

Energy auditing and enhanced implementation of energy efficiency strategies and actions through networks for SMEs

– learning across borders in Sweden, Germany and Switzerland

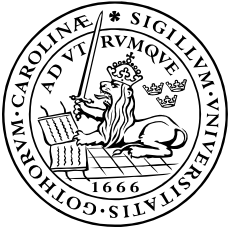
Malin Aldenius

Master Thesis 2015

Environmental and Energy Systems Studies

Department of Technology and Society

Lund University



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Dokumenttitel och undertitel

Energikartläggning och ökad implementering av energieffektiviserings åtgärder och strategier genom nätverk för SMF – vad Sverige kan lära av Tyskland och Schweiz

Sammandrag

Syftet med den här rapporten är att beskriva och utvärdera existerande tyska och schweiziska nätverk för energieffektivisering och utifrån vad som kommit fram, föreslå en modell för nätverk anpassad för Sverige. Forskningen är baserad på litteraturstudier av de existerande tyska och schweiziska energieffektiviseringsnätverken samt intervjuer med ansvariga inom nätverken, deltagande företag, forskare och tänkbara aktörer i Sverige. De nätverk som beskrivs i rapporten har fokus på icke energiintensiva företag och har som mål är att minska företags energianvändning och CO2 utsläpp samt öka antalet implementerade åtgärder.

Studier gjorda för att kartlägga existerande energieffektiviseringsnätverk i Sverige har visat att de svenska nätverken ofta är sporadiska och saknar tydliga mål och uppföljning. I motsats till detta, bygger tyska och schweiziska nätverk på en standardiserad struktur och har visat på goda resultat när det kommer till att minska deltagande företags energianvändning. För att utnyttja möjligheten att lära av andra länders erfarenheter, ges i denna rapport en detaljerad sammanställning av de tyska och schweiziska energieffektiviseringsnätverken.

Baserat på resultat från litteraturstudien och intervju svaren från de tyska och schweiziska nätverken togs det fram ett förslag på en svensk modell för energieffektiviseringsnätverk för icke energiintensiva företag. Modellen visar en möjlig uppbyggnad som består av fyra delar: rekryteringsfas, energikartläggningsfas, nätverksfas och uppföljningsfas, där nätverksfasen sträcker sig över en period från tre till fyra år. Modellen kompletteras med en beskrivning av vad som är viktigast att tänka på under varje fas när man startar och driver ett energieffektiviseringsnätverk.

Från studien drogs slutsatsen att: *en väl planerad rekryteringsstrategi, tydlig målsättning, regelbundna nätverksmöten samt årlig uppföljning av företagets arbete och framsteg* var de viktigaste delarna i ett väl fungerande nätverk.

Rekrytering: Personliga möten med framtida deltagande företag sågs som avgörande för att få framgång i rekryteringsfasen. Under mötet bör både den energiansvarige, någon från företagets ledning respektive ekonomiavdelning delta för störst chans till ett bra samarbete. Ett informationsmöte för potentiella företag bör också hållas. Rekryteringen sköts av en regional värd för nätverket och det är av stor vikt att denne är välkänd och respekterad av företagen i regionen.

Tydliga mål: Både individuella mål för deltagarna samt ett gemensamt nätverksmål bör sättas för energieffektivisering och CO2 utsläpp. Målen ska vara satta i siffror så som procent, kWh eller liknande för största tydlighet. Det gemensamma målet är ett av de viktigaste elementen i nätverken

för att få företagen att uppnå målen genom det sociala tryck det bidrar till. Målen är också ett viktigt verktyg för att sätta press på företagsledningen och göra energieffektivisering en mer strategisk fråga i företaget. Ytterligare möjligheter att motivera företagen sågs vara att knyta bidrag till nätverken som endast erhålls om målen uppfylls samt att ett letter of intent skrivs på i uppstarten av nätverket.

Regelbundna nätverksmöten: Mötena är en av de centrala delarna i processen och ska hållas under ledning av en erfaren moderator som kan verka drivande och få ut det mesta av utbytet av erfarenheter. De hålls med fördel ute på de deltagande företagen var tredje till fjärde månad och är ett sätt att minska företagets transaktionskostnader. Fyra viktiga element under mötena är: rundvandring på värdföretaget, utbyte av erfarenheter, rapportering av framsteg med att nå målen och presentation av ett relevant ämne av en expert.

Årlig uppföljning: Uppföljningen bör ske regelbundet för att kunna kontrollera och sätta press på företagen att uppnå målen. För att tydligt kunna visa att de implementerade åtgärderna gett resultat och kontrollera att företagen uppnår sina mål är det viktigt att allt rapporteras i siffror. Något som inte är utvecklat i de tyska och schweiziska nätverken men som med fördel skulle kunna rapporteras i uppföljningen i ett svenskt nätverk, är utvärdering av de extra fördelar som energieffektivisering för med sig (t.ex. produktivitet och hälsa). Även dessa bör anges i siffror och kan bidra till att göra energieffektivisering en mer strategisk fråga.

Eftersom nätverksmodellen som togs fram i denna rapport bygger på energieffektiviseringsnätverk som testats under flera år i Tyskland och Schweiz är nästa steg att starta ett pilotprojekt i Sverige. Projektet bör utvärderas noggrant under och efter nätverksperioden för att se hur modellen ytterligare kan anpassas efter svenska förutsättningar och behov, innan man startar upp fler nätverk i Sverige. Vidare forskning genom intervjuer och enkätundersökningar om hur de deltagande företag i Tyskland och Schweiz upplever nätverken skulle med fördel också kunna göras för att få en bättre bild av företagets uppfattning.

Nyckelord

Energieffektivisering, energieffektiviseringsnätverk, energikartläggning, implementera energieffektiviseringsåtgärder

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Abstract

The aim of this report is to describe and assess the existing German and Swiss energy efficiency network models and from the findings suggest a potential model suitable for Swedish circumstances. The research is based on literature studies of the existing German and Swiss energy efficiency networks as well as on interviews with managers of the networks, participating companies, researchers and possible actors in Sweden. The networks described in the report are restricted to non-energy intensive companies with the aim to decrease energy use and CO₂ emission and increase the number of implemented measures.

