e. workforce size, turnover etc, with corresponding financial abilities. (Weissenbach, K. et al, 2009). Furthermore it is necessary to impress the importance of open communication and clear interaction between all participants in order to maintain the required degree of transparency within the network. A company's participation in a network should be independent

of their sector of activity. The network should provide an intersectoral exchange in order to enable synergy between possible industrial solutions.

One important aspect which must be considered is that companies, active in similar or related areas and who are geographically near to one other, should not be participant in the same network. The natural competitive nature of their mutual relationship can only impair the optimum information flow; transparency in the LEEN

network method is one of the most important aspects for the success of the process thus establishing a prerequisite for avoiding a concurrency disturbance among the participants.

Within the network structure it is most important to accurately define items such as number and category of personnel involved in the project, (i.e architects, maintenance staff, consulting, technical support, etc.), energy supplier, house bank and other important issues. Any initial cost-saving estimation can be roughly gathered, but because the process must inevitably consider quite a significant number of important details, it is therefore recommended that the targeted energy savings should not be completed before the end of the start phase.

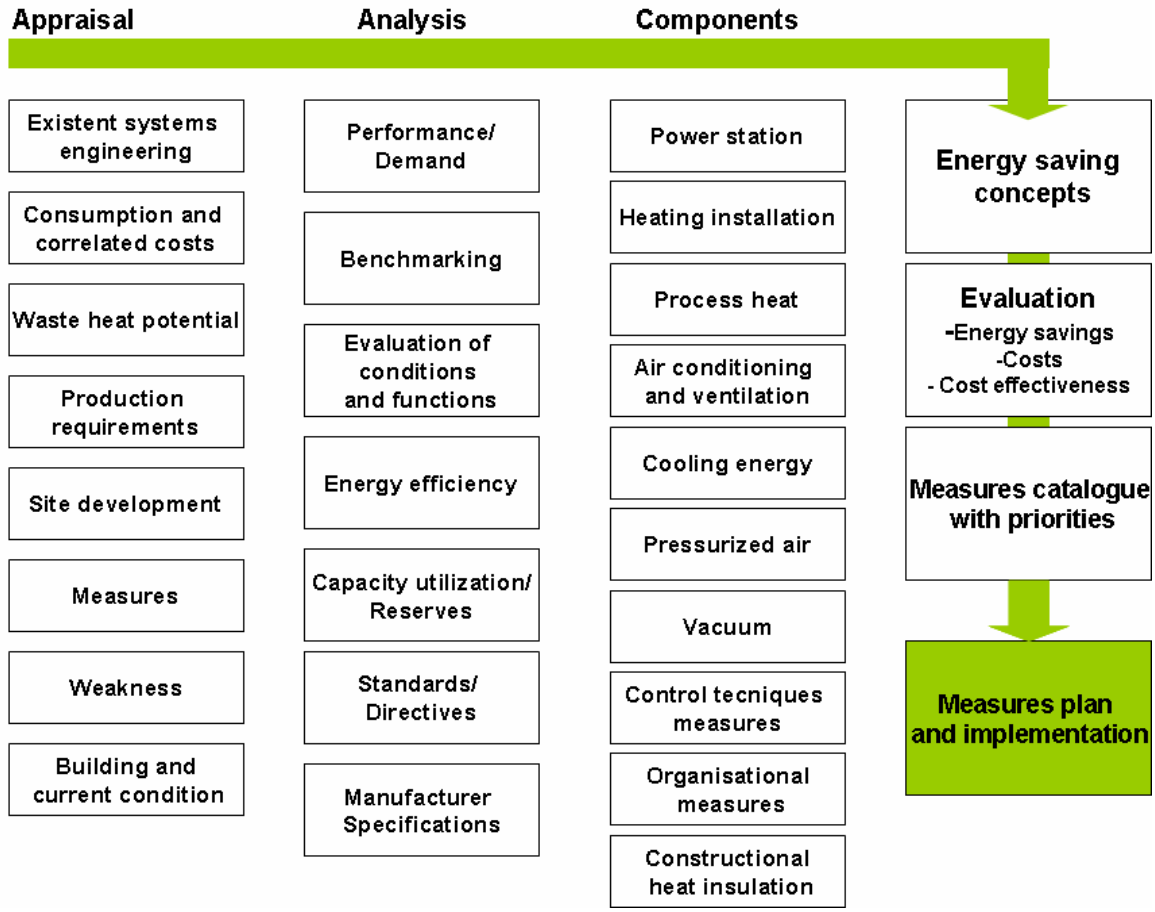
2.4.2 Phase 1 - Initial consultancy and tasks definition

The initial consultancy provides the basis for the development of an energy saving plan through the identification of the profitable energy saving measures in the company in general terms coupled with suggestions for the implementation. In this phase the responsible person is the consulting engineer, who by employing the pre-defined elements of the LEEN-MS process (Fig.5): as a basis for the analysis and development of the necessary corrective measures provides solutions and suggestions for their potential application.

Broadly speaking this phase is mainly composed of meetings with the companies´ executive boards which encompasses visits to establishments where the energy saving is desired, data collection, definition of objectives and extensive discussion of the initial consultancy report.

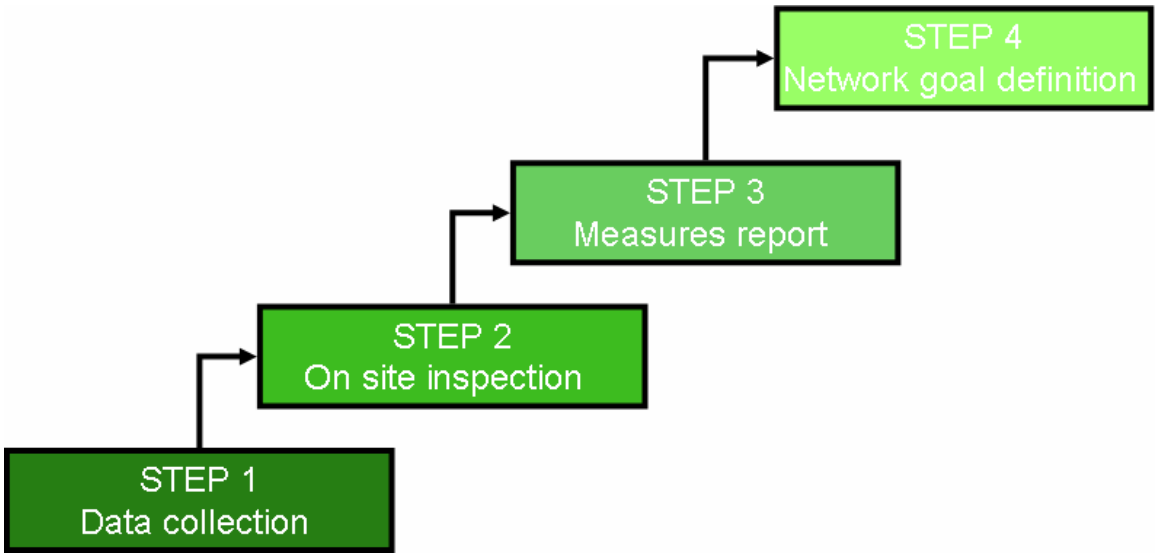
It is absolutely essential, that in order to generate an acceptable level of personal confidence and thus subsequently provide optimum support to the participants during the implementation phase of the energy efficiency measures, the engineers, consultants and moderators, must first undergo a recognized LEEN-management training program prior to their direct involvement.

Figure 6: Elements of the Initial consultation (Michael Mai, 2010).



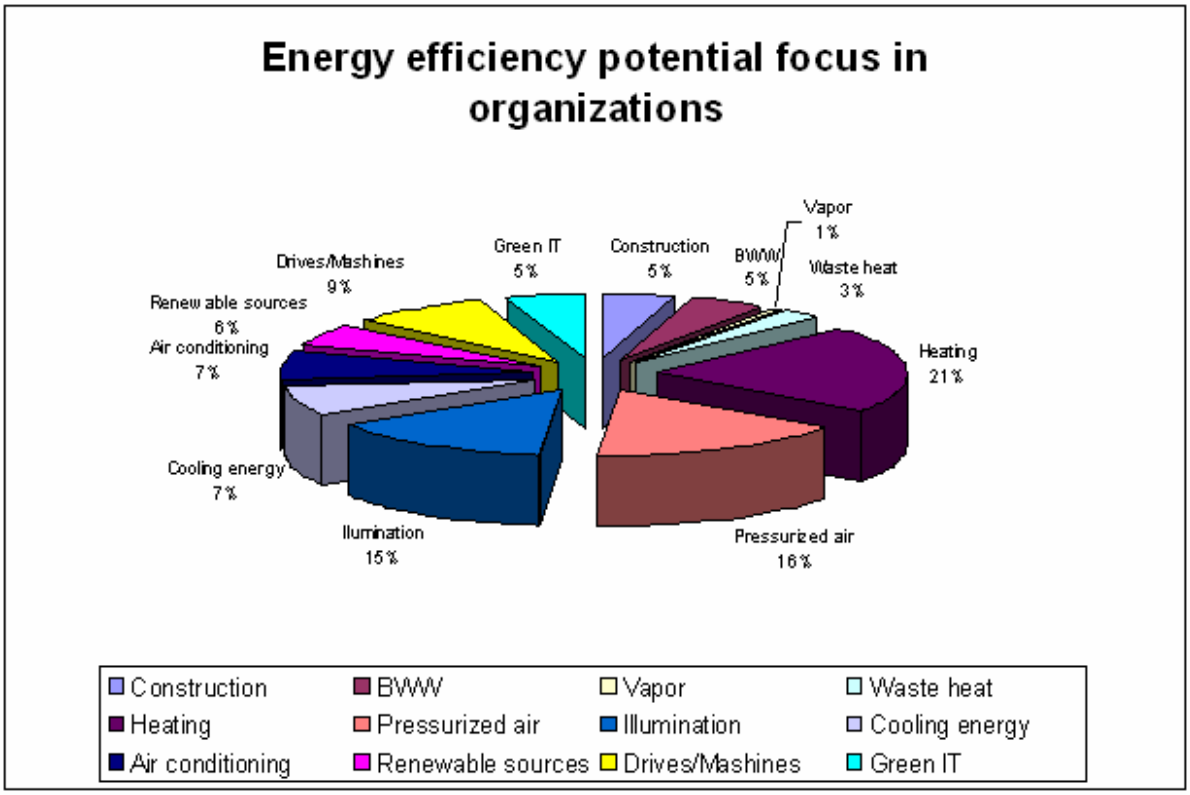
The process of objective-definition commences with the distribution of a questionnaire within the company in order to collect fundamental energy related data regarding questions concerning, for instance, Illumination, cooling, heating, air conditioning and use of compressed air etc., these to be answered by the person responsible for the individual energy application in the company (Step 1 - data collection). Later on, the consultant engineer together with the network manager should visit the company in order to obtain any accurate data required (Step 2 - on site inspection). These data elements are employed in the process of identification of the specific energy efficiency potential, which is ultimately presented to the other network members in the subsequent energy efficiency meeting.

Figure 7: Scheme of the Initial Consultation (Rocha, M., 2011).



The identified energy efficiency potential (the theoretical proportion of saved energy consumption) derived within the initial consultancy process serves as the basis for establishing the targeted potential savings (Step 3 – report with table of measures) in the energy efficiency network task definition (Step 4 – goal of the network).

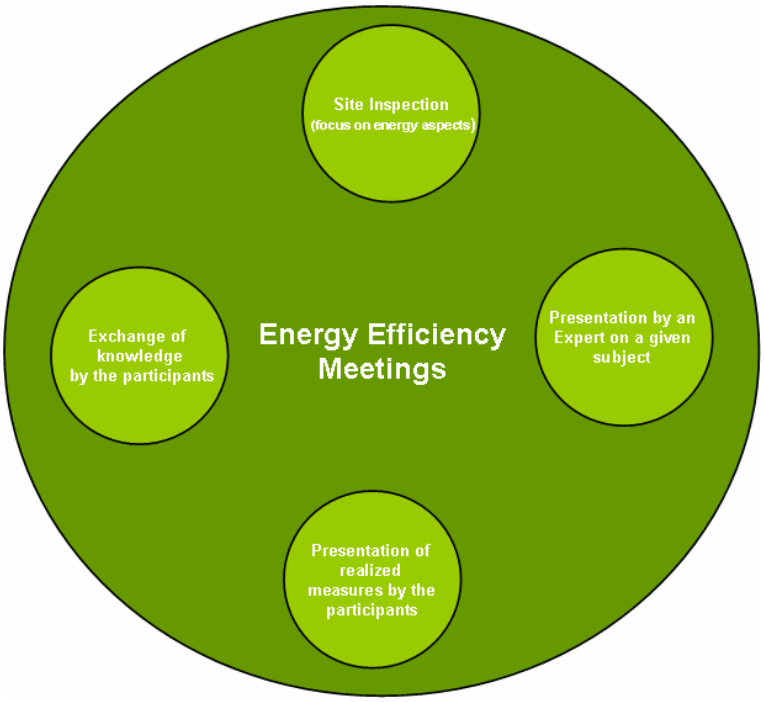
Figure 8: Overview of the corporative energy efficiency potential (Weissenbach, K, 2009).



2.4.3 Phase 2 - Energy efficiency meetings

Energy efficiency meetings are regular periodic, face to face, meetings involving principally the representatives of the involved companies, the nominated network teams, with the participation of experts that report on certain energy related subjects. These energy efficiency meetings have the set purpose of defining the overall targets, discussing both the methods and manner by which they are to be achieved, encouraging experience exchange and of course the associated gradual accumulation of shared knowledge (Weissenbach, K. et al, 2009) through the immediate communication between all members.

