Energy efficiency networks for companies – concept, achievements and prospects

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Abstract

In Energy Efficiency Networks (EENs), 10 to 15 regionally based companies from different sectors share their experiences in energy efficiency activities in moderated meetings. After an initial consultation and identification of profitable energy efficiency potentials in each company, all participants decide upon a joint energy efficiency and a CO_2 reduction target over three to four years. Information on new energy efficient solutions is provided by experts during these meetings and the performance of each company is monitored on an annual basis. A typical network period contains up to 16 meetings, after which the companies decide whether or not the EEN should be continued.

The main goals of an EEN are to reduce transaction costs, to overcome existing obstacles, to raise the priority of energy efficiency aspects within the company, particularly in cross cutting technologies and, hence, to reduce their energy costs. Results from 70 networks in Switzerland and more than 20 networks in Germany show that the participating companies can double their energy efficiency improvements. Almost every company has a profitable efficiency potential (internal rate of return > 12 %), being between 5 and 20 % of its present energy demand.

The first EEN was founded in Switzerland in 1987 and the idea was transferred to Germany in 2002. Currently, 50 EENs are operational in Germany. To foster the idea a "30-Pilot-Networks"project was initiated by the authors in 2008 funded by the German government. Besides implementing 30 EENs the main goal of the project was to improve an existing network management system (MS) to operate EENs at a high quality standard. The MS consists of an EEN manual with helpful documents (e.g. contract templates, checklists, technical manuals, presentation of energy efficient solutions) and about 25 software-based techno-economic calculation tools which are being developed under a joint user interface. The MS, labelled as LEEN (Learning Energy Efficiency Network) is intended to offer several elements needed for the European Norm 16001 (Energy Management Systems). EENs are financed and operated mainly by industry itself. They represent an innovative approach for medium-sized companies being applicable in any industry with minor adaptations.

Background and underlying theoretical concepts

Consultant engineers usually return from on-site visits at companies with substantial energy efficiency potentials that are easy to realise and usually have high rates of internal return (Romm 1999). The limited realisation of profitable efficiency potentials has been the subject of discussions about obstacles and market imperfections for more than a decade (e.g. IPCC 2001 and 2007), and the heterogeneity of these obstacles and potentials has been tackled by sets of several policy measures and instruments (Levine et al. 1995, DeCanio 1998).

Profitable energy efficiency potentials are often not exploited in industry, since management does not focus on energy issues. Energy efficiency is not considered being a strategic investment (Cooremans 2010). Furthermore, there are various obstacles to energy efficiency (DeGroot 2001): (1) in medium-sized companies, there is often no adequately informed energy manager. He may also lack time to gain the necessary knowledge as energy issues are only one of several tasks, (2) efficiency investments often have relatively high transaction costs compared to the capital investment. This aspect may be decisive for small efficiency investments (Ostertag 2003), (3) energy costs are often treated as overheads and not allocated to individual production lines or departments of the site. This reduces the incentive to invest in energy efficient technologies as the profit centre will not earn the full benefit of such an investment.

Another obstacle emerges if the buying department is focused exclusively on reducing the investment instead of minimizing the life cycle cost. This leads to wrong decisions as the capital cost of energy related investments often has a share in life cycle cost of five to 20 % while the energy cost is between 50 and 90 %. Furthermore, decisions on energy efficient investments are taken by 85 % of industrial companies solely on payback period calculations often limited to two or three years (ISI 2009). Given normal life times of these investments of between 10 and 20 years, this decision process systematically discriminates against the long-term energy efficiency investments. Furthermore, the co-benefits of energy-efficient new technologies are rarely identified or included in the profitability calculations by energy or process engineers. This is due to the lack of a systemic view of the whole production site and possible changes related to the efficiency investments (Madlener & Jochem 2004).

Social relations such as competitive behaviour, mutual regard and acceptance not only play a role between enterprises, but also internally within a company. Efforts to improve energy efficiency are influenced by the intrinsic motivation of companies' actors and decision makers, the interaction between those responsible for energy and the management, and the internal stimuli of key actors and their prestige and persuasive power (InterSEE 1998, Schmid 2004).