Previous research shows that Swedish experiences are delimited to more loosely composed networks without clear targets or monitoring. In contrast to this, the German and Swiss networks are built on structured management systems and have shown good results in decreasing participating companies' energy use. In this report a detailed description of their energy efficiency networks is given to use the possibility to learn from these countries' experience. Also the most important activities that should be included, based on the interviewees' opinions, are described.

From the research the conclusion was drawn that the most important parts of a successful network are: *a strategically planned acquisition phase, mandatory target setting, regular mandatory network meetings and annual monitoring of the companies' progress towards reaching the targets*. Another interesting result from the interviews was the possibility seen to use networks to make energy efficiency a more strategic question in companies. The opportunities lay foremost in the meetings and an adapted monitoring, but also in the possibility to put pressure on the top management.

Based on the results, a recommendation of a Swedish energy efficiency network model for non-energy intensive companies was made. The model has a suggestion for formulation of phases, as well as the most important parts to consider when starting and running an energy efficiency network. Since it is based on models tested over many years in Germany and Switzerland, the next step is to try the concept in a pilot project in Sweden to further adjust it to the Swedish circumstances and needs.

Keywords

Energy efficiency, energy efficiency networks, energy auditing, implementing energy efficiency measures

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Foreword

This thesis is part of my degree in Environmental Engineering, specialising in energy systems. It was carried out at the Department of Technology and Society at Lund Institute of Technology. However, most of the research and interviews were done in Germany and Switzerland, since the aim of this thesis was to look at their models for energy efficiency networks.

I could never have written this report alone and I therefore want to say thank you to everyone who has contributed to and supported me in my work.

Firstly I want to thank my supervisor at Lund Institute of Technology, Christian Stenqvist, for introducing me to the subject and for your countless comments on my work to help me improve the language, structure and content of the report.

Many thanks also to everyone who has put aside time for my interviews. For the sharing of knowledge and opinions with me about the LEEN (Learning Energy Efficiency Networks) networks I want to thank Mirko Krueck, Lisa Nabitz and Nicole Gruschwitz. From the EnAW (Energie-Agentur der Wirtschaft) I want to say thank you to Armin Eberle and Andreas Schläpfer who gave me a deeper insight in the Swiss network process. Thanks also to the companies from Energie-Modell Zürich who shared their opinions of the networks with me and to Catherine Cooremans for sharing your knowledge of how to make energy efficiency a strategic issue.

I also want to thank the interviewees in Sweden who helped me get a picture of the circumstances and what needs there are in Sweden when it comes to energy efficiency networks: Kristin Jonson at the Swedish Energy Agency, Anna Mattson at Eslöv Municipality, Anders Svensson at ENIG and Hanna Savola at Skåne County Board. Without all of you this report would not have been possible.

Since this thesis required a lot of travelling between Sweden and Germany as well as to the interviews, I am very grateful for the financial support given to me by Emil Possehl's Stipendiefond.

Last I want to thank Matti Reinhardt for all the support you have given me and the time you have spent correcting my English and helping me translating complicated German sentences.

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Malin Aldenius

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Introduction

1.1 Background

One of the EU 20-20-20 climate and energy targets is to improve energy efficiency by 20%, compared to the forecasted energy use, by 2020¹. To support the development, EU's energy efficiency directive came into force in 2012. The directive is currently of utter importance as Member States were to implement most of the provisions by 5 June 2014. One purpose of the directive is to make Member States introduce national energy efficiency targets and policies to reach EU's overall target (Article 7). In Sweden there has been a less ambitious target, since a couple of years, of 20% decreased energy intensity until 2020 compared to 2008 (prop. 2008/09:163) but the effort must be intensified for EU's energy efficiency target to be reached.

Small and medium sized enterprises (SMEs)² account for 30% of industrial energy use (SCB, 2010) and the potential for energy efficiency is often greater than in larger enterprises due to that less is done in the area. Also many of the easy improvements in the support processes are not yet implemented in SMEs (Paramonova et al. 2014). Even though the potential is great, there are still barriers to energy efficiency leading to that potential is not realised and measures are not implemented. Barriers can be lack of time, knowledge and access to capital (Thollander & Palm 2013) as well as the fact that energy efficiency is not a strategic question in many companies (Herbst et al. 2013). In companies where the core product process is not energy intensive and the cost of energy is relatively small compared to for example personnel costs, energy often does not have priority due to the fact that it does not have a large impact on the financial result (Sorrell et al. 2004).

In Sweden and elsewhere, economic incentives have been used to support the uptake of energy auditing in SMEs. However, the recent Swedish program of Energy Audit Checks has shown to be insufficient in supporting the companies to take the step from carrying out the energy audit to actually implement the found measures. The Swedish Energy Agency has therefore suggested energy efficiency networks or clusters as a complementing implementation tool (Energimyndigheten 2013a). The aim with these energy efficiency networks should be to provide clear guidance, support and motivation as well as ease for the individual company to:

- Become more cost efficient by lowering the energy use and transaction costs for gathering knowledge about energy efficiency measures
- Overcome barriers for implementing energy efficiency measures
- Make sure energy efficiency becomes a prioritised question in the company

An international study shows that such objectives can be reached through exchange of know-how between companies from different industrial sectors, clear targets for energy efficiency

¹ **Legal definition and quantification of the EU energy efficiency target:** "Union's 2020 energy consumption

² EU definition of SMEs: companies with less than 250 employees.

and CO₂ emission reduction, regular monitoring of the progress and support from experts within the area (IEA & IIP 2012).

Two countries with experience in this regard are Switzerland and recently also Germany, where energy auditing has been coupled with the formation of company networks that aim to enhance the implementation of strategies and actions following an energy audit. These regional networks are spread nationwide and built on structured management systems with clear targets and network meetings. These energy efficiency networks have shown good results with a doubled improvement in energy efficiency compared to the industry as a whole (Köwener et al., 2011). Contrary to the German and Swiss company networks, the Swedish experiences are delimited to more loosely composed networks. The international studies made of the Swedish company networks show that the structure of the networks needs to be developed especially when it comes to moving through the phases and setting targets. They also show that all of them lack when it comes to monitoring the results. Despite this the networks are still appreciated by participating companies and have delivered better energy efficiency improvements than stand-alone energy audits (Municio 2014) (Paramonova 2014) (Energimyndigheten 2013a).