Figure 9: Scheme of a typical Energy Efficiency Meeting (Rocha, M., 2011).



Ideally the meeting themes will be wide-ranging discussions, for instance concerning expectations (e.g. modernization of old buildings, or the reduction of energy consumption by improving illumination techniques), information concerning the basic organisational principles (e.g. communication within the network structure, application of common shared information, efficient team work and open, fair and confidential experience exchange), preparation for the initial consultancy, definition of time scales, objectives and project monitoring (for example through annual outputs).

The chairman of the energy efficiency meetings is the moderator, who leads, supports and animates the interaction between all the network participants (Weissenbach, K. et al, 2009). The moderator is an obligatory participant of the meetings and other organisational arrangements. He or she is the person, who initiates the general communication between the participating organisations and also the network members. In addition to their technical competence he or she must also present a high degree of social competence, thus contributing towards the network success.

The network manager may also act as a substitute for the moderator in meetings whenever this is necessary. The network manager, also designated as the general coordinator, assumes the major responsibility for the success of the network and is the primary contact person for the moderator, the technical personnel, and the executive boards of the participating companies (Weissenbach, K. et al, 2009). The network manager is responsible for the establishment of the rules of compliance with technical-measure implementation as well as the necessary time and finance planning aspects (budget controlling and decision responsibility etc.). In addition the network manager bears the responsibility for enacting the necessary contracts with the network team members and the participating companies (Weissenbach, K. et al, 2009) and assumes the main responsibility for those functions associated with the broad theme of public relations.

Together with the entire network team, this constellation establishes an environment within which confidential and competent performances of the energy efficiency network are possible, providing a transparent, intensive and procreative experience exchange between its members.

2.4.4 Phase 2 and 3 - Monitoring

The annual monitoring process seeks to present each participating company with an overview concerning their actually achieved energy savings and similarly to indicate the degree of possible CO_2 emission avoidance (Weissenbach, K. et al., 2009).

The LEEN-MS method suggests that at least two persons from the network team participate in the monitoring process of each defined task (for example the consulting engineer and the moderator). The data is collected on an annual basis, and quantified according to the fundamental data information provided by each company

concerned, eventually to be followed by a presentation of the results of the network as a whole.

Here the focus is tracking progress results on the method of data analysis, through both the “bottom-up” and “top-down” methods: While the “bottom-up” procedure analyses the degree of success of each individual energy efficiency implementation and their consequences for the corporate global energy saving (through measurement, calculations or addition of the values), the “top-down” procedure evaluates the global level of production efficiency attained by each company and the reduction in CO_2 emission achieved in the comparison period relative to the basic unit production level. i.e. Production performance per unit of energy consumed in the basis year. (Weissenbach, K. et al., 2009). Should a significant difference between the results attained by the bottom-up and top-down methods become apparent, (typically more than three percent), then the second monitoring level of either of both methods has to be applied (always providing the amount of data and the duration of data collection permit).

Normally the data collection occurs in both procedures at the end of the business calendar. In the bottom-up procedure the analysis of the achieved level of performance also includes a comparison with the potential levels defined during the initial consultancy process.

Both procedures may be conducted independently of one another, whereby the pertinent data should be collectable in an uncomplicated manner and also be capable of providing understandable and transparent results:

Two-level principle of the Bottom-Up method

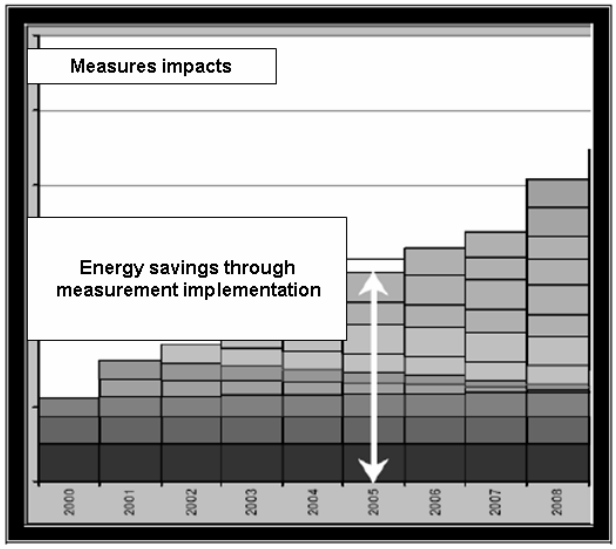
In the first level of the bottom-up method the consequences of each and every realized energy efficiency measure have to be added together, during this phase ignoring any effects dictated by external influences, for instance, inverse weather conditions, short-term differences in the production processes (e.g. production peaks, production shortfalls due to delivery time scale modifications, etc.), and in this manner allowing a general simplification of the data presentation process.

At this point the overall level of improvement achieved with respect to energy efficiency and CO_2 emission reduction, results from the sum of all subsequently

achieved savings promoted by the successfully applied efficiency improvement measures in the current business year (Weissenbach, K. et al., 2009) (also taking into account the inclusion of any possible extra energy consumption and CO_2 emission – not previously calculated - in the analysis year).

In the second level of the Bottom-Up method, the energy savings attained in the analysis year must also take into account environmental and external influences (e.g. natural influences and also any short term effects such as production peaks etc.) determined by the use of the aggregation procedure. This method determines for each business year the precise data associated with each implemented measure, and the accumulated energy savings and CO_2 reduction values stemming from each realised measure in the current year (Fig.10). It allows the observation of the actual efficiency development as well as considering the significance of external energy influences.

Figure 10: Principle of the second level of the Bottom-Up Monitoring (Bundesamt für Energie, (2001).



Two-level principle of the Top Down method

In the first level of the Top-Down method the specific production energy consumption and the amount of gas emission are calculated based on a production index (for example, MWh/Item, kWh/service element, etc). The energy efficiency development is calculated by comparing the performance difference between the analysis year and that of the basis year.

The second level procedure is similar to that of the Bottom-up method, the energy efficiency improvements in comparison with the basis year are calculated by taking into account the previously assessed influences, which might possibly affect the level of energy consumption. This result can be determined by calculation, based on the production index of the analysis year:

$$Index_{PROD}\ (t) = Output_t \times (Energy\_input_t / Energy\_input_{t_0}) / Output_{t_0}$$

The output production (from year t) based on a specific product index is weighted to a basis value (t_0) and factored to the basis year (Weissenbach, K. et al., 2009). An index value exceeding one hundred percent indicates the accomplishment of positive energy efficiency.

This method however provides no precise detailed information and is also unable to demonstrate any cause-effect relationships between the measures taken and the resultant energy savings achieved. Nevertheless, the primary advantages inherent in the procedure lie in its simplicity of application and the resulting economic gains. Essentially, it demonstrates any major tendencies and is therefore normally considered as an energy efficiency indicator (Europäisches Parlament, 2006).

2.4.5 Phase 3 - Public relations

The principle aim of public relations is to provide not only a positive image of the network companies as responsible, concerned institutions, engaged in a series of activities, primarily aiming to influence and encourage climate protection (e.g. sustainability and climate-neutral production), but also to initiate and support the learning network formation in other regions (multiplication effect).

Besides any active support of related internet sites and forums, the participation in regional events related to energy efficiency is an important component of the network's public relationship portfolio. Publicity activities deem to function as a major aspect of the overall communication strategy, aiming to provide social impulses resulting in an increased level of participation (Weissenbach, K., 2010). Just how public relations activities within LEEN-MS may be approached is discussed further in the LEEN-MS Communications Concept (see annex 1).

2.5 Comparison between DIN EN 16001 and LEEN-MS

For the comparison between the DIN EN 16001 and the LEEN-MS a parallel will be drawn based mainly on the contents of the LEEN central document and the DIN EN 16001 norm, but also including experience in seminars, meetings and other similar events. The analogy aims to bring out the most important differences and similarities between both systems and to investigate the advantages of their implementation for business organisations (Table 2).

Table 2: Comparison between DIN EN 16001 and the LEEN-MS (Rocha, M., 2010).

DIN EN 16001	LEEN	
1. Energy management system (EMS) requirements		
1.1. General requirements		
Implement, document, identify and evaluate the correlated aspects, develop, establish relevant legal and regulatory requirements, monitor the results and review the system in companies.	- No requirements toward an EMS definition. -Requirement to a system for standardised formation of networks.	Different from DIN EN 16001
Establishment of area of implementation and documentation.	- The definition of the implementation area of the system is limited to the organisational information as name, address, number of workers and site allocation.	
Continual improvement of energy efficiency.	- No obligation to direct implementation in companies.	
1.2. Energy policy		
The top management is obliged to define the energy policy, implement and maintain it. The policy must be the obligation to continual improvement of the energy efficiency within the company. Contents of energy policy: - Establishment of area of implementation and limits of the	- No obligation to define an energy policy and involvement of the top management in the process.	Lack

EMS. - Identification of energy aspects and evaluation of associated impacts for the organisation. - Obligation to continual improvement of energy efficiency within the company. - Obligation to make the energy policy, the efficiency objectives (strategic and operative) and results available to the public. - Framework for the definition and review of strategic and operative objectives. - Obligation of maintenance of defined requirements and legal compliances. - Implementation, documentation, compliance to legal and regulatory requirements and information to all in the system implementation involved persons. - Periodic review of the energy policy by the top management.		
1.3. Planning		
1.3.1. Energy aspects Energy aspects inform and review, update and define priorities. Guidelines to evaluation and review of energy aspects must include: -Evaluation of previous and currently energy consumption and energy factors; - Identification of energy areas with considerable energy consumption and their development when compared with the last periods; - Estimation of the future energy consumption; - Identification of all considerable persons related to energy consumption; - Identification and prioritisation of energy efficiency improvement opportunity; - Documentation of all energy efficiency measures.	The identification of the energy aspects and the potentials for energy efficiency enhancing are made with the support of initial advice, energy survey data, Initial advice report without obligation to document. The energy data are identified with basis on investee specific, being limited to the information content in the energy survey questionnaire (standard). Indirect energy aspects as for example influence of work force and suppliers to the final energy consumption.	To be developed

1.3.2. Legal and other requirements		
Identification and access to legal and other requirements concerning energy aspects. Appointment of how the legal requirements can be applied in the energy aspects.	- No systematic contemplation of legal requirements.	Lack
1.3.3. Strategic and operative energy tasks and programs		
Identification, definition, implementation, maintenance of strategic and operative objectives, compliance to legal and regulatory requirements. The objectives have to be in accomplishment with the energy policy. Definition of responsibilities within the organisation. The tasks must be measurable, documented and reached in a defined time frame.	- The strategic and operative energy efficiency tasks are defined independently of an energy policy (there is no obligation to establish an energy policy). There is a measure overview, which provides the guidelines to strategic and operative tasks with their respective deadlines to implementation.	To be developed
1.4. Communication		
1.4.1. Resource, duties, responsibilities and authorities – The resources disposal (personal, infrastructure, technical, financial, etc.) are defined by the top management.	- The responsibilities and resource in LEEN system are defined just for the networks and not for the companies themselves.	Lack
1.4.2. Trainings - all persons with activities (including the top management), which influence the energy consumption must (through appropriate preparation – information, trainings, etc.) be able to lead with her or his energy efficient responsibilities.	- Training is only planned for the network team (moderator and engineer), not for the internal workers of the companies. What distinguish the LEEN system from other systems is the Know-how-Transfer through energy efficiency meetings and other experience exchange events.	Lack
1.4.3. Communication is an obligation within the organisation. The decision about the public communication is committed to the company itself.	- Public relation for networks is defined in the communication concept.	Different of DIN EN 16001
1.4.4. The energy management system core information must be described and documented.	- No obligation to description and documentation.	Lack
1.4.5. Control of documents – The documents must be available in the newest version overall where needed.	- There is no obligation to documentation.	Lack

1.4.6. Operational control – The purpose of operational control is to ensure that those energy aspects that are deemed to be significant are controlled in such a way that the objectives and targets have a fair chance to be achieved.	- The organisation have to make the operational control and the definition of energy measures which should be at first implemented.	Lack
1.5. Review		
1.5.1. Monitoring and measurement – Monitoring means that the organisation should check, review, inspect and observe is planned activities to ensure that they are occurring as intended. The energy consumption must be periodically measured and registered and the energy program must be reviewed. Legal requirements have to be periodically updated. All information concerning the energy program implementation should be documented. Periodic reviews are to be implemented with correction of system failures.	- The energy consumption data are yearly collected, evaluated through the monitoring and reviewed without directly correlation with legal requirements. Methods: bottom-up und top-down.	To be developed
1.5.2. Analyse of legal compliance	- There is no obligation to deal with legal requirements.	Lack
1.5.3. Non conformity, correction and preventive actions should be applied in order to avoid failures	This procedure of non conformity identification, correction and preventive action implementation is foreseen in the monitoring phase in a general form.	To be developed
1.5.4. Control of records	- Not foreseen.	Lack
1.5.5. Intern audits of the EMS done by the top managment with objective to follow the objects attainment	- Periodic monitoring is designated but without obligation of top management involvement and single analysis of measures implementation.	To be developed
1.6. EMS review by the top management		
1.6.1. Input parameter for the Management-Review	- There is no obligation of involvement of the top-managements[8].	Lack
1.6.2. Management-Review results	- Not applied.	Lack

[8] Review is currently only applied in the EEN Modell Hohenlohe, but is not a standard by LEEN.