The question arises as to how these obstacles and market imperfections could be alleviated and social processes used more beneficially by designing an appropriate instrument. One answer for medium-sized companies seems to be local learning networks of energy managers. The major components of the underlying framework of learning networks can be summarised as follows:

- To compensate for a lack of knowledge and market awareness, each participating company is given an initial consultation and all participating energy managers are informed of new and reliable efficiency technologies by a senior engineer. Advantages and limitations of the new energy efficient solutions and changes to the production and product quality at the production site are then discussed among the participating energy managers, identifying risks and co-benefits.
- Based on the concept of innovation research, and in an atmosphere of trust, the exchange of experiences about energy efficient solutions leads to lower transaction costs of the followers and late applicants compared to the costs of the first movers. The different attributes associated with company size of participating network members – the large ones with their potential to hire specialists and the small ones with close contact between the energy manager and the management – leads to new ideas of how to handle energy efficiency investments and organisational measures within the companies.
- Finally, the framework also integrates social and individual psychology concepts: (1) a knowledgeable energy manager receives social acceptance from his colleagues during the regular meetings; (2) once a common efficiency and CO_2 reduction target of the network has been agreed upon, social cohesion and responsibility motivates the energy managers who can also argue within their company that it has to contribute to the joint targets; (3) there is low competitive behaviour within the network as an allied group; (4) individual motivation through professional career enhancement is supported by fast learning opportunities and obvious successes in reducing the energy cost validated by the yearly monitoring by the consultant engineer; (5) the motivation of management to achieve high public reputation as a company striving for a sustainable production status. (Schmid 2004, Flury-Kleubler et al. 2001).

The first successful performance of locally organised energy efficiency networks – called EnergyModel – was observed in Switzerland in the late 1990s (Bürki 1999, Graf 1996, Kristof et al. 1999, Konersmann 2002). The creation of the Swiss Energy Agency in 2002 within the context of the CO_2 law for industry induced an additional incentive for further network generation. One major role of this Agency is to act as an intermediary in the CO_2 reduction target negotiation between companies and the federal government. Companies that reduce energy-related CO_2 emissions within the framework of a negotiated target, and accept an annual evaluation can be exempted from a surcharge on fossil fuels, currently set at 36 CHF (or €25) per ton CO_2.[1]

Around 70 energy efficiency networks are now working in Switzerland. About 2,000 companies are involved in this scheme, representing 3.9 million tonnes of CO_2 which is more than one third of the total CO_2 emissions of the Swiss industry and service sector. The target agreements are mostly based on energy efficiency improvements over a given period of time, e. g. four years, or on fossil fuels substitution by options such as industrial organic waste, renewables, or electricity[2]. The target agreements achieved until 2010 amount to more than one million tonnes of CO_2 or 29 % of a fixed efficiency development since the year 2000 (EnAW 2011). The energy efficiency networks are financed by the participating companies with individual contributions of some 2,400 to 15,000 Euro per year, depending on the size or the annual energy costs of each company. The average annual energy cost savings after four to five years of operation are 165,000 CHF (or €120,000) per company.

Concept and operation of energy efficiency networks

Starting from the positive Swiss experiences, an initial learning energy efficiency network (LEEN) was launched in mid 2002 in Germany, in the Hohenlohe region by the government of

1. This was approved by the Swiss Parliament in line with the Swiss CO_2 law in 2008.

2. (Electricity is almost CO_2-free in Switzerland, arising from 60 % hydro power and 35 % nuclear power generation).