Due to the lack of structure and regular monitoring in Swedish networks there is a need to learn from other countries' experiences in order to create successful energy efficiency networks. This research can be done with advantage by reviewing the established German and Swiss network models to learn from their experiences.

1.2 Aim and research questions

The aim of this report is to describe and assess the existing German and Swiss energy efficiency network models and from the findings, suggest a potential model suitable for Swedish circumstances. The research will be based on literature studies coupled with interviews.

The aim leads to the following research questions:

- 1) How are the German and Swiss energy efficiency networks designed when it comes to structure (phases, time frames, roles, costs, motivations to take part) and content (acquisition, energy audit, network meetings, monitoring, target setting)?
- 2) Which are the key factors that have made the German and Swiss networks successful in decreasing companies' energy use and get more measures implemented?
- 3) How should the phases of a Swedish energy efficiency network be formulated and which activities should be included under each phase?

1.3 Disposition

Section 1 gives a background to the research in this report followed by the aim and research questions.

Section 2 presents the research methods used in this report. It gives an overview of how the literature studies are carried out, what methods the interviews are based on as well on how the analysis of the report will be done.

Section 3 gives a deeper understanding of why we need to work with energy efficiency today. It describes the barriers such as: lack of time and knowledge and the fact that energy efficiency often is not a strategic question today. Also a short presentation of the legislations and subsidies that motivates the work with networks is given. A description of what a network is and why is it is motivated to use networks as a tool to increase energy efficiency is also given.

Section 4 contains a detailed description and assessment of the German and Swiss energy efficiency networks. Descriptions are coupled with interview opinions of what should be considered and why.

Section 5 analyses the findings from the German and Swiss networks to point out the most important factors that should be considered when starting up a network in Sweden. The conclusions lead to a suggestion for a Swedish model and what should be considered when starting and running a network.

Section 6 concludes the findings of this report and suggests further research.

Method

The aim of this report is to suggest a model for energy efficiency networks for SMEs in Sweden by learning from how the successful German and Swiss model has been carried out. An inductive method³ is used in the report and the main way to gather information about previous experiences in Sweden, Germany and Switzerland are through literature studies and interviews. The results and methods used in Germany and Switzerland are analysed in order to find out the best model for energy efficient networked based on Swedish needs and conditions.

When a literature study and interviews are carried out there are four principles that should always be kept in mind: multiple sources of evidence is considered more trust worthy than a single source, organise and document the data collected in a database, maintain a chain of evidence so the reader can follow it from the research question to the conclusion and be careful with electronic sources (Yin 2014).

2.1 Literature studies

A study of previous documentary information is the base of most reports. It can include; personal documents, articles, agendas, administrative documents and books. Today most information can be accessed through the internet and it is important that it is carefully used and realised that it may not be lacking in bias. Another problem that should be noted is that

³ Inductive method: Unprejudiced knowledge is generated through observations and patterns are looked for in social phenomenon to show general principles. A conclusion is drawn from the gathered experience.

with the amount of information available today, reviewing can be a time consuming procedure. On the positive side documentation is a stable source for information and can be reviewed repeatedly. It also covers a wide span of information and prevents that double work is carried out (Yin 2014).

The literature study for this report includes a comprising research about the existing energy efficiency networks in Germany and Switzerland. Here it is looked at how they are designed referring to; their aims, the different phases of the network, network meetings and key players. The information is found foremost online through the analysed networks own documents as well as through articles describing and analysing the outcomes of the networks.

Current planned work with networks in Sweden is also studied, with focus on the Swedish Energy Agency's documents and a report carried out by the consultancy firm, CIT Industriell Energi AB, a Chalmers Industriteknik Company. This is done in order to focus this report on areas where information is missing. It is also a way to contribute with a different perspective on how to design a Swedish energy efficiency network for SMEs.

Management tools available today and how they can be used in a network was studied, as well as the needs and barriers for energy efficient measures to be carried out in SMEs in Sweden. By knowing the critical areas for SMEs, the focus of the network can be concentrated on where it is needed the most, to promote energy efficiency.

2.2 Interviews

Interviews are considered an important source of knowledge. For interviews either a quantitative or qualitative method can be used. The quantitative method is more structured and has a set template of interview questions. The qualitative method is less structured, the questions can be adjusted during the interview and the answers are richer. The qualitative interviews can be unstructured or semi-structured. In the unstructured interview, only one question is asked and follow-up questions are added where necessary. The semi-structured interview is based on a list of prepared questions but adjustments can be made when it comes to order and follow-up questions can be asked (Berglund n.d.)

An interview can with advantage be recorded in order to get more accurate information. It is though important that the interviewee gives his consent for recording, that it is recognised that it is not a substitution for listening and that it is time consuming to transcribe the interview afterwards (Yin 2014).

To complement the literature studies and get a more thorough view of how the networks in Sweden should be designed interviews was carried out in Sweden, Germany and Switzerland. The semi-structured interviewing technique was used and targeted questions was formulated for each interviewee, which were open to invite to follow up questions. The focus in the interviews was on the interviewee's personal opinions and attitudes toward the network projects. Questions for Swedish organisations had the objective to find the research gaps and what needs there are today. In Germany and Switzerland the aim was to get a deeper analysis of the networks and find out what has worked well and what needs to be improved. An important focus was on the motivations and methods to attract the SMEs to participate in

networks. In table 1 the organisations that were interviewed can be seen. These key actors were chosen for interviews in order to create a complete picture of how the situation with energy efficiency networks looks today. The interview questions asked can be seen in Annex 1 to 5.

TABLE 1. ORGANISATIONS INTERVIEWED FOR THE REPORT AND THE PURPOSE OF THE INTERVIEW.