2.5.1 Similarities between LEEN-MS and the DIN EN 16001 standard

As the table 2 indicates, the systems LEEN and DIN EN 16001 share a strong similarity particularly within the general procedures and the system implementations:

- Energy characteristics, identification, monitoring, update and review: With the help of the data survey questionnaire, the energy aspects and potential are identified during the site inspection. The results obtained by the implementation of energy efficiency measures are periodically monitored (bottom-up and top-down methods) giving the organisation the alternative to correct the actions which are not representative for the energy saving results.
- Definition of strategic and operative energy targets: The LEEN-MS provides through the identification of energy aspects (energy potential) and preparation of a list of energy efficiency measures to be applied the guidelines to definition of strategic and operative targets.
- Association between the energy efficiency measures implementation and their consequences for the energy efficiency improvements and the CO_2 emission reduction: Both systems aim the enhancement of energy efficiency, energy costs reduction and gas emissions which can be obtained by the implementation of energy efficiency measures.

2.5.2 Differences between the LEEN-MS and the DIN EN 16001

Table 3: Differences between LEEN-MS and DIN EN 16001 (Rocha, M., 2011).

LEEN Network management system	Norm DIN EN 16001
• No duty to documentation control	• Duty to documentation control
• Planning phase: o The initial advice report in LEEN System provides the guidelines for target definition followed by the preparation of a corporative measurement. o The elements of planning phase are the initial advice and the tasks definitions	• Planning phase: o The energy policy offers the basics for the strategic and operative tasks definition o There is no defined element for the planning phase
• Handling with legal duties: o The energy tasks have no obligation to provide continual energy improvement and compliance with legal specifications.	• Handling with legal duties: o The task definition, it´s implementation, maintenance of strategic and operative energy targets should be executed conform

	to the energy policy and other legal requirements.
• Responsibility: o The responsibility for the measure implementation are committed to by the organisation itself without any individual binding responsibility or definition inside the organisation. o The network team support the organisation by the measures implementation, organisational access to new development and information through activities such as energy meetings, seminars and other energy related events. o The participant organisations are responsible for the internal communication (within the organisation) as well for the implementation and measures accomplishment.	• Responsibility: o The responsibility for the elaboration and legal compliance are defined by the definition and implementation of the energy efficiency measures, finance plan and time schedule. o The top management appoint the responsible person (energy management agent) for the tasks assignment and the objectives tracing.
• Communication : o Important in the LEEN system is the open communication between all network participants and externals, especially through the experience exchange.	• Communication: o External communication, especially public relations is not a main issue of the system. o No duty to experience exchange.
• Monitoring elements: o The attainment of energy targets is done by the control of the implemented measures and through the application of bottom-up and top-down methods	• Monitoring elements: o The attainment of the energy targets is done by internal audits, with the monitoring through the top management as consequence.
• Consulting: o The consultancy and the related costs are divided between the organisation members of the network.	• Consulting: o There is for each organisation an individual consultancy.
• Management-Review: It is a possibility but not a duty.	• Management-Review: The top management is obliged to deal with the Management-Review

2.5.3 Possible connections between LEEN-MS and the DIN EN 16001 and the advantages for the companies by implementing the systems

Firstly it is important to define the approach of both systems:

- The DIN EN 16001 aims to provide support for individual organisations by the development and implementation of energy systems and processes to improve their energy efficiency
- The LEEN-MS is a system to identify the energy saving potential and help the participants to overcome the existing obstacles that prevent companies from realising these potentials. The main factors are: exchange of knowledge between the participants, expert information and the process of group formation with the commonality try to solve the same problems.

Independent of the differences in approach between both systems, many advantages can be observed for the participating organisations, including:

- Practical implementation of legal requirements and consequently increased confidence when confronted with legal issues (for example CO_2 handling certificates);
- Sustainable economy: Through the reduction of energy consumption and CO_2 emissions, involvement of employees in internal decision processes and an improved work-process configuration;
- Possible organisational restructuring of work-flow through transparency when concerning an improved awareness of energy consumption.

Taking into account that an ever increasing number of companies have organised themselves into energy network groups (for example inter-trade organisations, action alliances, etc.), the LEEN-MS can provide an enormous degree of assistance to these companies in the implementation of an appropriate energy management system based on DIN EN 16001.

In addition, the LEEN-MS offers a combination of instruments to overcome the difficulties inherent in an energy management implementation. These instruments are in the majority of instances a combination of competitive, cooperative and innovative nature, all of which eventually corresponds to an increase of know-how between the participants, less work loading and increased employee motivation. Among others here are some of the major advantages that the LEEN-MS can provide to the participants:

- Experience Exchange with other organisations – group-dynamics significantly increases the individual motivation.
- Cost reduction by exhausting the energy efficiency enhancement potential;

- Support by competent and engaged professionals;
- The participant organisations experience a boost in technical and organisational development;
- Individual consulting for the organisations;
- Definition of concrete objectives towards the enhancement of energy efficiency;
- Target tracking through monitoring;
- Independent evaluation of the measures plan;
- More motivation through jointly objective targets;
- Side effect: high productivity restructuring and high product quality;
- Standardised quality of the procedure;
- Experience exchange oriented towards the practical aspects;
- Improvement in competitiveness;
- Development of scientifically endorsed solutions for the companies;
- Joint use of the network structure;
- Synergy effect;
- Increasing the employee competence through learning effect.

3. The current situation concerning the practical implementation of energy efficiency measures

For a number of years now, the energy consumption and the economic growth in Germany have been developing independently of one another. With a primary energy consumption of less than 7 Gig joules per 1.000 Euros gross domestic product (GDP), Germany belongs to the most productive group of industrialised countries regarding energy consumption. The specific power consumption has been radically reduced in recent years. Between 1990 and 2006 the average improvement of the specific energy consumption (energy intensity) has been one point seven percent (1,7%) per annum,(Bundes Wirtschafsministerium, 2007).

To further encourage the reduction in energy consumption the number of specific measures toward energy-efficiency system implementation have been increasing in the last years, and include amongst others, partnerships towards climate protection, energy efficiency and innovation[9], financial and legal supports, such as the German directive concerning energy supply and other related energy efficiency measures (EDG-L) from November 2010 in reaction to the directive 2006/32/EG from the European Parliament dated from 05th of April 2006 concerning energy efficiency and energy services (Table.4):

Table 4: Energy efficiency, measures and applications (Europäisches Parliament, 2006).

Residential and tertiary sector	
Measure	Appliance
Heating and cooling systems	Heat-exchanger, new boiler with a high efficiency, installation and modernisation of district heating and cooling systems
Isolation and aeration	Hollow-wall and roof isolation, double and triple window glazing, passive heating and cooling
Warm water	New machine installation, efficient use of space heating, Washing machines
Illumination	New and efficient lamps, digital control system, sensors disposition for illumination systems in commercial building uses
Cooking and cooling	New energy efficient machines, systems and waste heat recovery
Other equipment and machines	Co-generation of heat and power equipments, new efficient machines, time control system for an optimal energy use, reduction of the waste of energy in standby modus, construction of condensors to limit the idle power , low-loss

[9] For example the partnership between the Federal Ministry for environment and nature protection, the Federal Ministry for economy and technology and the German Chamber of Trade (DIHK). The partnership aims the creation of companies based on climate protection, information and qualification of employees in energy area.

	power transformers
Industrial sector	
Measures	Practical examples
Manufacturing process	Efficient application of air pressure, condenser, circuit breakers and valves, application of automatic and integrated systems, energy efficient standby modus
Motors and electrical drives	Increased Adoption of electronic regulation systems, integrated application programs, frequency converters, high efficiency electric motors
Air conditioning and regulation	New machines and systems, natural air circulation
Management of demand	Load management, regulating systems for acute load situations
High efficiency combined heating and power cycle	Combined heating and power cycle facilities

The measures shown in Table 4: have been supported by the German national energy efficiency plan as follows:

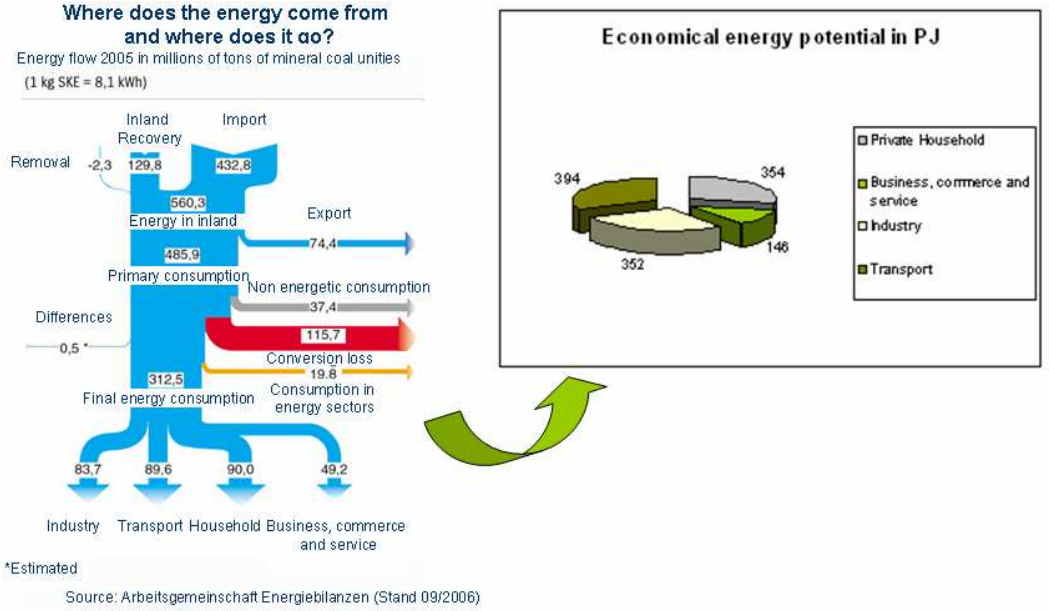
- The consequent consolidation of CO_2 programs toward building renovation and modernisation and enhancement of other government programs
- Considerable intensification of the energy efficiency specification in buildings generally.
- Construction of more combined heating and power cycle facilities
- Emphasizing the significance of industrial energy management systems
- The technological and efficiency program implementation for future drive-technology
- The extension of research in the area of energy efficiency increase in the construction, industrial, commercial and service sectors and the start of a technology program “Climate protection and energy efficiency” (EEAP, 2007).

Although many energy efficiency measures have already been implemented and significant reductions in energy consumption achieved in some sectors, there is still a huge non-exploited potential for increasing energy efficiency in areas such as business, commerce, services, agriculture and industry, particularly in small and medium-sized business.

Alone in Germany the technical potential existent in all sectors represents one thousand four hundred sixty three PJ (1.463), which corresponds to fifteen point five percent (15,5%) of the total energy consumption (9.412PJ). The economic potential

of one thousand two hundred forty six PJ (1246), corresponds to thirteen point two percent (13,2%) of the total energy consumption (9.412 PJ). The inputs of all areas put together[10] are depicted as shown (Fig.11).

Figure 11: Energy flow 2005 in millions of tons of mineral coal unities and the corresponding economic energy potential in PJ (Arbeitsgemeinschaft Energiebilanzen, 2006, Bundesrepublik Deutschland, 2007).



The utilization of technical potential within an organization corresponds to the reduction of energy consumption, which is possible under specific technical conditions (for example exchanging of machines for less energy intensive items), taking into account directives, structural, ecological and other limitations (Pehnt, Martin).

Another example of the utilization of technical potential is the improvement of manufactoring processes (increase of efficiency, use of cross-sectional technology and energy recovery, etc.). In the case of industries these potentials can be mainly found in pumping, pressurized air, hydraulic and propulsion systems.

From the economical point of view about two thirds of the present industrial energy consumption in Germany corresponds to heating processes (industry, business and service), half of which is used in furnaces and one fifth in dryers. A large part of the

[10] Potential energy savings (absolute in consumption units, relative in percent specification).

energy consumption is related to cross-sectional technologies (for example the heating allocation for space and process).

Overall the energy consumption in cross sectional technologies corresponds to about 70% of the total energy demand, and from industrial electricity consumption about two thirds of this amount flows in electric motors and their uses which integrates with the production of pressurized air, air conditioning and the functioning of pumping and ventilation (Schmid, C , 2004).

Economical potential generally defines both the period of application and the conditionally dependent proportion of the technical potential, which under specific circumstances is considered economically feasible. In other words it demonstrates how to make the most use of a limited quantity of a product or service which is in high demand, in the most cost-effective manner. An example of this is the life cycle of some form of energy saving measure, an investment amortization period, the loan interest rate or the interest reduction when utilising one´s own capital in a restructuring process. In addition the variation in general economic conditions is also a significant factor (for example changes in the crude oil price, changes in the fiscal write-off facility, energy, ecological or CO_2 taxes) (Anonymous, 2008).

In order to calculate the economic potential it is relevant to take into account the total costs of high investment in energy efficiency measures and the correlated energy saving. The calculation and the specification of the investment total can be done as follows:

- Cost overrun: By the construction of new pumps, for example only the cost overrun for more efficient pumps are considered and not the total cost. This method indicates which savings may be attained in relation to energy costs by the divergence of the standard cost. Thus it is possible to calculate how quickly the energy cost saving can refinance the cost overrun and which interest rate favours the additional invested capital (Feihl, 2010). For example, a highly qualitative energy saving lamp costs about ten times more than a normal item. In contradiction, it offers ten times more durability and consumes five times less energy than the normal one. If considered over the whole durability period, the high quality lamp is far cheaper than the other. Decisive in the whole life cycle of the energy efficient technology are the following calculations (Pehnt, M., 2010).
- Total costs: All costs are considered in this calculation.