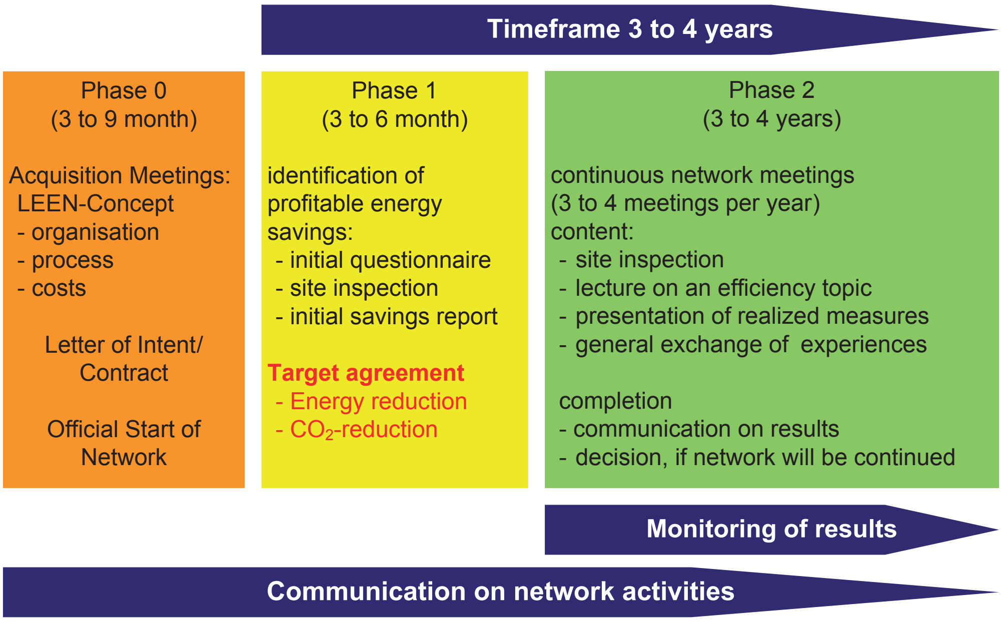

Figure 1: Setting up and operating an energy efficiency network for the first three to four years

Baden-Württemberg. This network was accompanied by a scientific evaluation (Jochem & Gruber 2004). As the results of this pilot network were very positive regarding the reduction of energy cost and CO_2-emissions by overcoming the various obstacles (Jochem & Gruber 2007), additional efficiency networks have been launched since 2005 by various institutions reaching a total of 40 networks by the end of 2010.

The main activities of the energy efficiency networks are (1) an initial consultation for each company by an experienced engineer, (2) an agreement on a common target for energy efficiency improvement and for CO_2 emission reduction of the network with a time horizon of three to four years on the basis of the results of the initial consultation, (3) regular meetings (four times per year) with presentations on technical and organisational issues by invited senior experts and exchange of experiences among the energy managers, and (4) an annual monitoring of energy efficiency progress and the reduction of energy related greenhouse gas emissions for each company and the network.

These major elements are embedded in a sequential process (see Figure 1):

- The acquisition phase (Phase 0) is a pre-phase to the network. Normally, it takes three to nine months to acquire the dozen companies required for a network. Existing energy or environmental working groups of a Chamber of Commerce or a regional industrial platform may minimise the efforts of this phase.
- The energy efficiency network starts operating with Phase 1 (so called initial consultation phase): the consultant engineer conducts an initial consultation for each company of the network. The consultation normally takes about eight to ten days per company depending on its size. It starts with a questionnaire which is completed by the company that may also add energy related material such as power demand profiles or planned energy efficiency investments. This information provides the engineer with an overview of the company's energy use and management before carrying out an on-site inspection (one to two days). Together with the energy manager, the consultant engineer indentifies energy efficiency and eventually energy substitution options. The engineer then writes a report evaluating the possible measures, describing the technical characteristics of the solutions suggested and their economic risks and profitability (net present value, internal rate of return). Based on the aggregated results of these (confidential) reports, the engineer suggests a common energy and CO_2 reduction target with a three or four years time horizon. The energy mangers of the network discuss the suggested targets and decide upon them.
- After the target setting, the network enters Phase 2 (networking phase). Energy managers of the companies meet on a regular basis (typically three to four times per year). These meetings incorporate a one hour site visit of the company hosting the meeting in order to give each colleague an overview of the production and energy related plant and machinery. During the meeting, which is moderated by a LEEN-trained moderator, a senior expert reports on an energy efficient technology or organisational measure that had been previously agreed by the energy managers. The expert is usually chosen by the moderator and is not committed to the network. The presentation may be co-refereed by one or two energy managers from the participating companies and the topics cover cross-cutting technologies such as heat generation and distribution, electrical motors, compressed air, ventilation, air conditioning, process cooling, illumination, heat recovery, green IT, energy management systems, green electricity and gas supply, modern forms of wood use and use of organic wastes, etc. Organisational measures and competences are also the topic of a meeting (e.g. profitability calculations, co-worker motivation, cooperation between the energy manager and the procurement department of the company). Implemented measures and

investments will be reported and discussed in an environment of mutual exchange and personal trust. This point is vital to the network, giving the other participants first hand information on practical observations, failures and benefits. Furthermore a telephone hotline for spontaneous questions and technical advice is set up for the whole network period by the consultant engineer and the moderator.