Organisation	Role	Purpose of interview
The Swedish Energy Agency Kristin Jonson	They are in the process of investigating the possibility to start up regional energy efficiency networks for SMEs in Sweden.	To get an overview of what they want to achieve with the network project and how far they have come. It is important to find out what has already been done and where the knowledge gaps are.
Swedish organisations Hanna Savola (Länsstyresen Malmö) Anna Mattson (Eslöv Kommun)	The Swedish county administrative board (Länstyrelsen) and municipalities (kommuner) have a possible role in administrating and hosting the networks.	To get a picture of their view of starting a network project in Sweden and what role they want to have in the process.
ENIG Anders Svensson	An existing Swedish energy efficiency network for certain sub-sectors.	To get their view on working with SMEs in networks and their opinion on how they can be part of the process.
Research Dr. Catherine Cooremans (University of Geneva)	Researcher and teacher in Energy Management.	To get her opinion about networks possibility to contribute in making energy efficiency a strategic question in participating companies.
Fraunhofer Institute Lisa Nabitz	Fraunhofer Institute was part in starting up the 30 Pilot Networks project in Germany and are administrating LEEN.	To get deeper knowledge of the starting process of the network project LEEN as well as how they work with auditing and their opinions of what is working well and what needs to

		be improved.
LEEN ltd Mirko Krueck	Developer and distributor of the LEEN-Management system	To get deeper knowledge of the management system and the dissemination as well as their opinions of what is working well and what needs to be improved.
EnAW Armin Eberle	Non-profit service agency that consults and supports companies in reaching targets for energy efficiency and CO ₂ reduction. Hosting the Energi-Modell and KMU-Modell	To get deeper knowledge of the starting and running process of the networks their opinions of what is working well and what needs to be improved.
Network hosts/president Andreas Schläpfer (president Energie-Modell Zürich) Nicole Gruschwitz (Energie Baden-Württemberg (EnBW))	Network president of the Energie-Modell Zürich respectively host of LEEN networks.	To get an understanding of how companies are motivated and attracted to take part in the networks and their opinion of positive and negative sides of the network project.
Swiss companies 3 companies from the service and industry sector	Participating companies in Energi-Modell Zürich, the network running the longest.	To get their view of the networks and what is positive and negative. To find out what motivated them to take part and what they gain from participating will be the main purpose of the questioning.

2.3 Analysis

Analysis is a systematic way to value something in a strategic and well thought-out way. In order to give a suggestion for a Swedish energy efficiency network model a qualitative analyse will be done of the collected data from the interviews and literature study. The activities found to be most important in the German and Swiss network will be discussed based on the literature studies and interview answers. The conclusions will lead to a

recommendation of a Swedish energy efficiency network model for non-energy intensive companies.

Theory

3.1 Energy efficiency

“Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input” (IEA 2014a). With today’s growing problem with the increase of the greenhouse effect and the rapid decrease in fossil fuels, energy efficiency is an important tool for an economic growth and a sustainable development. It is the fastest and most cost effective way to address economic, environmental and energy security challenges. By improving the energy efficiency the impact of greenhouse gases and other air pollution on the environment can be decreased and at the same time fuel is saved and it is economically profitable for the company (Wollin 2014). The connection between economic growth and increased use of energy and resources must be broken. Increased energy efficiency is a way for a company or country to become more competitive and increase their degree of self-sufficiency (IVA 2013).

3.2 Barriers for implementation of energy efficient measures

Even though there are many advantages with energy efficiency there are numerous barriers that prevent companies from implementing energy efficiency measures even when they are seen to be economically profitable. A barrier can be defined as: “A postulated mechanism that inhibits investments in technologies that are both energy-efficient and economically efficient” (Sorrell et al. 2004). Thollander (2008) categorises barriers into three main groups based on: economic barriers, organisational barriers and behavioural barriers. Important barriers under each category can be seen in table 2.

The economic barriers can be divided into market failure and non-market failure barriers. Market failure barriers violate the idea of an ideal market for products or services and make a flaw in how the market operates (Brown 2001). Examples of barriers are: imperfect information, adverse selection, principal-agent relationship and split incentives (Thollander 2008). The non-market failure barriers are not based on market failures but still inhibit the energy efficiency measures to be implemented. Commonly it is due to low energy costs compared to other goods and services in the company and energy issues therefore get low priority (Brown 2001). These barriers can for example be: hidden costs, limited access to capital, risks and heterogeneity (Thollander 2008).

The behavioural barriers affect the rational decision making related to energy consumption. The most important barriers are: form of information, credibility and trust, values, inertia and bounded rationality (Thollander 2008).

Organisational barriers can be due to lack of power of for example the energy management or due to how the culture of the organisation looks in the company (Thollander 2008).

TABLE 2. BARRIERS PREVENTING ECONOMICALLY PROFITABLE ENERGY EFFICIENCY MEASURES FROM BEING IMPLEMENTED. SOURCE: (THOLLANDER 2008)

Economic barriers - Market failure	Economic barriers - Non-market failure	Behavioural barriers	Organisational barriers
Imperfect information	Hidden costs	Form of information	Power
Adverse selection	Limited access to capital	Credibility and trust	Culture
Principal-agent relationship	Risk	Values	
Split incentives	Heterogeneity	Inertia	
		Bounded rationality	

The barriers having the largest effect on measures not being implemented have been seen to differ between companies depending on factors such as: company size, company structures, the energy intensity, management preferences and transaction costs (Fleiter et al. 2013). In an audit of non-energy intensive companies in Sweden Thollander (2008) concludes that the largest barriers are: *technical risks, access to capital and lack of time or other priorities*. A large barrier also lies in that the top management does not prioritise energy issues and therefore the energy managers are not given enough time to work with energy efficiency questions (Herbst et al. 2013). In SMEs it is also common that there is no person dedicated to energy issues which may lead to a lack in knowledge to carry out energy management. A small energy saving potential in the individual company also makes the economic incentive rather low compared to larger companies.

3.2.1 The strategic value of energy efficiency

The investment behaviour is also important when it comes to implementing energy efficient measures in companies. For a long time, the focus to motivate desired investments in companies has been purely economic; “profitability leads to investment”. Lately it has been realised that a lot more factors are impacting the choice of which investment will be implemented. The key influence might instead be the strategic value of the investment. Energy efficiency is often not a strategic issue in SMEs, the reason differs between organisations depending on the salience of energy consumption, which in turn is linked to energy intensity, size and sector (Fawcett et al 2012).