- Limit Costs: Taking into account a fixed interest rate, this calculation is made based on an absolute limit to the total investment in which the measure may be considered economically feasible.

Although the economic potential's utilisation contributes towards conformance within corporative requirements some constraints unfortunately still exist (legal, sustainable or organisational, through for example, enhancement of the production processes and the compliance with laws). They may be informational, legal, financial, organisational, motivational or of other natures (Bundesrepublik Deutschland, 2007). Many examples may be primarily identified in the industrial, services and production sectors:

- The reduced importance of proportionately low energy costs in comparison with the overall significantly larger general corporative costs which include relatively high energy transaction costs[11], particularly for small and medium sized companies;
- Investments in energy saving in concurrence with other potential core business investments which carry an assumption of a higher underlying return;
- Absence of information from energy experts and authorities;
- Deficiency of knowledge concerning energy saving options;
- Absence of information concerning producers of energy saving technologies;
- Competence for questions concerning energy are inadequately defined;
- Lack of time and high work load;
- Concerns about the course of operations and reliability of the production process;
- Insignificance of energy costs generally;
- Costs for researching information applicable to energy saving technologies are too high;
- Long amortization time for investments;
- Financial restrictions: Available capital must be invested in more important issues;
- Workforce motivation deficiency;
- The decisions are based on risks (amortisation) instead of on economical advantages (interest rates) (Marx. G., 2010).

The existing barriers can be largely overcome with activities such as energy consulting, standardisation and increased use of energy audits, informative program implementation and integration of energy efficient concepts in qualification and further-education training. One example of possible solutions is the present

[11] Energy transactional costs are the costs of administration for the network coordination.

experience exchange in Switzerland and in Germany with the “learner” networks (energy efficiency networks). Under those guidelines companies from different sectors exchange experience with each other, share the costs and motivate one another reciprocally. These forms of networks can lead to an increase of energy saving for the involved companies up to a factor of two to three (Müssig, S., 2010). Examples demonstrate an annual reduction in energy costs of about ten percent (Dena, 2010).

4. The current state of the LEEN-MS implementation existent in networks

This chapter aims to provide details concerning the current state of LEEN-MS implementation in existent networks in order to analyse to which extent the system specifications may be applied, where the problems and discrepancies have been observed and what impressions the network participants have relating to LEEN–MS as a whole. For this purpose the participants were interviewed by questionnaire, requesting details relating to their practical experience gained by use of the system followed by the presentation of a case study of one of the network participant company.

4.1 Choice of interview candidates

In order to obtain statements which were as meaningful and as realistic as possible with regard to LEEN-MS use, the interview candidates were carefully chosen based on their personal experience with LEEN-MS. For this reason the interviews focus primarily on the moderators and engineers, all of whom are certified on LEEN-MS, and also on company representatives, who are still active within a network.

4.2 Interview process

To obtain comparable and quantifiable results, two different kinds of questionnaires, with the same basic schema were administered, each one composed of eleven questions: One for moderators and engineers (Questionnaire 1 - Annex 2) and another for the company representatives (Questionnaire 2 – Annex 3).

The structure of each questionnaire was drafted in three different sections:

- General questions;
- Questions related to MS system in general, and its implication on the effectiveness of both moderators and consultant engineers as support persons for the participating organisations;
- Questions concerning future system development.

The general questions were posed in the beginning of the questionnaire in order to identify the role of each candidate in the LEEN-MS application. For that purpose closed questions were applied requiring the interview candidates to elicit a specific reply concerning a specific topic, and so restricting the range of possible answers,

thus not only assisting the candidate in finding the applicable answer but also the assisting the subsequent allocation of results during the interview analysis.

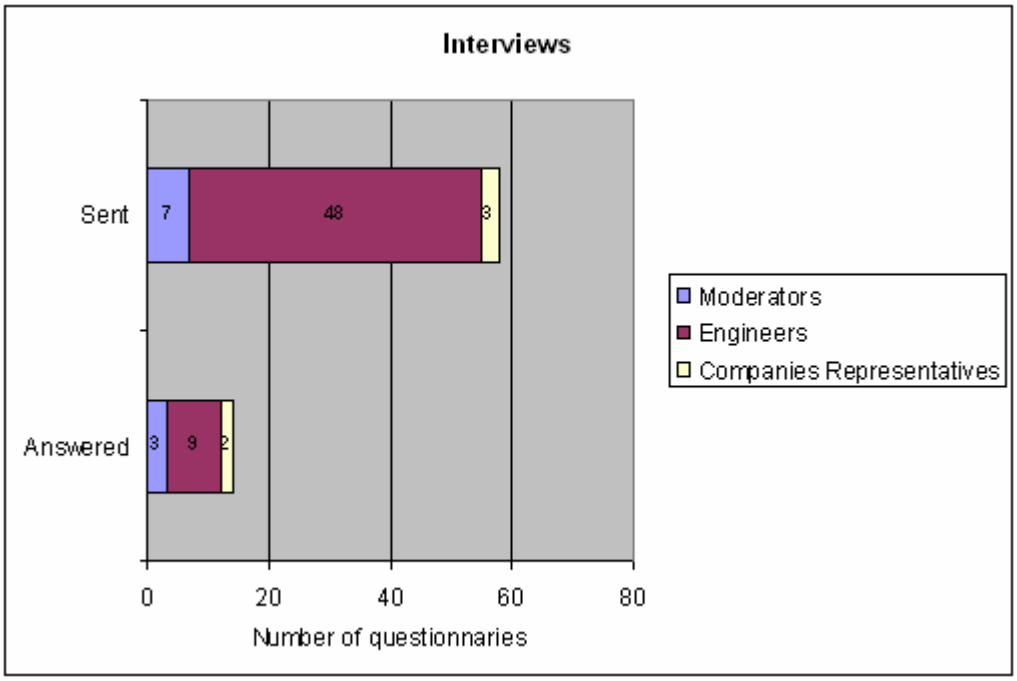
Within the second thematic section open questions were formulated in such a manner that enables an individual answer, giving the interview candidates the opportunity to express their personal opinions about the extent to which the LEEN-MS influenced their performance within the energy networks. The objective of the open questions in this part was to discover more about the effectiveness of the offered tools, training programs, know-how transfer, methods etc.

Also with open questions, the third section aimed to discover more concerning the system development perspectives under the point of view of persons, who have experience with this and other management systems. The central idea is to identify if the LEEN-MS is capable of being integrated with other management systems, and to what extent this might be possible. Aside from that, these questions were also aimed towards estimating the feasibility of future tool development where deficiencies exist.

4.3 Interview development

In the period from August to September 2010, seven moderators, forty eight engineers and six company representatives were requested to complete the questionnaires and return them. The questionnaires were sent mainly by e-Mail in Word and PDF format, some interviews were arranged by phone. A total of 18 questionnaires were returned, a feedback rate of 24,4%, of which 4 questionnaires were returned completely blank, the reason for this being the apparent inexperience of some moderators and engineers within networks and their consequent difficulty in providing a system evaluation. As a result only 14 questionnaires were suitable for use in the research (Fig. 12).

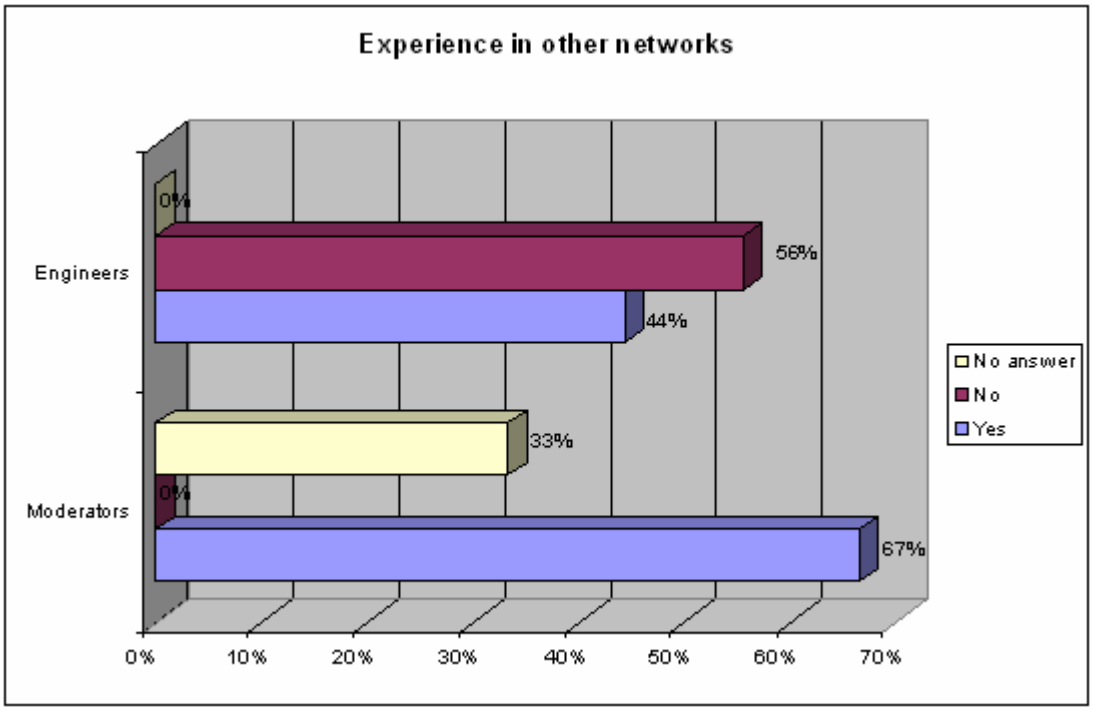
Figure 12: Number of interviews (Rocha, 2010).



4.4 Closed questions - Moderators and Engineers

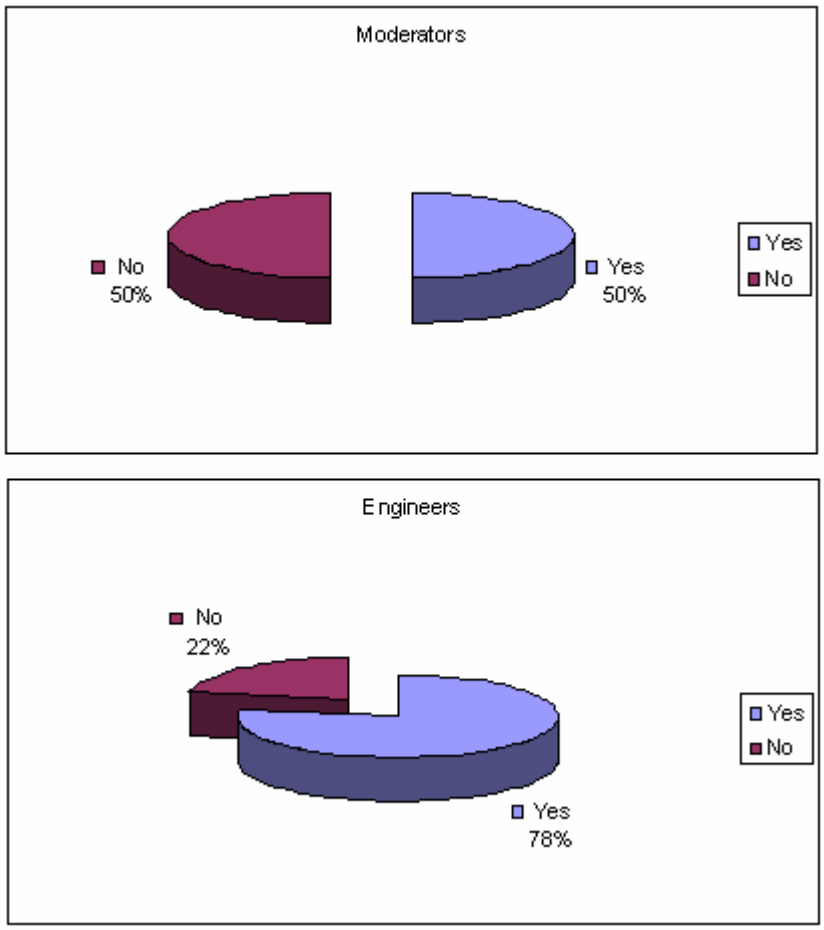
Between the moderators and the engineers the level of experience in energy networks was divided: it became apparent that the majority of the interviewed engineers appeared to have gained their experience within energy networks which were based on a form of network management system other than LEEN-MS (67%), whereas in the case of the experienced moderators this proportion corresponded to 44% (in which it corresponded to just 3 Moderators, what is not considered very representative for the results). However, here the fact must be considered that the answers presented were related, in the main, to experience gained within a network environment which was comparable in standard to LEEN-MS. Indeed, in some cases the networks experienced by them were based on the same basic principles of LEEN-MS (They were in fact the networks from the beginning of the LEEN-MS development phase – at this period in time it had simply not been given this name). Nevertheless, broadly speaking, all interview candidates could be said to have experience with networks based on the LEEN-MS standard. (Fig 13.)

Figure 13: Experience in networks based on other methods (Rocha, M., 2011).



Generally speaking the level of satisfaction with the system of internal network communication can be considered good. The greater majority of interview candidates were satisfied with the system (78% of the engineers and 67% of the moderators), a minority were unsatisfied (22% of the engineers and 33% of the moderators). Interestingly, the practical engieers exhibited a much higher degree of communicative satisfaction than the more politically orientated moderators. Neverthless, even with such a positive level of satisfaction, in the opinion of the interview candidates the standard of communication still could benefit from improvement, particularly in those areas such as assistance (33%) and network monitoring (22%).