- During Phase 2, the consultant engineer and the moderator jointly conduct an annual monitoring of implemented measures and investments (bottom-up analysis) and the total performance of the site (top-down analysis). They track the energy efficiency progress and the CO_2-emission reduction of each company (confidential reporting) and the progress of the total network in its aggregated form. In order to maintain the independence of the consultant engineer, the implementation of the measures remains the responsibility of the company which is able, but not required to realise measures with the help of the engineer.
- The internal and public communication on the network's activities and achievements is the final module of the network, which may include press releases or press conferences (e.g. when the target is set or reached) or mutual exchange of experiences in seminars and conferences with members of other energy efficiency networks.

The LEEN management system supports all these tasks and activities by providing the engineer, the moderator and the energy managers with appropriate documentation, suggested text elements of contracts, reports and press releases as well as calculation tools for investments and the annual monitoring. These useful elements and tools have been and still will be developed by Fraunhofer ISI and partners in two publicly funded projects between 2006 and 2008 (Bauer et al. 2009) and 2008 to 2013 (ISI 2010). The LEEN management system aims to guarantee a minimum professional standard for the initial consultation, the annual monitoring, and the moderation of the meetings as well as to minimise the cost for all related tasks.

The confidence that develops between the participants fosters the general (and increasingly free and trustful) exchange of experiences and ideas during the network meetings and associated bi-lateral communication. When a network reaches the end of Phase 2, the companies may decide to terminate the network, to continue it, or to change the moderator or the consultant engineer. Experience with various networks illustrate that participants normally decide to continue the network for several years. The oldest network in Germany has been operational since 2002, and the oldest in Switzerland since the late 1980s.

The cost of the network's operation (initial consultation, moderation of the meetings, annual monitoring of the companies and the network, and the project management) is around 60,000 to 80,000 Euro per year assuming 10 participating companies and a three to four year operation of the network. 6,000 to 8,000 Euro are generally paid by each company each year. Sometimes sponsors such as local utilities or Chambers of Commerce take over the role of the network manager and of the moderator and in some cases, the cost of operating the networks is sponsored by federal states of Germany or by the Federal Government (see below the project of 30 Pilot-Networks: www.30pilot-netzwerke.de).

The initiator of an energy efficiency network may be a Chamber of Commerce, the environmental department of a city administration, a moderator or consulting office, a regional utility or a regional industrial platform. The initiator may or may not take over the role of the network manager depending on the interest of the institutions participating in the acquisition phase. In contrast to Switzerland, where no utility is managing energy efficiency networks, more than one third of the current 45 networks in Germany are operated by utilities (i.e. one large utility (EnBW) and a few municipalities). The consultant engineer is either selected before the acquisition phase starts or is chosen by the companies of the new network in a limited tendering process.

PRECONDITIONS AND FACTORS OF SUCCESSFUL LEARNING NETWORKS

The development of a learning network for energy efficiency is not an easy task if policy conditions (such as the Swiss CO_2 law) are not present to convince companies to get involved. The Swiss CO_2 law allows companies to be exempted from the payment of a CO_2 surcharge (presently 36 CHF (or €25) per t CO_2 emitted), if the company meets an individually agreed annual reduction target. Such a policy instrument incentivises the participation in a network. As such policy incentives are not given in many countries one has to consider useful preconditions and facts that help to successfully generate and operate energy efficiency networks:

- The design of the energy efficiency networks with its initial consultation and its meetings over several years generates transaction costs that have to be recovered through savings in energy costs. Therefore, annual energy costs of at least €150,000 should indicate profitability for a company.
- When launching a new network, a favourable institutional setting is an important factor. The initiating institution should have the trust of local organisations such as the Chamber of Commerce, the local municipality or utility, or a regional industrial platform, energy agency or trade association. The chances for successfully initiating a new energy efficiency network are extremely low, if there is a lack of confidence by the companies in the initiating institution or person.
- To ensure the success of the network, it is important that the representatives sent by the companies to the meetings of the learning network participate in an active and constructive way. Almost all the companies found the meetings very helpful in expanding their horizons and in discussing new topics. Several judged the exchange of experiences within the group to be a key element of the whole activity and a stimulus for taking energy-efficient actions. The participants thought it important that the discussions be open and that participants are able to speak frankly about success, failure and how problems were solved.
- The top management of the participating companies should be included in the flow of essential information and participate in the network once a year.

- The moderator and consultant engineer organising the meetings and the general information flow, and operating the hotline should operate at a high professional standard.
- The company group should not be too heterogeneous with respect to size. Companies can be heterogeneous as long as they have a substantial share of their energy consumed in cross-cutting technologies. These technologies are the common ground to discuss and experience ideas for higher energy efficiency. To guarantee a certain openness of the participants, companies within the network should not have the same customers.
- One should not always expect the network to initiate new measures identified by the initial consultation. Some companies wanted to receive confirmation of their own already planned efficiency investment decisions rather than suggestions for new measures. The network was, however, an important aid for getting some company Boards to agree to the implementation of investments already planned by their energy managers.
- A convincing factor in some companies is the common target. Such a target creates a social coherence between the companies, supporting their exchange of information and experience. Therefore, the joint target helps the moderator and the energy managers to focus on their contribution to that target. This effect of joint target setting should not be underestimated as it also supports the participants to get investments accepted in order to achieve set efficiency goals in their companies.

In some networks co-operative procurement of energy efficiency goods was discussed. Highly efficient electric motors, energy-saving lamps and highly insulated windows are the most promising technologies for this purpose. However, co-operative procurement was realised only in a few cases, due to time restrictions, the handling of different product specifications and logistical problems.

HURDLES BETWEEN ENERGY USING COMPANIES AND TECHNOLOGY PRODUCERS

Energy efficient plant and machinery requires significant investment and therefore higher capital cost than their less efficient options, but they also generate savings on energy cost. This substitution of energy cost by more capital intensive efficiency investments is often not adequately explained by technology manufacturers. They do not demonstrate the total cost of ownership or internal rates of return of the more efficient solutions. Even worse, the authors found many cases in which technology producers did not react to their customers request to deliver more energy efficient solutions:

- In many cases, the manufacturers could not (or refused to) answer the questions on the projected energy demand or efficiency of the plant or machinery offered to their customers.
- In some cases when asked to deliver a more efficient plant or install high efficiency electrical motors, ventilators or pumps in machines or plant, the producers refused to deliver such products or they refused to provide the usual guarantee on those "specially ordered" products.

This innovation-insensitive or even unfriendly behaviour from the technology producers was a surprise for the authors. The interviews with innovative companies in the network and consultant engineers suggest the following reasons:

- The procurement manager of the energy using company is not sufficiently well-informed to insist upon energy efficient advanced components being purchased in the new machine or plant. Even worse, the procurement manager may get an additional bonus from his company for reducing the final investment price. Hence, minimizing life cycle cost is not his objective. This bargaining process is anticipated by the technology producer who inserts cheap and low efficient components into the machinery and plants he sells.
- The technology producer also tends to avoid a segmentation of his product portfolio in order to keep the production series large enough to reduce production costs or the cost of production planning. He may also avoid costs of research and development for as long as possible.
- The technology producers reacts to the customer's decision process by using only the pay back period, instead of demonstrating the high profitability of an energy-efficient solution by adding a life-cycle cost analysis and the internal rate of return results.

Given this interaction between the energy using company and the technology producer, there is a vicious cycle stagnating innovation in energy efficient solutions: the demand for low investments by the customer with little or no energy efficiency specifications in the tender, and his decision process that is based on the risk of not getting his invested capital back, leads to energy-ineffective offers and investments. The technology producers mostly react to the behaviour of their customers and are often also driven by their short-term interests not to change the production process. Instead, they would be well-advised for securing their long term competitiveness to take up a pro-active role and go after new energy-efficient solutions and present the new solutions by life-cycle analysis and profitability figures.