According to Cooremans (2012), the investment process consists of five important steps; initial idea, diagnosis, build up solution, evaluation and choice and implementation. The chain of steps can also be seen in figure 1. Around it individual, organisational and environmental

factors are also affecting the process. Along the course of the investment process the less strategic investments will lose the competition for reaching the implementation step. This is a main problem when it comes to increasing the energy efficiency; since energy often has a very low strategic value for companies and external factors such as energy culture has a great impact (Cooremans 2012).

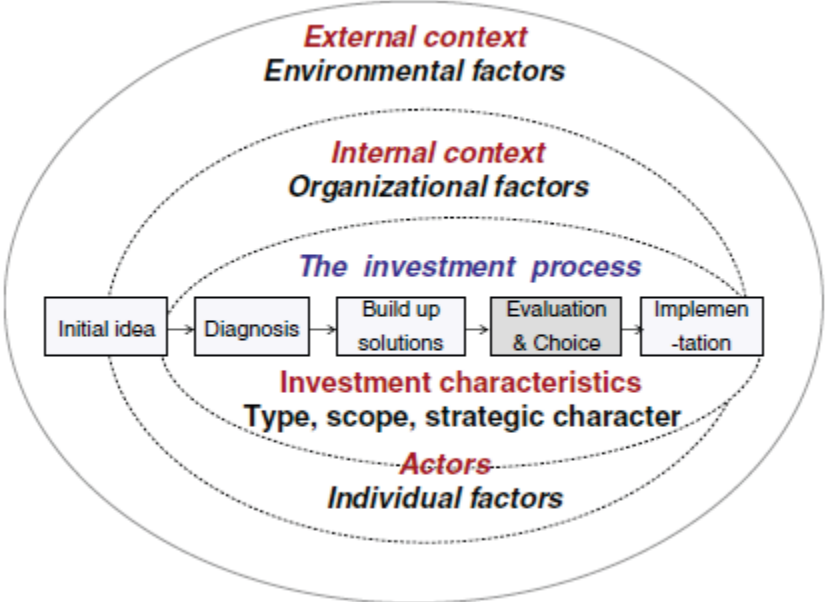


FIGURE 1. COOREMANS’ (2012) MODEL OF INVESTMENT DECISION MAKING.

If an investment gets through is simply dependent of its strategic value, which means that a project must be perceived as increasing the value proposal and decreasing the costs and risks of a company (Cooremans 2012). The three dimensional concept “value-costs-risks” is shown in figure 2. The concept can be used as a visual tool to identify and highlight the positive link between energy efficiency and core business to make it a more strategic question.

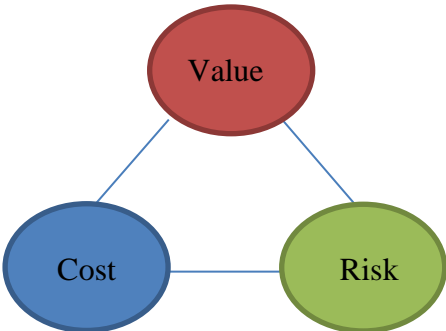


FIGURE 2. THE THREE DIMENSIONS OF COMPETITIVE ADVANTAGE. SOURCE: (COOREMANS 2012)

Standing in the way for investments in energy efficiency are often uncertainties around new technologies and prices as well as problems between the energy managers and the administrative departments. It is therefore an important step to get the upper management of the company more involved by underlining the positive impact energy efficiency has on the

core business (Cooremans 2011). There will always be a competition between investments and in the end the project considered most strategic will win (Cooremans 2012).

3.2.2 Driving forces to energy efficiency

Driving forces for SMEs to implement energy efficiency measures are less studied but research of barriers at Linköping University identified the four most important driving forces to be (Thollander 2008):

- Long-term energy strategy
- Existence of people with real ambition
- Lower costs due to lower energy use
- Threat of rising energy prices

Different motivations vary a lot between different sectors and organisations. The fact that energy use is often not considered important by the top management means that a structured energy management system can play an important role with monitoring, targeting and reporting (Fawcett et al 2012). To overcome the strategic barrier and "hidden" cultural barrier, the following should be considered according to Cooremans (2008):

- Every company is unique
- Act on the cultural dimension: information & change management
- Make energy visible: energy management
- Identify & emphasize strategic importance of energy use for any company

Financial measures are often used to help companies overcome energy efficiency barriers. In Sweden one way used to support SMEs is the Energy Audit Check, which should motivate and support the companies in carrying out energy audits. The use of voluntary agreements to support companies to implement measures after the energy audit is carried out has been seen to be a good complement (Fawcett et al 2012).

3.3 Why is more research about networks needed?

In March this year a suggestion was made to the European Regional Development Fund⁴ for investments in growth and employment 2014-2020. Here it is stated that the 'competitiveness of SMEs should increase'. The energy audit checks used by the Swedish energy agency to support energy auditing in SMEs today will be funded by the Regional Development Fund. In the report they make a suggestion to complement the energy audit checks by funding national, regional or sector specific company networks.

When following-up the energy audit checks, the Swedish energy agency also saw that something more than a single effort is needed to make SMEs implement energy efficient measures. A goal for the agency is therefore to develop a new management system where

⁴Link to suggestion for the Regional development fund:
<http://eu.tillvaxtverket.se/download/18.2d4ad9a1144e334a2e495585/1396602984905/Nationellt+regionalfondsprogram+f%C3%B6r+investeringar+i+tillv%C3%A4xt+och+syssels%C3%A4ttning+2014+2020.pdf>

companies work in a self-driven way to continuously and systematically decrease their energy use on long-term bases. Looking at the Regional Development Fund's suggestion and previous experience of work with less systematic networks, regional energy efficiency networks for SMEs are considered an interesting possibility (Energimyndigheten 2013a).

At the moment the Swedish energy agency is working on finding a design for the networks and finding out which key players will take part. To do this, the CIT Industriell Energi AB at Chalmers was given the job of auditing current networks and giving a suggestion of how a new network can be designed connected to the Regional Development Funds. The report from CIT was presented in June 2014 and now it will be looked at by the Swedish energy agency to see how the information can be implemented with respect to what is said in the Regional Development Funds. The Regional Development Funds are still just a suggestion and nothing has been decided yet, but the Swedish Energy Agency is planning according to how the proposal looks today (Jonsson 2014, pers. comm., 25 August). During spring 2014 the master thesis project 'Identification and evaluation of Swedish energy efficiency networks' has been carried out at Lindköping University by N. Broberg (2014). As it can be seen in this report, there is a wide range of energy efficiency networks in Sweden already and much is to be learned from previous experiences. From the report it can be seen that there are still a lot of improvements to be done when starting up a new network and gaps in the research. The conclusion from both reports is that it is important to base the networks on clearer targets and follow-ups. Also the meetings and administrative work must be more structured in order for the network to continue to work over periods.