Figure 14: Satisfaction with the system communication method (Rocha, M., 2011).



Both the engineers and the moderators have demonstrated experience with various management systems. Their levels of competence include experience with energy systems, (33% and 44% for moderators and engineers respectively) and also environmental management systems (33% and 22% for moderators and engineers respectively).

With respect to any future improvement to the system, the interview candidates in general registered a requirement for development towards a situation comparable to that defined in the DIN EN 16001, a refinement of the forms offered by the system was also considered necessary, as was improvement in the fields of public relationships and communication within the networks.

4.4.1 Closed questions - Corporate representatives

In considering the scale of the parent organisations of the interview candidates, the interviews were well distributed between all categories: small, medium and large. Fifty percent were associated to companies with a business volume exceeding 50

billion Euros and with more than 250 employees, these businesses being allocated to the category of “large-sized” companies. The rest were distributed within the two smaller dimensions. Important to be considered is that the amount of 2 corporate representatives can influence in the result causing uncertainty.

The corporative representatives have been active in networks in each case since 1998 and 2008 respectively. One hundred percent of the companies’ representatives are very satisfied with the methods employed in communication within a network, nonetheless, 50 percent of them suggested a general improvement of the communication process in the field of monitoring.

All interview candidates confirmed having experience with various other management systems, particularly with energy (100%), environmental (100%), quality (50%) and occupational safety management systems (50%). In this context 100% of the interviewed persons play an active role in their companies with integrated management systems.

The opinions concerning which manner of support the LEEN-MS offers by the implementation of an energy management system were divided: 50% answered that the system provided assistance in the initial stages towards initiating an energy management system, and the other 50% answered that there was very little or no support at all from the system concerning this point, mainly because of the consideration that the system aims to support networks and not organisations as such. In this context it is to be observed that the companies’ representatives have accumulated more experience within management systems in the fields of either energy or environmental management (100%) than the moderators and engineers (less than 50%).

4.4.2 Open questions - Moderators and Engineers

As a complement to the closed part of the interview, the open questions demonstrate the detailed opinions of this group of interview candidates.

The majority of the moderators and engineers have been active as certified members in the LEEN-MS standard since 2009 with only eleven percent active since 2010. When considering the experiences gained during this period the salient points concerned with the level of support the LEEN-MS provides to the network participants were as follows:

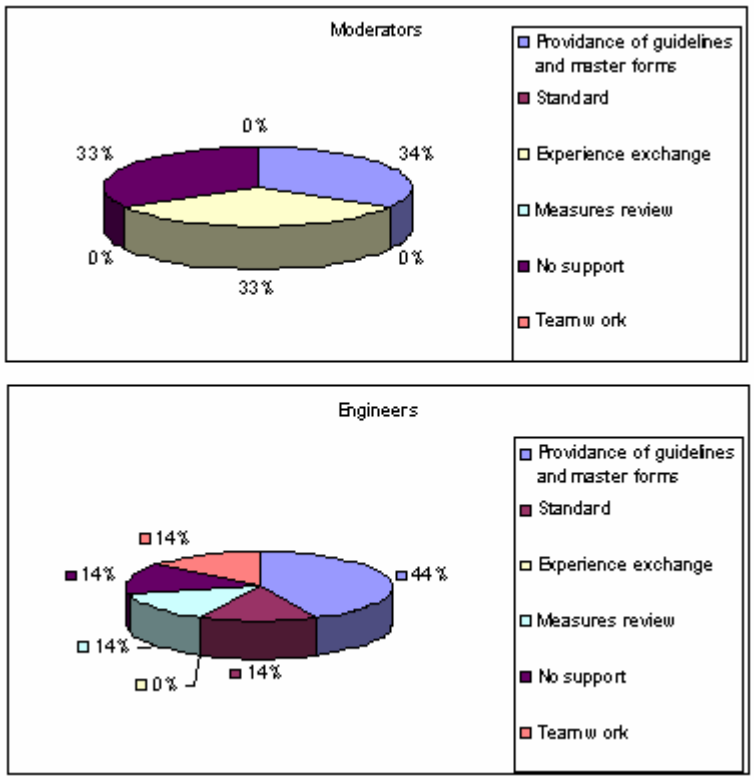
- Standardised document guidelines;
- Standardised evaluation, data collection and report formats;
- Software (systematic calculation systems);
- Experience exchange.

In general the engineers and moderators view the system as a significant support of their activities, particularly through the contribution provided by guidelines, software, forms, and method. To provide assistance to the LEEN-MS system users, various tools and information are offered facilitating the network formation process and supporting their development. Here are some examples:

- Documentation guidelines:- Letters of Intent; invitations to tender, energy data collection form, Express Check questionnaire (see example in annex 4), annual energy data entry form for energy consumption, Initial consultant report, annual report (Monitoring report) etc..
- Periodic Newsletter containing news related to energy themes;
- Hotline for questions concerning energy issues within networks;
- Software:
  - Investment calculation Tool (see example in annex 5): The tool provides a simplified approach to calculating investment amortisation (both static and dynamic), the pertinant internal rate of interest and the current actual value, thus providing assistance in devising a financial plan (IREES GmbH, 2010);
  - Measures overview Tool: This comparison tool provides an overview of all considered measures and their potential financial advantages. Besides the input parameters, investment, and the associated annual costs (energy and others), the results determined by the application of the four accepted evaluation processes are presented. (for example amortisation period and internal rate of interest) (IREES GmbH, 2010);
  - Top-down and Bottom-up monitoring tools.

All of these assist in the avoidance of time-loss, optimising the support for the network participant companies and stimulating the participants to involve themselves even further in the energy efficiency thematic; only about one third of the moderators and eleven percent of engineers think that the system provides inadequate support to their work.

Figure 15: What is the extent of the practical support provided by LEEN-MS to networks? (Rocha, M., 2011).



When questioned on whether the system supports the compliance with other management systems the following advantages were mentioned:

- The system helps to identify and allocate the corporative energy consumption in the most important energy applications and related production areas;
- Appraisal of costs-reduction potential (with a list of suggestions for measures implementation);
- Provides suggestions concerning energy efficiency measures;
- Technical support by the measures implementation;
- Complies with some steps of a PDCA cycle (common structure for all management systems based on ISO standard) particularly those related to energy management: identification of the actual condition (energy ascertainment), monitoring (energy consumption checks), planning (development of an energy strategy with possible potential exploitation measures) and reviewing (re-evaluation of the system);
- Provides guidelines, master documents (consultancy report) and tools such as software and forms.

As suggestions for the future development and improvement to the system the following points were mentioned:

- Expansion of central assistance;
- More experience exchange between the different networks. The participants would like to receive more feedback concerning the issues that are not working in the networks in order to improve their know-how;
- The LEEN-MS is seen as resembling a preliminary stage for the DIN EN 16001 norm. Because of this it was suggested by the interview candidates that future development should progress towards a system similar to the DIN EN 16001 standard. In this point the candidates were in agreement concerning the necessary political impulse required in order to achieve the necessary level of recognition of the system overall;
- The review discussion is essential, not only in order to correct any failures in the system, but also in order to motivate the executive boards of the companies involved, thereby maintaining the momentum of the improving energy situation.

4.4.3 Open questions – Corporative representatives

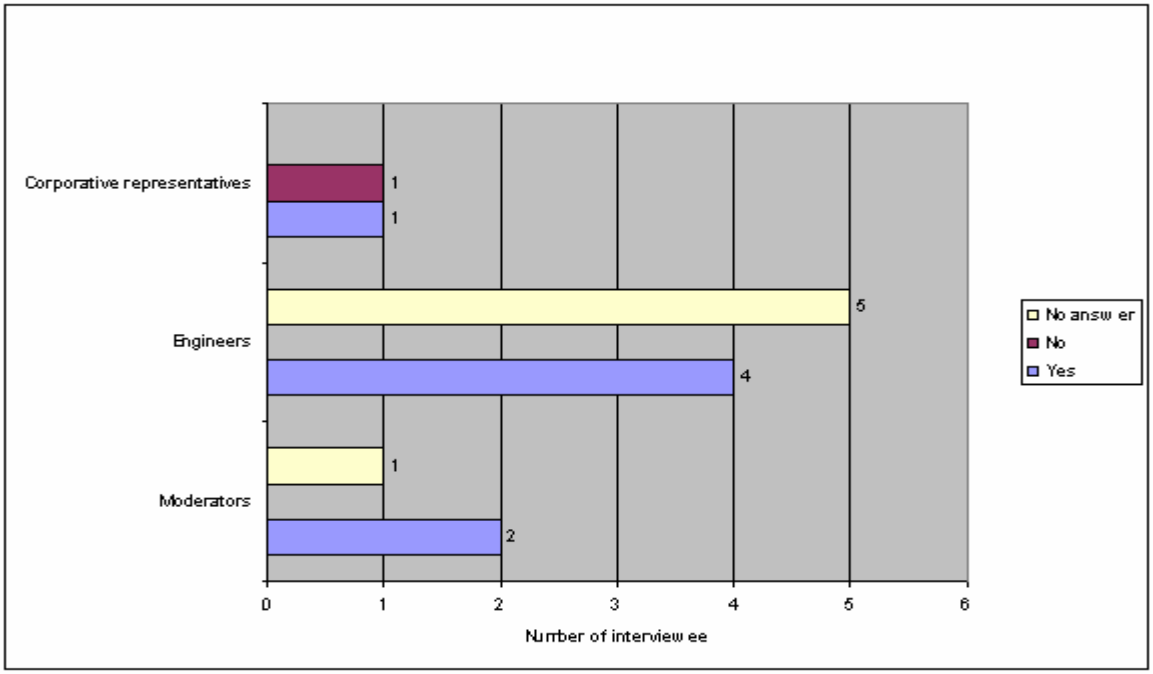
The most important outcome achieved within their companies was savings in air conditioning and heating systems by the implementation of co-generators. One of the companies achieved a value of 225.000 Euros of energy saving per year. Another company realized savings in areas such as pressured air leakage, optimization of the pressured air control system, illumination optimization, heating and air conditioning system (with circa 5% of energy savings) and optimization of the oxygen-reduction equipment. The company has been forced by circumstance to become increasingly more involved with energy themes. This has strongly motivated the associated participating companies in collaborating with the application of the various energy efficiency measures, leading to significant results of the network as a whole in reducing its energy consumption.

The highlight provided by the systems, in the opinion of the company representatives lies in the successful level of experience exchange between company organisations, the network teams and other competent experts. One criticism being that occasionally the energy efficiency meetings are too short to arrange all the necessary discussions. What remains then is only an initial motivation, without all the necessary points being discussed.

Suggestions for future system development:

- The initial advising process could be extended by a few more days, offering the organisations an improved possibility to discuss all the points necessary. Particularly the larger sized companies feel themselves to be disadvantaged because there is often insufficient time to detect all the existing energy potentials;
- The initial advice form must be improved. There is lot of information which makes the form confusing;
- The Review should happen periodically with the involvement of the company's executive board in order to motivate the continuous engagement of the participating companies by energy efficiency enhancement;
- The system should also concern itself with external directives, guidelines and regulations and their consequences to the organisations (for example with Energy Saving Act – EnGG, Energy Saving Regulation - EnEV, Renewable Energy Sources Act – EGG and Energy Efficiency Law – EnEfG).

Figure 16: Is LEEN-MS appropriate to the support of requirements implementation of management systems? (Rocha, M., 2010).



4.5 Case Study

In order to illustrate the general role of the LEEN-MS by the implementation of energy efficiency measures in business organisations a case study will be presented. The case study is based on the company Polyrack Electronic – Aufbausysteme GmbH[12].

The company Polyrack Electronic-Aufbausysteme GmbH is considered a medium sized company, it's workforce being comprised of 230 employees and actively participant, since 2008, in the Black Forest network (constituted by 12 companies). The company's main regions of activity are Germany, USA, China and Switzerland in the sector of development, production and sales of solutions for the electronic industries.

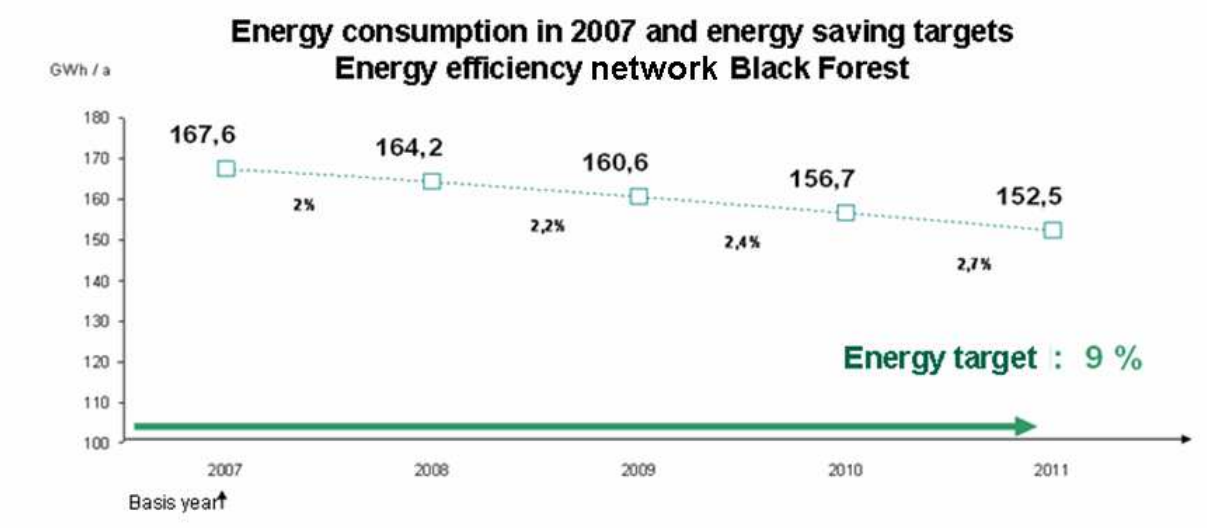
What led the company to participate of an energy efficiency network? The management board decided to participate in the network specifically because of the possibility this offered to increase the energy efficiency within the organisation. The production processes at that time accounted for fifty eight percent of the total energy consumption. Another fundamental reason for doing so was the possibility of intensive experience exchange with consultants and other organisations.