This hurdle of innovation-unfriendly symbiosis of technology demand and supply seems to be one reason why consultant engineers usually find substantial profitable energy efficiency potentials in sites they visit. The policy process and the activities of the trade associations have to take up this issue by asking for tenders with more specifications in energy efficiency and total cost of ownership. This would help to make fast and substantial progress in implementing energy-efficient technologies in industry.

Achievements

The achievements described in this section are mainly based on the following projects:

- EEN Hohenlohe (2002–2006): Implementing the initial German energy efficiency network in Hohenlohe.
- Environmental communication and energy efficiency in SME (2006–2009): Development of an energy efficiency network management system and establishing and evaluating five EENs (Bauer et al, 2009).

Table 1: Efficiency gains and reduced specific CO_2-emissions (in %) of four energy efficiency networks in Southern Germany

Name of efficiency network	Period observed	Energy efficiency gain in %	Reduction of spec. CO_2-emissions in %	Method used
EnergyModel Hohenlohe	2004 – 2008	8.1	7.5	top-down
Energy network Ulm same network without the participating utility	2004 – 2007 2004 – 2007	5.9 4.5	24[1)] 4.0	top-down top-down
Central Germany[2)]	2005 - 2008	8.0	6.6	bottom-up
East-Wurttemberg	2006 -2008	4.0	3.8	top-down

[1)]Substitution of natural gas by wood chips of a cogeneration plant [2)] 8 companies out of 13 participating

Source: Bauer et al, 2009

- 30 pilot networks (2008–2013): Establishing 30 networks nationwide and enhancement of the initial management system for EENs (ISI 2010).

After the initial network was established in the region of Hohenlohe, a second demonstration project was launched in Germany with funding from the German Federal Foundation on the Environment, two federal states and three private companies. The project's main objectives were: (1) to evaluate different network managers from an institutional point of view (including a large German utility company) and (2) to develop a network management system that guarantees a minimum performance standard for the activities of network managers, moderators and engineers in Germany.

After this demonstration project was completed with positive results (see below and Table 1), the German government decided to fund a nationwide network project, the so called 30 pilot-networks. The objective of this project is to disseminate knowledge of how to generate and operate efficiency networks for medium-sized companies over all 16 federal states (see first results below). Another objective is the enhancement and extension of the management system for EENs and the further development of investment calculation tools operating under a joint user surface.

The achievements observed in five energy efficiency networks over a period of two to four years (between 2004 and 2008) look promising and first conclusions could be drawn reflecting similar results as found for the Swiss industry (Kristof et al. 1999, Konersmann 2002):

- On the average, the companies participating in the efficiency networks agreed upon an efficiency target of around 2 % per year which is a double of the average industry achieved during the last five years. This joint target was met by all five networks. However, the authors observed substantial deviations for individual companies due to very different reasons (e.g. substantial or no new investments, high growth or decline in production, low or strong support from the board; Bauer et al. 2009).
- The results of the reduction of specific CO_2 emissions were a little less than 2 %, as electricity demand with its higher specific CO_2 emissions increased its share in all networks. However, in one network (Ulm), the CO_2 emissions dropped by 24 % between 2004 and 2007 due to a substantial substitution of a gas-fired cogeneration plant to wood chips (see Table 1).
- After three to four years, the energy cost savings of a company ranged in the order of €120,000 per year and 500 tonnes CO_2 reduction per company (average).
- Six companies out of the 48 companies participating in four networks received within three years an award for high efficiency performance or environmental protection.
- Since 2005, the third largest German electricity utility initiated 16 energy efficiency networks with 200 companies until March 2011 which is one third of all presently operating energy efficiency networks.
- An interesting observation was (and still is) that several participating companies started checking their products for higher efficiencies (e.g. high efficient ventilators, gear boxes) or developing new products and systems (e.g. energy management systems); other companies approached their technology suppliers asking for improved and high efficient solutions (e.g. lower weights of transport lines, better insulation and control techniques of kilns).
- While 100 measures were planned and implemented, 60 new ideas – mostly more complex and sophisticated – were born and developed for further improvement of the companies' energy performance.