However, when it comes to more details of how the phases and activities should be formulated more research is needed. The recruiting of companies when starting up a new network was also seen to be a big problem. To gain more experience on these topics international experiences can be studied with advantage. Two countries that have seen good results when it comes to decrease in energy use by using networks are Germany and Switzerland.

3.4 Network theory

A network is a structure consisting of nodes and ties, where nodes are the actors and ties the connections between them. If the nodes are human the ties can be communication such as friendship, knowledge or financial exchange. In a technological network such as a railroad network, the nodes could be the train-stations while the ties could be the railroad connecting them and the trains travelling between them. Networks, either technical or social, can have more or less tightly coupled structures and be formal or informal (Orgnet n.d.). In this study, the nodes consist of humans and their organisations and the ties are the communication and exchange between them which aims to increase the energy efficiency. The networks are discussed in relation to the governance of energy efficiency policy, as an implementation tool to increase the uptake of energy efficiency measures in companies.

Informal networks have been an important way to share knowledge in work places for a long time. Research has shown that people tend to prefer learning by human interaction instead of using set up knowledge databases (Teigland et al. n.d). According to Teigland informal

networks are therefore formed between colleagues and between companies. It has been seen that even in informal networks knowledge is not only shared, new knowledge is also developed. These networks can be defined as “a social collective where individuals with similar tasks share knowledge about their work, which eases creativity and learning in a group” (Teigland et al. n.d). Since the informal company networks showed to be a good way to spread and develop new knowledge, the concept continued to develop during the end of the 20th century during which the industrial networks appeared first and later strategic networks and clusters developed. These three different types of networks are described in figure 3 (Elmhester 2008).

The type of networks of concern in this report falls under the definition strategic networks and consists of a group of companies with a joint vision and the main objective that everyone involved should benefit from it. The networks are regional and the participating companies are of different size and varying sectors. They deal with challenges related to energy efficiency improvement and how to get more energy efficient measures implemented in a cost effective way. Important elements in the networks are:

- Management system with a minimum quality standard
- Exchange of knowledge between companies in regular meetings coordinated by an experienced and certified moderator
- Clear targets for energy efficiency and CO₂ emission
- Regular monitoring of the process
- Energy audit carried out by certified consultant engineers
- Letter of intent for the participating companies
- Financed foremost by the companies
- The participants commit to work with energy efficiency over a longer time period

Industrial network: In the 1980s the view of networks developed to an industrial network theory and could include companies, universities and hospitals. Compared to the informal networks the industrial networks were more organised and strategic, with the most significant difference that they were not joined deliberately. The industrial networks can be seen as summarising all market relationships a company has, including customers, suppliers and competitors (Elmhester 2008).

Strategic networks: What is called strategic networks today started developing on the market in the 1990s. The most common view of a strategic network is that it consists of more than two companies and every participant makes an active choice to be part of the network. There should also be a leader in form of a 'hub' and an aim to reach a joint target (Elmhester 2008). One definition by Jarillo (1988, p. 32) that is commonly used to describe strategic networks is: "long-term, purposeful arrangements among distinct but related for-profit organisations that allow those firms in them to gain or sustain competitive advantage vis-à-vis their competitors outside the network".

For a strategic network to work in an efficient way it is important that the exchange of information and knowledge can be shared freely. The first thing that must be done is therefore to create trust between the companies in the network group. This can be done by giving one of the member companies in the network a more leading role to initiate and motivate interaction between the members (Lundberg 2008).

There is no strict definition of how a strategic network should be designed, how it is geographically located or who can take part. Strategic networks can be national, regional or branch specific. However, it has been seen that networks with more ambitious and clearly defined goals have reached better results (Elmhester 2008).

Cluster: According to K. Elmhester (2008) clusters are a less strict version of the strategic networks when it comes to targets, formal commitments, steering mechanisms and organisation. A cluster is often defined as: "A geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. The geographic scope of clusters ranges from a region, a state, or even a single city to span nearby or neighbouring countries" (Porter 2000).

FIGURE 3. DESCRIPTION OF THE THREE NETWORK FORMS INDUSTRIAL NETWORK, STRATEGIC NETWORK AND CLUSTER.

3.4.1 The reason to use networks to improve energy efficiency in companies

Companies have a lot to gain by cooperating, not the least SMEs. Gibb and Scott (1985) found in their research that SMEs often work by the method "learning by doing" that is to say employees learn from the solutions they come up with when encountering a problem. By taking part in a network, companies can avoid making every mistake themselves and instead

learn from others' experiences. This collaboration often does not happen on its own due to the companies' fear to be seen as weak if they ask for help from other companies. Companies are also often suspicious if the initiative of cooperating comes from a competing company (Elmhester 2008). Varamäki and Vesalainen (2003) therefore say that companies need support from an external initiator to start working together. They also say that if SMEs once try working together it is usually received favourably and is seen as a good way to strengthen their competition towards the bigger companies.

To be successful, work with energy efficiency must be carried out continuously by a company. The company must be prepared to adjust to constantly changing conditions in the firm and on the market such as energy prices, taxes, demands from the authority and policies (Municio 2014). By using networks to help the companies in their work with energy efficiency, a more individual process support can be offered to the companies than through isolated subsidies. A tax for example does not set targets nor does it guide companies in how to implement realised measures. Supporting tools and subsidies can be tied to the networks to ease the companies work with energy efficiency (Regeringen 2014).

The knowledge and experience exchange between peer companies is a way to follow up the work after energy auditing is carried out and to help companies that lack the experience or financing to work on their own with energy efficiency. (Municio 2014). The networks can also give companies the support they need to fulfil governmental legislations and are an efficient way to help them set and achieve goals and targets within the company (Elmhester 2008). Energy efficiency networks are also a way for companies to get an unbiased external perspective on the process of the company (EnAW 2012c).