At the point of time in which the company decided to participate in the network there existed no provision for governmental financial assistance or indeed any similar support. The only possibility available to the company was the financial support of the KfW Bank[13]. The costs for the initial advice were financed by this institution.

In 2008 the LEEN-MS team conducted a site inspection in the participant companies towards the investigation of the available energy data. Following this phase a list of energy potential measures to be implemented was prepared for each company. Based on those lists the energy efficiency goal for the network was established: 9% energy efficiency enhancement until 2011 based on the year 2007. All companies account for the achievement of this goal in which they implement the suggested energy measures.

[12] The information contained in the case study was authorized by the company Polyrack in 24.09.2010.
[13] KfW Bank is a German government-owned development bank active in areas as housing and environmental protection, assistance to small and medium sized companies, financing to developing countries and export and import financing.

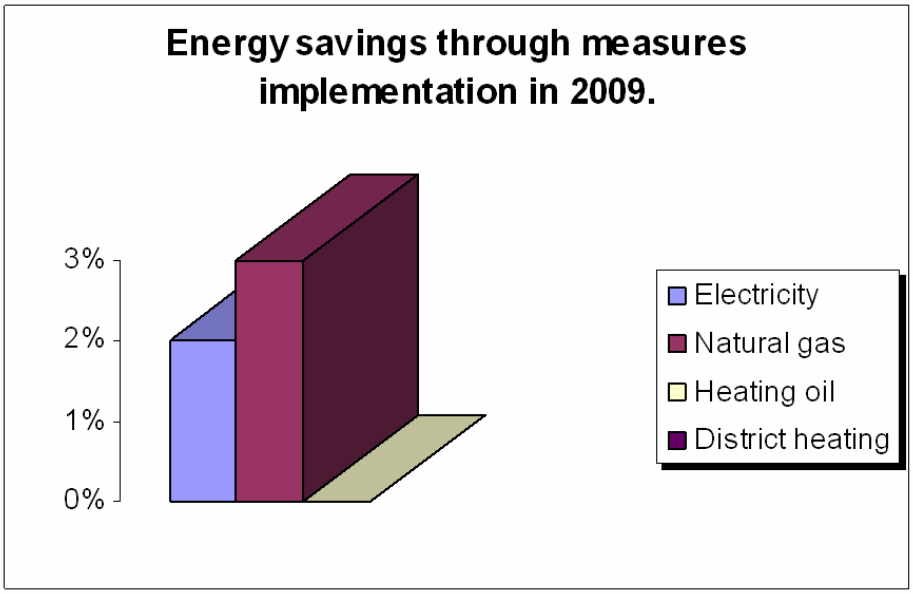
Figure 17: Network energy efficiency target (IREES, 2010).



In order to check the energy results and the goal achievement, the network is annually evaluated based on the measures efficiency progress by the monitoring methods (bottom-up and top-down).

For the company Polyrack Electronic-Aufbausystems 25 possible energy measures were identified in which the areas as heating, air conditioning, pressurized air and electro-technics could be identified. When compared with the year 2007 the company showed an energy efficiency improvement of 3% by the bottom-up monitoring in 2009. The contribution from Polyrack Electronic-Aufbausysteme GmbH by 2009 to the collective energy efficiency target corresponded to 3%. In which the single success of the company was particularly located in the reduction of fuel consumption contributing to about 3% of the CO_2 emission reduction and about 139 MWh energy savings.

Figure 18: Energy savings through measures implementation in 2009 (Rocha, M., 2011).



The results could be obtained with the implementation of the following measures in 2009:

- Regulation of blow pipe boiler in one of the sites was adjusted, in which the gas losses could be reduced into five percent (necessary investment of 250 Euro and energy saving of 50.000 kWh/a);
- Reduction of the blower rotation speed (necessary investment of 50 Euro and energy saving of 60.000 kWh/a);
- Optimization of the Oxy-Reduct-equipment (here, air oxygenation was possible with the availability of approximately 5% rest-oxygen). No necessary investment and energy saving of 5.000 kWh/a);
- Air filter installation, optimization of illumination, compressed air leakage and;
- Implementation of an energy system control[14].

The highest level of energy efficiency success was observed by the process of Oxy-Reduct optimization (50% reduction of the specific energy consumption), followed by the supply of compressed air leakage (15% saving) and other associated intersectional technologies.

The total financial investment necessary for the project amounted to 15.000 Euros, financed entirely by the company. The duration of the measure implementation was a mere 3 months with a remarkably brief calculated payback period of only 8 months.

Besides the top-management engagement within the network, the energy efficiency success could be obtained thanks to the necessary support of the LEEN-MS by the identification of energy efficiency potentials, suggestion for implementation of the correlated measures and monitoring of the network results. The major advantages observed during the whole process were the speedy and competent support provided by the consulting engineers in the process of identifying the potential energy efficiency improvements, also in the development of the optimum measures for implementation, and finally the intensive experience exchange process practiced throughout the whole project period.

[14] The company developed and implemented an energy controlling system, which helps the identification of energy fluctuation and provide confidential information about the energy consumption with help of a software, counters, sensors and other equipments (www.econ-solutions.de).

5. Evaluation of LEEN-MS concerning the compliance to the DIN requirements during the implementation of energy efficiency measures

The main subject of the present work as described in the first chapter is to clarify to what extent LEEN-MS complies with the DIN EN 16001 requirements, and which contribution the energy networks offer towards an efficient energy use in business organisations. In a limited sense, the conclusions drawn by the comparison between the LEEN-MS and the DIN EN 16001 norm, interviews with the individual system users and the case study mentioned previously, provide some answers to the following questions:

5.1 Which aspects of the DIN EN 16001 standard specifically encourages the LEEN-MS process, and which factors have to be additionally taken into account?

Based on the table produced in chapter 2 it may be observed that both the DIN EN 16001 and the LEEN-MS closely follow the schema of the PDCA cycle, both being very similar in the general performance of their basic functions but differing from one another in some performance aspects.

- **Similarities:**

As showed in the table 5, the similarities between both systems reflect the aspects from the DIN EN 16001 covered by the LEEN-MS.

Table 5: Aspects from the DIN EN 16001 encouraged by LEEN-MS (Rocha, M., 2011).

PDCA Elements	DIN EN 16001	LEEN
PLAN	Identification and definition of energy aspects, implementation of measures, maintenance of strategic and operative objectives, compliance to legal and regulatory requirements are elements of	With the support of elements like initial advice, energy survey data, Initial advice report service the strategic and operative energy efficiency tasks

	this phase.	are defined in this phase.
DO	Measures implementation is planned for this phase based on the energy efficiency plan.	Measures implementation with the LEEN-MS technical support is planned for this phase.
CHECK	The energy consumption must be periodically measured and registered, and the energy program must be reviewed. Legal requirements have to be periodically updated. Periodic audits and reviews are to be implemented with correction of system failures	The energy consumption data are collected annually, evaluated through the monitoring and review processes. Methods: bottom-up und top-down.
ACT	Non conformity, correction and preventive actions should be applied in order to avoid failures	This procedure of non conformity identification, correction and preventive action implementation is foreseen in the monitoring phase.

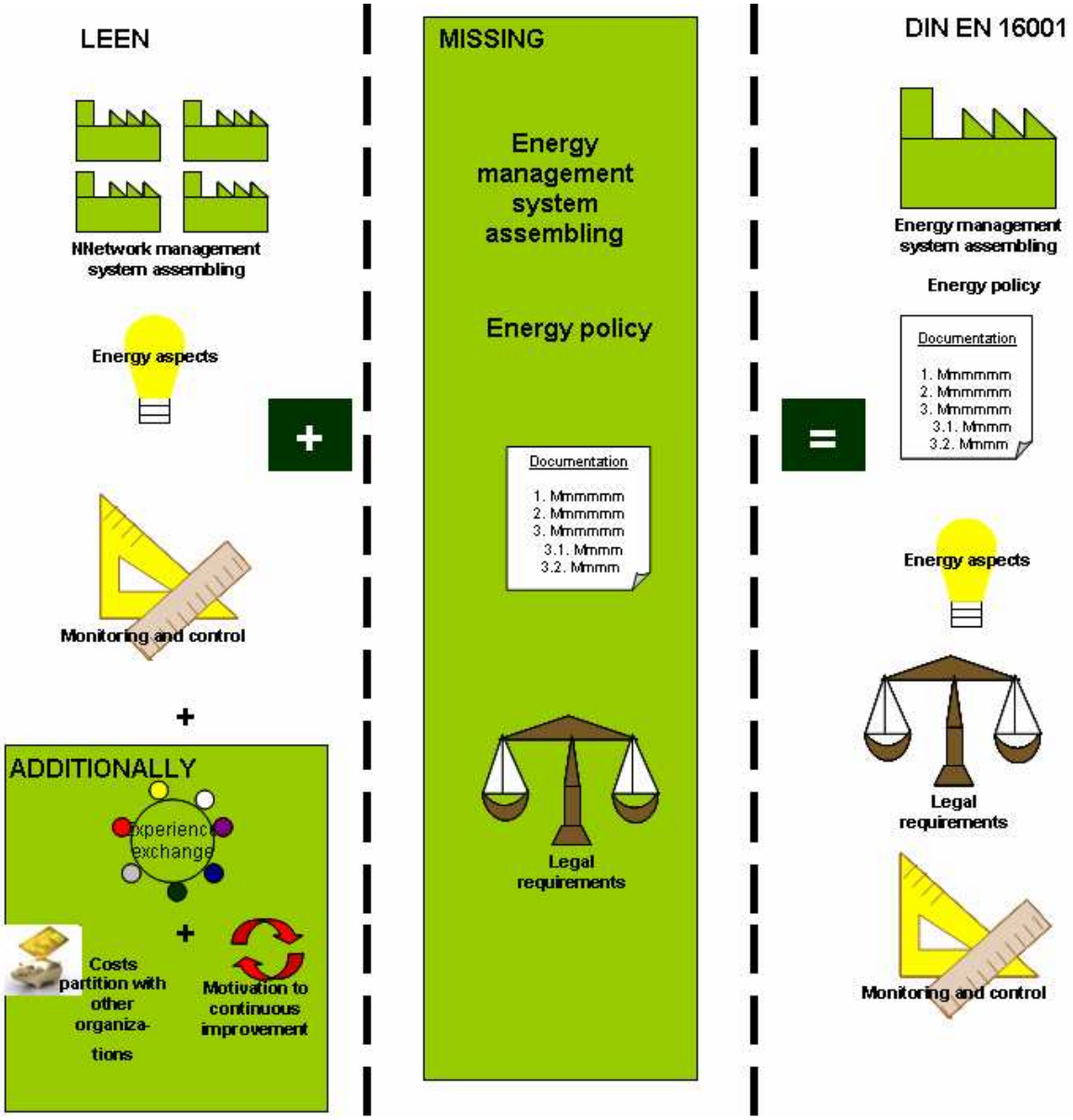
- **Differences:**

The differences listed in the chapter 2 helps to draw the factors which could be added in the LEEN-MS in order to comply with the requirements of the DIN EN 16001:

- The system could require a direct implementation in companies instead of being a system for standardised formation of networks;
- The reference to an obligation for the preparation of an energy policy and involvement of the top management is missing;
- The contemplation of legal requirements can be added;
- The responsibilities and resource in LEEN-MS could be also defined for companies themselves, not only for the networks;
- Training could be offered also for the internal workers of the companies and not only planned for the network team (moderator and engineer);
- Public relation and communication could be adapted to the foreseen communication of the DIN EN 16001;
- The obligation to description and documentation could be added;
- Operational control could be implemented in the system itself;
- The implementation of the “Management-Review” could be put in practice.

If the LEEN-MS were to be compared to the approach implicit in the DIN EN 16001 requirements it would be necessary for the LEEN-MS system to comply with several additional aspects which allow a fundamental change of focus; instead of being limited to network activity, to also allow support of energy management implementations at a business organisation level, production of an energy policy, documentation and contemplation of legal requirements etc. thus participating in additional activities in order to come on a par with the DIN EN 16001 standard (Fig. 19).

Figure 19: Missing LEEN-MS elements in a comparable to DIN EN 16011 approach (Rocha, M., 2010).



5.2 Level of approval for the LEEN-MS by the network participants (organization, consultant engineer and moderator)

As described in chapter four, the level of satisfaction with the LEEN-MS system can be considered as acceptable. The majority of the interview candidates showed themselves to be satisfied with the system: 100% of the corporate representatives, 78% of the engineers and 67% of the moderators against 22% of the engineers and 33% of the moderators, who were unsatisfied. Nowithstanding such a positive degree of approval, in the opinion of the interviewed, the communication system in areas such as assistance (33%) and monitoring of networks (22%) indicates room for further improvement.