The authors concluded in 2008 that the learning EENs represent a new effective instrument for energy and climate change policy which is in the core of the interest of industry given the high profitability oh many efficiency solutions. In addition, it the EENs could be considered as in instrument of innovation and industrial policy, given the increasing demand for high energy efficient solutions and related cost reductions if thousands of companies would ask for them. It would strengthen the investment goods industries and their potential for exporting those solutions to the world market.

STATUS AND PRELIMINARY RESULTS OF THE 30-PILOT-NETWORKS PROJECT

The project 30-Pilot-Networks has two main goals: implementing 30 energy efficiency networks in Germany, and further developing a network management system to set up and professionally operate energy efficiency networks which may number 600 to 700 by 2020. The latter contains several elements:

Table 2: Energy efficiency measures of 50 initial consultancy reports and their profitability.

	No of measures	partial investment*	CO_2-reduction	yearly cost reduction	NPV (i=10%, 20 yrs)	internal rate of return (20 yrs)	static amortisation	dyn. amortisation (i=10%)	energy reduction [% MWh]	CO_2-reduction
		[1,000 €]	[CO_2 t/a]	[1,000 €/a]	[1,000 €]	[%]	[a]	[a]	[%]	[%]
profitable measures	**332**	**5,260**	**9,750**	**2,070**	**12,360**	**39.3%**	**2.5**	**3.0**	**7.8%**	**7.6%**
all measures	**417**	**16,000**	**10,600**	**2,260**	**3,720**	**12.9%**	**7.1**	**12.9**	**13.2%**	**10.3%**

* additional investment that leads to the energy reduction

Source: own calculations

- An acquisition manual that describes how potential medium-sized companies can be acquired for a network. This supplies the initiator of an efficiency network with (1) valuable references about how existing work groups attracted companies, (2) assistance on how to set up an informative meeting (e.g. timetable, agenda) and (3) gives instruction how to describe the network to potential participants in a meeting.
- A manual for the initial consultation phase that describes the typical course of such a consultation. However the main support is given by a design report incorporating the results of the consultation and a variety of technical tools that help the engineer calculate energy savings (currently existing, high efficiency motors, boilers, compressed air, CHP). About 15 other tools are in various states of development, all of which will run under a single-user interface which is also under development. As the calculation method and used equations are documented in detail, the whole process is transparent to the engineer and company. The identified measures are summarised in one table. This table gives the company an overview of each measure, informing them of its energy- and CO_2 reduction and its profitability. All measures are aggregated to provide the company with an overview of the overall investment cost and cost savings when all profitable measures are implemented.
- A manual for the network meetings helps the moderator to prepare these meetings. It contains samples of agendas, e.g. an agenda for the first meeting where the order of technical topics of the following meetings is defined, and an agenda for the meeting where the reduction targets are set. Furthermore the moderator is given a list of technology experts for presentations during the meetings, with contacts if required.
- A fourth part of the manual describes the communication process within the network. On the one hand, it focuses on the flow of information in the network by giving advice on how to present the results of the initial consultation to the Board, how to motivate the staff and co-workers, or how to communicate the activities and success. On the other hand, it supports the public relations process of a network, e. g. with suggestions for press conferences, press releases, flyers, and other possible publications.

These four manuals are the core of the handbook for energy efficiency networks. The handbook is enhanced by samples of contracts, presentations, check lists, guidelines and other information documents to implement and carry out a network.

The last few networks of the planned 30 Pilot Networks are still under acquisition. Due to the economic crisis in 2008/2009 it was difficult to convince companies to participate in long-term projects like the EEN. As of April 2011, 26 of the 30 networks are operational. Eight of these networks have finished the consultation phase. The first analysis of two networks resulted in nearly 420 measures where 330 were found to be particularly profitable with an internal rate of return higher than 12 %, based on 10 to 20 years lifetime (see Table 2). These measures require an additional investment (compared to a standard investment) of about €5.3 million which lead to energy cost savings of about €2.1 million per year. Hence the average rate of return is nearly 40 % and the net present value over 20 years (i=10 %) outnumbers the investment by a factor of 2.5. The annual CO_2 reduction of the profitable measures is equivalent to nearly 10,000 tonnes per year which is about 7.6 % of the total emissions of the company. All in all the consultation of 23 companies indicate highly profitable energy efficiency potential (see Table 2).