SMEs often lack one or more resources to address areas outside their strategic core competence. These resources can be provided if the companies choose to collaborate in a network (Elmhester 2008). Energy efficiency networks can help to decrease costs not only by decreasing energy use but also by reducing the transaction costs and raise priority of cross-cutting technologies. The networks also help companies to overcome barriers such as lack of time, knowledge or experienced risks and help to make sure that energy efficiency gets prioritised in the company (IEA & IIP 2012).

For energy to get prioritised in the company its strategic value has to be raised. According to Dr. Cooremans' (2014, pers. comm., 9 December) the three dimensional "value-costs-risks" diagram (figure 2) and the model of investment decision making (figure 1) could be used in networks in order to contribute to making energy efficiency a strategic issue. However, it should be noted that networks do not have the possibility to get companies to make more strategic decisions, but they can perceive the measures to be more strategic. The possibility to see what other companies have done and what result it got makes the measure look strategic.

- **The three dimensional value-costs-risks diagram (figure 2):** If information supplied by the network leads to better practice in the companies there is a possibility to reduce costs and risks of energy supply which may lead to an increase of the value proposal. To be able to make it strategic, multiple benefits must be analysed *with the three dimensional "value-costs-risks" diagram and turned into numbers* during the

monitoring. Networks can also contribute to raising the level of measures implemented by showing how the measure decreases risks and costs and increases a company's value proposal.

- **The model of investment decision making (figure 1):** A network has the possibility to affect the three first steps in the chain: *initial idea*, *diagnosis* and *build up solution*. Most focus must be put on the initial idea. The network must perceive the project as increasing the value proposal and decreasing the costs and risks of a company.

In figure 4 a summarising list of the main arguments for a company to join an energy efficiency network can be seen.

Why should a company take part in an energy efficiency network?

- Stronger competition against other companies
- Get individual process support, e.g. with implementation of measures and follow-up after an energy audit has been carried out
- Support in fulfilling governmental legislations
- Get an external perspective on the company's process
- Lower energy and transaction costs
- Raise priority of energy efficiency and cross-cutting technologies
- Get help overcoming barriers
- Possibility to make energy efficiency a strategic question

FIGURE 4. REASON FOR COMPANIES TO PARTICIPATE IN AN ENERGY EFFICIENCY NETWORK.

3.5 Legislations and incentive for getting more energy efficient measures implemented

Energy efficiency networks are a way to contribute to the relevant national and international climate policy targets. The legislations, targets and subsidies that affect the decision to start energy efficiency networks for SMEs in Sweden, Germany and Switzerland are presented in table 3.

TABLE 3. LEGISLATIONS, TARGETS AND SUBSIDIES AFFECTING ENERGY EFFICIENCY NETWORKS. SOURCES: (EC 2013), (EC 2014), (BMUB 2013), (ENERGIMYNDIGHETEN 2013A), (IEA 2013), (REGERINGEN 2013). (BAFU 2013), (ENAW 2012c)

	Sweden	Germany	Switzerland
EU 2020 target	<p>Applies to Sweden as a member state of the EU.</p> <p>Target: Energy use shall be 20% more efficient by 2020 compared with 2008 and a 20% reduction in</p>	<p>Applies to Germany as a member state of the EU.</p> <p>Target: Reduce primary energy consumption by 2020 by 20% compared to 2008 level.</p>	<p>Not a member of the European Union, but has a negotiated agreement on electricity, to have compatibility between the Swiss and EU market rules.</p>

	energy intensity between 2008 and 2020.		Aim: cut the consumption of fossil fuels by 10% compared with the 2010 level.
EU energy efficiency directive	As a Member States Sweden should have transposed the provisions at the latest by 5 th June 2014.	As a Member States Germany should have transposed the provisions at the latest by 5 th June 2014.	Not a member state.
International Energy Agency (IEA)	The recommendations apply to Sweden as a Member State.	The recommendations apply to Germany as a Member State.	The recommendations apply to Switzerland as a Member State.
National targets	<p>20% reduction of energy intensity by 2020 compared to 2008 and 50% by 2050. (prop. 2008/09:163).</p> <p>9% more efficient final energy use by 2016 compared to the average between 2001 and 2005.</p> <p>According to the Swedish Environmental Code (SFS 2014:901) (Miljöbalken) the best technology from an environmental perspective should be used, primary material and energy should be used sparingly, possibilities for recycling and reuse should be used and renewable resources should be used as far as</p>	<p>20% reduction of primary energy consumption by 2020 and 50% by 2050.</p> <p>10% reduction of electricity consumption by 2020 and 25% by 2050.</p> <p>The “Energiewende” resolution of 2011 is to increase energy productivity with 2.1% annually to reach a 50% reduction of primary energy consumption by 2050 (base year: 2008).</p>	<p>20% decrease of fossil fuel consumption by 2020.</p> <p>Cap the electricity consumption growth at 5% between 2010 and 2020.</p> <p>In excess of the national targets the 26 different cantons have much power to develop own energy laws, policies and measures, a wide verity can therefore be seen within the country.</p>

	possible.		
European Regional Development Fund	Budget funding period in 2007-2013: €1626 million whereof €62 million for the energy sector.	Budget funding period in 2007-2013: €25489 million whereof €544 million for the energy sector.	
Other subsidies	The energy audit checks focus on SME and is an economical support for carrying out energy audits. It supports companies with an energy use over 500 MWh per year with 50% of the price for energy mapping with a maximum of 30,000 SEK.		Since 2008, the CO ₂ levy is one of the key instruments to achieve the target, for decreasing CO ₂ , by putting a tax on fossil combustible fuels. In 2014 the tax was 50€ per ton CO ₂ .

EU 2020 target: The EU has an energy efficiency target to decrease primary energy use by 20%, compared to projected energy use, by 2020 (EC 2014a). There is no sector specific target for the industry in purpose of letting the country use the way which is most beneficial for them (IVA 2013).