In general the engineers and moderators view the system as a significant support of their activities, particularly through the contribution provided by guidelines, software, forms, and method. All of which assist in the avoidance of time-loss, optimizes the support for the network participant companies and stimulates the participants to involve themselves even more in the energy efficiency thematic.

The major advantage demonstrated by the system, in the opinion of the company representatives is the open experience exchange between organisations, network teams and other competent experts.

For a better support of the system and an increase of the system users satisfaction some aspects were identified as potential candidates for improvement in the future:

- The system should also concern itself with external directives, guidelines and regulation and their consequences to the organizations (for example with Energy Saving Act – EnGG, Energy Saving Regulation - EnEV, Renewable Energy Sources Act – EGG and Energy Efficiency Law – EnEfG);
- The wider dissemination of the system could be supported to a significantly higher degree by political activities such as the tax incentives for those who have implemented the system, as currently applied in Switzerland;
- New technologies and lucrative ideas obtained through research should be published with more frequency by the network's newsletter;
- involvement of the executive boards should be mandatory in network reviews;
- The tools offered should be improved;

5.3 Which support is provided in practice by LEEN-MS to the business organisations?

In general the opinion of the interview candidates as described in chapter four indicate that the system provides acceptable technical as well as administrative support for the participating organisations:

Technical support:

- Assistance in identifying the corporative energy consumption in the specific form and the relevant areas;
- Provide suggestions concerning energy efficiency measures;
- Allow fast and competent support to be provided by the consulting engineers.
- Encourages experience exchange concerning technical issues

Administrative support:

- Assistance in complying with typical steps of a PDCA cycle (the common structure for all management systems based on the ISO standard), particularly those activities related to energy management: i.e. identification of the actual condition (energy ascertainment), monitoring (energy consumption checks), planning (development of an energy strategy, where possible, applying potential exploitation measures) and reviewing (continual re-evaluation of the system);
- Provides guidelines, master documents (such as consultancy report), software tools (systematic calculation systems) and structured forms.
- Offers standardised evaluation processes;
- Encourages motivation of the participants.

5.4 How does LEEN-MS contribute to an improvement in energy efficiency?

The single elements of LEEN-MS contribute to an improvement of energy efficiency by providing the necessary support in motivating the steps towards identification of potentials, implementation of measures and monitoring of energy results:

- Initiating a network (*Plan*) – From the very beginning, the initiation of a network structure provides the opportunity for business organisations of all sizes to participate. It allows the costs to be shared, and individual time and effort to be reduced.
- Energy Efficiency meetings (*Do*) - One particular advantage of the LEEN-MS is the experience exchange process, which occurs essentially during the regular network energy efficiency meetings, consisting primarily of the exchange of information concerned with new technological innovations and their application possibilities. This advantage is even more valuable when it occurs not only within the individual networks but also externally between the networks themselves (for example the development of a panel for networks, providing regional experience exchanges[15], etc). Furthermore the experience exchange generally, motivates the participants towards a continuous improvement process by which the companies are better able to maintain the improvement of their process and management system not only by the recertification and audit activities, but also periodically through the ongoing discussions in the energy efficiency meetings.
- Initial advice and tasks definition (*Plan*) – The initial advice process assists in identifying the energy efficiency potentials and subsequently suggests relevant efficiency improvement measures in conjunction with the support of an expert. It serves as a general energy consultancy process for the companies, providing the guidelines for the definition of concrete targets for energy efficiency enhancement.
- Monitoring (*Check*) – Periodical assessment of the measures implementation progress, motivating the organization to further improve their activities toward energy saving.
- Public relations – The external (global?) advertisement of energy efficiency programs deems to support and encourage the competitiveness of the participant companies through their positive public image.

[15] Regional experience exchange is an event for the experience exchange between companies from different networks by the presentation of experts and workshops.

6 Overview for further researches

Because of the fact that the LEEN-MS and the DIN EN 16001 have not existed for a particularly long period of time, (LEEN-MS will continue in a development phase until the end of 2012, and the DIN EN 16001 norm was first presented towards the end of 2009), the contents of the present work can serve only as an assessment of the current situation with regard to drawing any general conclusion towards the future system development and the opening up of further avenues for studies.

Further research requires to be conducted in addressing just how the characteristics of LEEN-MS may assist in contributing towards the compliance with future standards such as the DIN EN to ISO 15001 (international energy management standard, the launching of which is foreseen for 2011), which additional aspects should be included into the system and how to improve support for the increase in system application generally (for example analysing the possible consequences of a tax concession for users of the system application).

Additional detailed researches and their findings would greatly assist in assessing the individual project suitability of the LEEN-MS towards the support of energy efficiency measures implementation, and provide further insight into the extent to which the LEEN-MS might contribute to global environmental protection.

7 Conclusion

The prognosis for the future is that, within the next few generations at least, the trend in energy cost will continue to increase further, which will almost certainly exert a strong influence on organisational competitiveness, requiring business to develop economical and technical solutions to enable survival in the marketplace. The implementation of energy efficiency measures is just one of the possible solutions.

In order to provide a stronger support for the companies concerned with energy efficiency enhancement the LEEN-MS and the DIN EN 16001 norm were developed. Although the LEEN-MS and the DIN EN 16001 have different approaches, the application of LEEN-MS in comparison to DIN EN 16001 can be viewed as an advantage for those companies, who only require a basic structure, particularly for small and medium-sized companies. Through the division of costs, particularly, consultancy, structuring of an energy management system, planning and implementation of energy efficiency measures, the companies are able to find the necessary support in the network structure required for engaging in energy efficiency issues.

Some existent networks have demonstrated a significant degree of success in reducing not only their energy consumption but also gas emissions, by employing LEEN-MS – typical examples are the Swiss and German networks: The Energy Efficiency Hohenlohe has for example reduced its CO_2 emissions based on year 2001 by 17.100 tons and increased their energy efficiency by 20,1% (in 2007) – one fifth (1/5) less energy consumption than in the year 2001. In general the participant companies were able to reduce their energy consumption costs by an average of 120.000 € (Modell Hohenlohe, 2010).

Basically the implementation of an energy management system motivates the change of comportment concerning energy consumption. As a direct result it is possible to attain long term energy savings coupled with corresponding advantages: costs reduction, sustainable economy, improved public image, environmental protection and compliance with legal issues (W. Kahlenborn, S. K., 2010).

In Germany there is an on-going discussion concerning a possible future connection between tax benefits and the implementation of a management system (EMAS, 16001): It befits all business organisations, regardless of size to grasp the advantage and consider participating in an energy efficiency network as preparation

for an individual energy management system implementation. The system enables all organisations to engage in practical energy saving measures through the identification of saving potentials, allocation of consumption in specific areas and implementation of energy measures. Energy costs savings of 10% through the implementation of an energy management system can be considered a very realistic figure for all companies (VDI Nachrichten, 2010).

For internationally active organizations there exists the prospective application of the ISO 50001 standard (which is still in the development phase), in implementing an energy management system which will enjoy world-wide acceptance. This standard will probably be available around the beginning of the year 2011[16].

The change in energy costs over the past few years and the future prognosis all indicate that the business organisations must develop sensibility, applying practical methods wherever possible to counter the difficulties caused by energy dependency and by so doing thus maintaining their competitive existence. With the application of simple, cost effective measures, in this case, the implementation of an energy management system (national, European or global) the organisations have the possibility to contribute to a sustainable energy consumption. The decision if an energy management system should be implemented in the organisation or not and which form of implementation should be chosen, remain specific to each organisational strategy.

[16] International Organisation for Standardization: ISO launches development of future standard on energy management www.iso.org (20.04.2010).

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9 Annexes

9.1 Annex 1: Pages 75 and 95 are an example of the communication concept.

4. Veranstaltungen

4.1 Konzeptioneller Ansatz

Mit den Veranstaltungen werden zwei unterschiedliche Ziele verfolgt werden. Zum Einen soll der Erfahrungs- und Informationsaustausch der operativen Ebene (Netzwerke mit deren Management) gefördert zum Anderen der Kreis der Multiplikatoren aus Verbänden, Verwaltung, Politik Kammern, regionalen Wirtschaftsplattformen, Energie-Agenturen etc. mindestens erweitert werden. Es soll einmal jährlich über die Fortschritte des Projekts 30 Pilot-Netzwerke informiert werden.

Der Förderantrag vom 13.08.2008 zielt beim Erfahrungsaustausch der in Netzwerken aktiven Akteuren in erster Linie auf den Erfahrungsaustausch unter den zertifizierten Moderatoren, Ingenieuren und Netzwerkträgern ab. Dieser soll in regionalen Veranstaltungen mit Workshopcharakter und in Jahreskonferenzen erfolgen.

Moderatoren, Ingenieure und Netzwerkträger sind wichtige Zielgruppen für den Erfahrungsaustausch. Allerdings zeigt die Erfahrung aus bereits durchgeführten Veranstaltungen, dass auch Unternehmen ein Bedürfnis am Erfahrungsaustausch über Netzwerkgrenzen hinaus haben. Sie schätzen gerade den Austausch mit Kollegen aus anderen Netzwerken und die damit verbundenen zusätzlichen Anstöße für die Arbeit in ihren Netzwerken außerordentlich. Sie sollen deshalb ebenfalls grundsätzlich eingebunden werden.

Für den Erfahrungsaus- und Informationstausch sind somit folgende Zielgruppen zu berücksichtigen:

- an Netzwerken teilnehmende Unternehmen
- Initiatoren/Netzwerkträger
- Moderatoren und
- beratenden Ingenieure.

6. Umweltgerechte und klimaneutrale Umsetzung des Kommunikationskonzepts

Die meisten Umweltbelastungen entstehen bei der Umsetzung des Kommunikationskonzeptes durch die Konferenzen und Veranstaltungen. Deshalb werden diese unter größtmöglicher Beachtung des vom Bundesumweltministerium unter Beteiligung des Umweltbundesamt herausgegebenen „Leitfadens zur umweltgerechten Organisation von Veranstaltungen" geplant und durchgeführt.
Leitfaden: http://www.bmu.de/umweltgerechteveranstaltungen
Checkliste: http://www.beschaffung-info.de/doks/checkliste_umweltgerechte_veranstaltungen.doc

6.1 Handlungsfelder

Wie jedes menschliche Handeln wirken sich kommunikative Maßnahmen wie die Herstellung und der Versand von Faltblättern, Broschüren, Einladungen, die Bereitstellung von Informationen im Internet oder die Vorbereitung, Organisation und Durchführung von Energieeffizienz-Tischen und Veranstaltungen negativ auf die Umwelt und die Treibhausgasemissionen aus. Ein Teil der Umweltvorteile der Energieeffizienz-Netzwerke wird so wieder kompensiert. Es muss das Bestreben sein, die durch die Tätigkeit zur Reduzierung der CO_2-Emissionen verursachten negativen Umweltauswirkungen auf ein Minimum zu begrenzen bzw. die verbleibenden Belastungen soweit wie möglich zu kompensieren und damit eine Vorbildfunktion wahrzunehmen.

Die umweltfreundliche Beschaffung von Produkten und Dienstleistungen unter Berücksichtigung des Umweltzeichens Blauer Engel, des Europäischen Umweltzeichens und Labels mit ähnlicher Zielsetzung und die möglichst klimaneutrale Durchführung von Veranstaltungen wird deshalb bei der Umsetzung des Kommunikationskonzeptes beachtet werden. Dabei werden die Maßnahmen so gewählt, dass der Erfolg der Kommunikationsmaßnahmen nicht behindert, sondern durch eine aktive Außendarstellung der Aktivitäten befördert wird.

Dabei gibt es Handlungsfelder, die unmittelbar beeinflusst werden können und Handlungsfelder auf die nicht oder nur in geringem Umfang Einfluss genommen werden kann. So entscheidet der Projektträger beispielsweise selbständig über den Einsatz von Printmedien und bestimmt damit direkt den Papierverbrauch während der Projektphase.

9.2 Annex 2: Questionnaire 1 – Moderators and Engineers

QUESTIONNAIRE
LEEN-NETWERK MANAGEMENT SYSTEM
Master Thesis from Marcia Rocha

COMPANY:	**FUNCTION:**
NAME:	**DEPARTMENT:**
E-MAIL:	

1. Do you have experience with networks, which are NOT based on the LEEN-MS standard?

☐ Yes ☐ No

If "yes", in which network were you active? For how long?

Answer:

2. Do you have experience with Energy Effiziency Networks based on the LEEN standard?

☐ Yes ☐ as an Engineer ☐ No
☐ as a Moderator

If "yes", in which network were you active? For how long?

Answer:

3. For how long have you been certified on LEEN ?

Answer:

4. What is your level of satisfaction with the system?

☐ Very satisfied ☐ satisfied ☐ not satisfied

5. To what degree has the LEEN-System influenced your success in networks?

Answer:

6. What do you see as the advantages or disadvantages of the LEEN-MS (for example compared with individual consultancy)?

Advantages:

Disadvantages:

7. Are you satisfied with the communication methods used within a network?

☐ Yes ☐ No

In what respect might it be improved?

☐ In the initial consultancy ☐ In the assistence

☐ In the Monitoring ☐ Others:

8. Do you have experience with other Management systems? If yes, which ?

a. Energy management systems

☐ DIN EN 16001 ☐ Others

b. Quality management systems

☐ TQM ☐ ISO 9001 ☐ Others

c. Occupational Safety

☐ OHRIS ☐ OHSAS ☐ Others

d. Environmental management systems

☐ EMAS ☐ ISO 14001 ☐ Others

9. Is the LEEN-MS effective in supporting your implementation of management systems requirements? If "yes", how?, if "no", why?