The first results of the analysis of the project 30 Pilot Networks on the potential energy savings and profitability of different technologies are based on the examination of nearly 50 initial consultancy reports (see Table 3). Lighting and compressed air have the best economic evaluations. Nearly 90 % by number are profitable and the low difference of the profitability between profitable and all measures indicate only a few being less profitable. Space heating reveals a different picture. Many, especially larger, investments are not profitable. Only 64 % of the investments indicate profitable measures. These results are preliminary as they are based on the initial consultancies. Nevertheless there is strong evidence that a high number of identified measures are profitable and profitability of different technologies is varying.

Prospects

The fact that companies from energy efficiency networks doubled their yearly progress (see Table 1) in energy efficiency compared to the industry average in Switzerland as well as in Germany suggests that the mutual exchange of experiences by energy managers of medium sized companies could be considered as a new and effective policy instrument. Of course, this success depends on well-qualified moderators and consultant

Table 3: Energy efficiency measures of 50 initial consultancy reports and their profitability by technologies.

	No of measures	partial investment*	CO_2-reduction	yearly cost reduction	NPV (i=10%, 20 yrs)	internal rate of return (20 yrs)	static amortisation	dyn. amortisation (i=10%)
lighting		[1,000 €]	[CO_2 t/a]	[1,000 €/a]	[1,000 €]	[%]	[a]	[a]
profitable measures	61	1,224	1,697	343	1,886	27.9%	3.6	4.6
all measures	71	1,356	1,774	356	1,876	26.2%	3.8	5.0
compressed air								
profitable measures	64	860	1,890	371	2,640	43.1%	2.3	2.8
all measures	73	1,052	1,955	391	2,633	37.1%	2.7	3.3
electric devices								
profitable measures	99	710	1,034	262	1,764	37.0%	2.7	3.3
all measures	144	5,126	1,074	421	-1,158	7.2%	12.2	-1.0
process heat								
profitable measures	53	209	635	126	932	60.1%	1.7	1.9
all measures	63	590	1,405	154	807	26.0%	3.8	5.1
space heat								
profitable measures	132	2,917	4,319	924	5,466	31.6%	3.2	4.0
all measures	205	19,438	5,637	1,191	-7,786	5.4%	16.3	-1.0

Source: own calculations

engineers who have been trained for this task and network-related activities. It also depends on the up-to-date knowledge of investment tools and the reporting from the consultant engineers, which guarantee high quality recommendations for the participating companies.

Intensive evaluations will be performed in all 30 Pilot Networks during the next three years. Regular exchange on a regional basis and on the federal level of all actors involved (i.e. moderators, consultant engineers, trade associations, energy agencies and participating companies) by newsletters, regional meetings and annual conferences is the basis for improvements and communication of the concept and its positive achievements. The concept also puts emphasis on regional meetings, and on best practice of cross cutting technologies and organisational measures. Other forms of networks will have to be developed such as branch-specific networks where competition with regard to energy efficiency is low. These networks will have the advantage that production processes can also be included in the mutual exchange of experiences. These different types of participating actors in different forms of networks will be developed during the next two years by the authors and hopefully realised by interested first mover companies within the next few years.

The 30-Pilot-Network-Project running until the end of 2013 is supposed to prepare the ground for further development. Assuming a financial incentive like an energy tax reduction considered by the German government, the operation of 600 to 700 energy efficiency networks in Germany by 2020 is possible. This is indicated by the experience of the CO_2 surcharge law in Switzerland which encouraged the development of 70 energy efficiency networks between 2002 and 2005. The additional CO_2 reduction potential of this policy option, realising 700 efficiency networks, is estimated to reach 10 million tonnes of CO_2 equivalent by 2020 and to generate additional profits of €100 million after taxes for the potential 10,000 companies involved.

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