☐ Yes ☐ No

Answer:

10. How might be the LEEN-MS be improved in order to provide better support for the network team and the organisations (changing the structure, improvement of training, etc.)?

☐ Extention as a complement to other themes .....

☐ Extention towards a system similar to the DIN EN 16001 standard .....

☐ Improvement of the consultant activities .....

☐ Improvement of the available forms .....

☐ Improvement in Public relations activities .....

☐ Communication improvement within the network .....

☐ Others: .....

What are your suggestions for improvement?

Answer:

9.2 Annex 3: Questionnaire 2 – Corporative representative

QUESTIONNAIRE
LEEN-NETWERK MANAGEMENT SYSTEM
Master Thesis from Marcia Rocha

COMPANY:	**NETWORK:**
NAME:	**DEPARTMENT:**
E-MAIL:	**ACTIVE IN NETWORK SINCE:**

1. How large is your company?

Size of the workforce:

☐ < 10 ☐ <50 ☐ <250 ☐ More than 250

Business volume (m. €):

☐ ? 2 ☐ ?10 ☐ ?50 ☐ greater than 50

2. How long have you been active in Energy Efficiency issues?

Answer:

Why did you decide to participate in a network?

Answer:

3. Which energy saving measures were suggested by the network team, and were subsequently implemented?

Answer:

4. Which results could be obtained by these implimentations within the network?

Answer:

In which specific areas were the greatest energy savings observed?

Answer:

How did the LEEN-MS support your company in achieving energy savings results?

Answer:

5. Which management systems have been implemented in your company?

a. Energy management systems

☐ DIN EN 16001 ☐ Others

b. Quality management systems

☐ TQM ☐ ISO 9001 ☐ Others

c. Occupational Safety

☐ OHRIS ☐ OHSAS ☐ Others

d. Environmental management systems

☐ EMAS ☐ ISO 14001 ☐ Others

6. Does the company employ an integrated management system?

☐ Yes. For how long? ☐ No

Has LEEN-MS provided any support for an implementation of management system requirements?
If "yes" in what manner?

Answer:

If you answered "no", what changes would you suggest be applied in LEEN-MS in order to achieve the necessary level of assistance for the implementation of your management system requirements?

Answer:

7. What do you see as the advantages or disadvantages of the LEEN-MS (for example, when compared with individual consultancy)?

Advantages:

Disadvantages:

8. Are you satisfied with the communication methods used within a network?

☐ Yes ☐ No

In which area might it be improved?

☐ In the initial consultancy ☐ In the assistence

☐ In the Monitoring ☐ Others:

What are your suggestions for improvement ?

Answer:

9. How might the LEEN-MS be improved in order to provide a better support for the network team and the organisations (changing the structure, improvement of training, etc.)?

☐ Extention as a complement to other themes ……

☐ Extention towards a system similar to the DIN EN 16001 standard ……

☐ Extention to include information concerning legal issues and their consequences ……

☐ To provide an award or certificate for the companies as participants of networks ……

☐ Improve the method philosophy generally ……

☐ Reduction of time loss ……

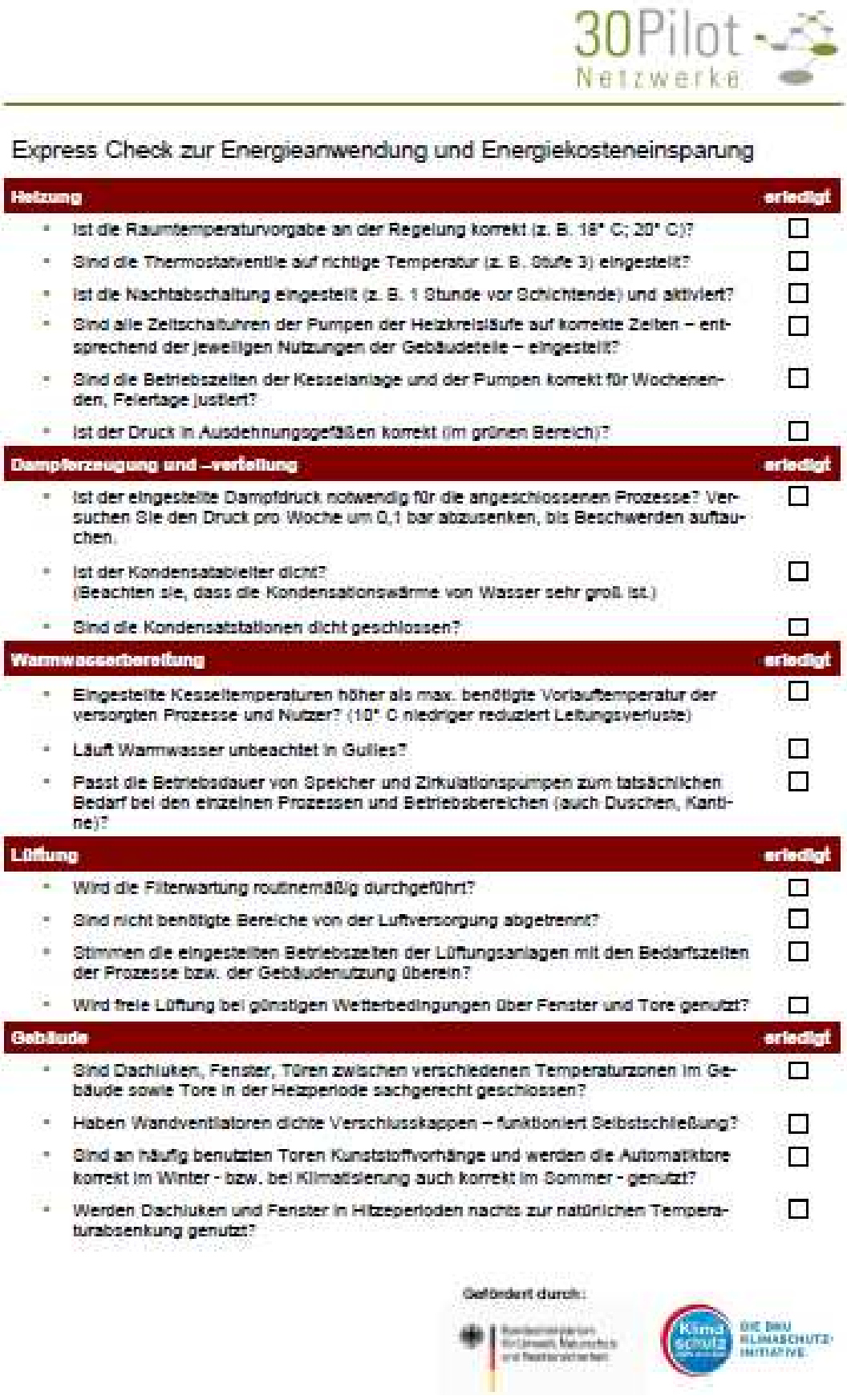
☐ Others: ……

10. Would you recommend the application of the LEEN-MS to other companies ? Why?

☐ Yes ☐ No

Answer:

9.3 Annex 4: Questionnaire Express-Check



30Pilot Netzwerke

Express Check zur Energieanwendung und Energiekosteneinsparung

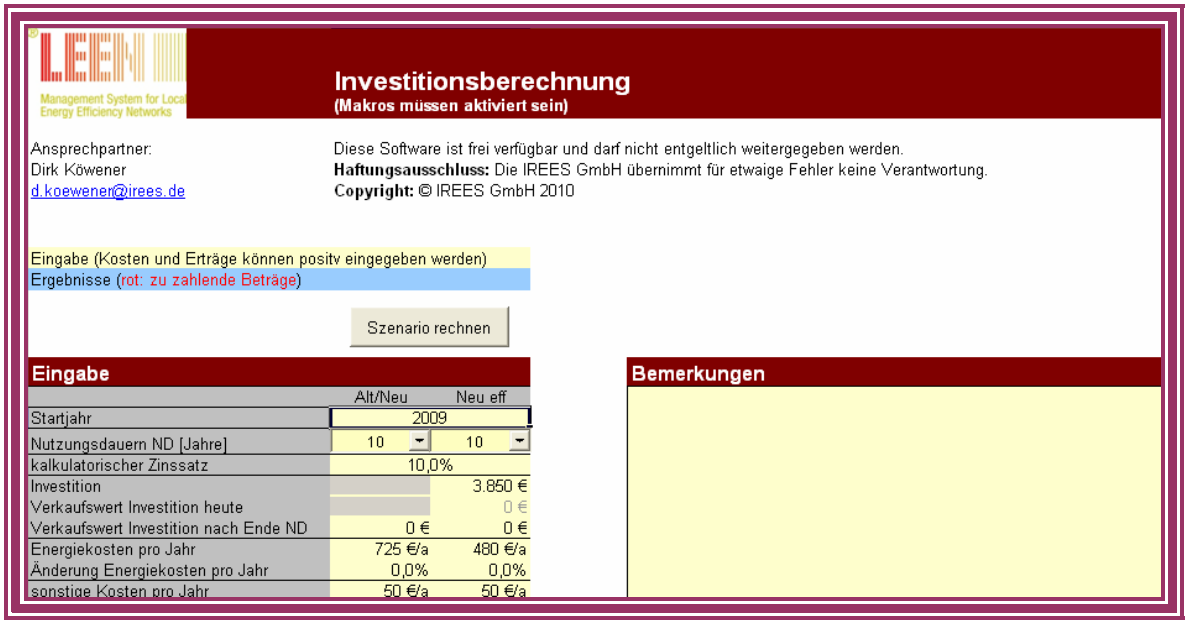
Heizung	erledigt
• Ist die Raumtemperaturvorgabe an der Regelung korrekt (z. B. 18° C; 20° C)?	☐
• Sind die Thermostatventile auf richtige Temperatur (z. B. Stufe 3) eingestellt?	☐
• Ist die Nachtabschaltung eingestellt (z. B. 1 Stunde vor Schichtende) und aktiviert?	☐
• Sind alle Zeitschaltuhren der Pumpen der Heizkreisläufe auf korrekte Zeiten – entsprechend der jeweiligen Nutzungen der Gebäudeteile – eingestellt?	☐
• Sind die Betriebszeiten der Kesselanlage und der Pumpen korrekt für Wochenenden, Feiertage justiert?	☐
• Ist der Druck in Ausdehnungsgefäßen korrekt (im grünen Bereich)?	☐
Dampferzeugung und –verteilung	**erledigt**
• Ist der eingestellte Dampfdruck notwendig für die angeschlossenen Prozesse? Versuchen Sie den Druck pro Woche um 0,1 bar abzusenken, bis Beschwerden auftauchen.	☐
• Ist der Kondensatableiter dicht? (Beachten sie, dass die Kondensationswärme von Wasser sehr groß ist.)	☐
• Sind die Kondensatstationen dicht geschlossen?	☐
Warmwasserbereitung	**erledigt**
• Eingestellte Kesseltemperaturen höher als max. benötigte Vorlauftemperatur der versorgten Prozesse und Nutzer? (10° C niedriger reduziert Leitungsverluste)	☐
• Läuft Warmwasser unbeachtet in Gullies?	☐
• Passt die Betriebsdauer von Speicher und Zirkulationspumpen zum tatsächlichen Bedarf bei den einzelnen Prozessen und Betriebsbereichen (auch Duschen, Kantine)?	☐
Lüftung	**erledigt**
• Wird die Filterwartung routinemäßig durchgeführt?	☐
• Sind nicht benötigte Bereiche von der Luftversorgung abgetrennt?	☐
• Stimmen die eingestellten Betriebszeiten der Lüftungsanlagen mit den Bedarfszeiten der Prozesse bzw. der Gebäudenutzung überein?	☐
• Wird freie Lüftung bei günstigen Wetterbedingungen über Fenster und Tore genutzt?	☐
Gebäude	**erledigt**
• Sind Dachluken, Fenster, Türen zwischen verschiedenen Temperaturzonen im Gebäude sowie Tore in der Heizperiode sachgerecht geschlossen?	☐
• Haben Wandventilatoren dichte Verschlusskappen – funktioniert Selbstschließung?	☐
• Sind an häufig benutzten Toren Kunststoffvorhänge und werden die Automatiktore korrekt im Winter - bzw. bei Klimatisierung auch korrekt im Sommer - genutzt?	☐
• Werden Dachluken und Fenster in Hitzeperioden nachts zur natürlichen Temperaturabsenkung genutzt?	☐

Gefördert durch:

Klima schutz

DIE SKU KLIMASCHUTZ-INITIATIVE

9.4 Annex 5: Investment calculation Tool



Investitionsberechnung

(Makros müssen aktiviert sein)

Ansprechpartner:
Dirk Köwener
d.koewener@irees.de

Diese Software ist frei verfügbar und darf nicht entgeltlich weitergegeben werden.
Haftungsausschluss: Die IREES GmbH übernimmt für etwaige Fehler keine Verantwortung.

Eingabe (Kosten und Erträge können positv eingegeben werden)
Ergebnisse (rot: zu zahlende Beträge)

Szenario rechnen

Eingabe

	Alt/Neu	Neu eff
Startjahr	2009	
Nutzungsdauern ND [Jahre]	10	10
kalkulatorischer Zinssatz	10,0%	
Investition		3.850 €
Verkaufswert Investition heute		0 €
Verkaufswert Investition nach Ende ND	0 €	0 €
Energiekosten pro Jahr	725 €/a	480 €/a
Änderung Energiekosten pro Jahr	0,0%	0,0%
sonstige Kosten pro Jahr	50 €/a	50 €/a

Bemerkungen