EU Energy Efficiency Directive: To help countries reach EUs target the EU energy efficiency directive came into force in 2012. The aim of the directive is to put pressure on the member states to introduce goals and policies that help them contribute to meeting the EUs targets. Of special importance for the manufacturing industry the directive requires larger companies to undertake energy auditing every 4th year (EC 2014a). For SME the governments should at least promote programs that encourage implementation of energy auditing (EED 2012/27/EU, Article 8).

International Energy Agency (IEA): In 2011 the IEA published a report on recommendations of energy efficiency policies for the member states. For the industry four important recommendations are given to the member states. For the case of starting energy efficient networks in Sweden the recommendation *Energy efficiency services for small and medium-sized enterprises (SMEs)* is of high importance. In this recommendation it is said that the government should provide a package of policies that are directed towards SMEs to support (IEA 2011):

- That energy audits are carried out by experienced engineers and are easily accessible for the companies
- That information about proven practice for energy efficiency and energy performance is easily accessible and directed towards SMEs

European Regional Development Fund (ERDF): The aim of the fund is to strengthen the social and economic unity within the EU and to reduce the differences between regions. The fund is one of EUs main tools to fulfil the Lisbon Contract. Out of the four main areas the funds focus on, the most significant for managing energy efficient networks is *Support for small and medium-sized enterprises (SMEs)*. The resources are allocated over the areas depending on how developed the region is (EC 2014b). For a program to be funded, national financing is required for about an equal amount of the funding money. For the funding period 2007-2013 the ERDF had a budget of €201bn (EC 2014b).

3.6 Monitoring of energy efficiency

The most common ways to follow up the increase in energy efficiency is through bottom-up and top-down monitoring.

Bottom-up monitoring: In the EU directive on energy end-use efficiency and energy services⁵ the bottom-up method is defined as: “A bottom-up calculation method means that energy savings obtained through the implementation of a specific energy efficiency improvement measure are measured in kilowatt-hours (kWh), in Joules (J) or in kilogram oil equivalent (kgoe) and added to energy savings results from other specific energy efficiency improvement measures”.

The evaluation is calculated based on data from the single energy efficiency improvements individually. The sum of the savings from all improvements calculates to the total savings for the chosen period (energy unit per year). A baseline is needed to compare the result to how the development would have been without the implementation of the measures (EMEEES n.d.).

Advantages:

- Allows direct monitoring of the effect of an energy efficiency improvement measure
- Gives a better control of the effects of a policy program

Disadvantages:

- Costly and time consuming data collection if high accuracy is needed
- Only shows the active efforts to improve energy efficiency

Top-down monitoring: In the EU directive on energy end-use efficiency and energy services the top-down method is defined as follows: “The amount of energy savings or energy efficiency progress are calculated using national or aggregated sectorial levels of energy savings as the starting point”

⁵ESD: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0085:EN:PDF>

The top-down method is based on the time-related alteration of energy consumption parameters between the basic year and the year of the analysis. It is based on global data like the specific energy consumption values of the entire operation process (EMEEES n.d.).

Advantages:

- Captures every energy-related change regardless of its origin or cause

Disadvantages:

- Only provide measurement of the development of specific or unit energy consumption, or the diffusion of energy-efficient technologies within a sector or type of end-use, without indicating its origin
- Indicators must be adapted to the requirement of the monitoring of the directive and cleaned from factors not linked to energy services or other EEI measures

Results

In this section a detailed description and assessment of the Swiss and German energy efficiency networks is given. In Switzerland Energie-Agentur der Wirtschaft's (EnAW) networks are described and in Germany Learning Energy Efficiency Networks (LEEN) are described. Information from literature studies is coupled with interview opinions of what should be considered and why. The two networks are chosen due to that they are approaching non-energy intensive companies and are based on structured management systems. They are also regional and not sector specific and have shown good results when it comes to improving the energy efficiency in companies.

4.1 Switzerland

4.1.1 Background

The development of the Swiss networks can be seen in figure 5.

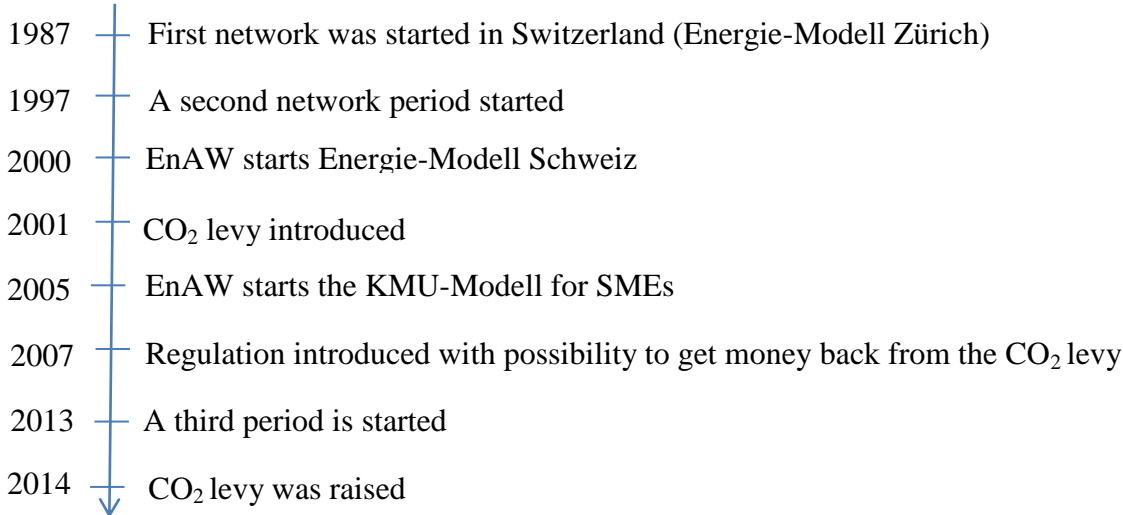


FIGURE 5. TIMELINE SHOWING THE DEVELOPMENT OF THE SWISS NETWORKS.

In 1987 eight of the most energy intensive companies in Zürich went together to tackle an overhanging threat of shortage in electricity supply. This was the start of the first energy efficient network in Switzerland which came to be called Energie-Modell Zürich. The idea was based on that a decrease in CO₂ emission and improvements in energy efficiency are best reached if companies work voluntarily together, sharing know-how, to reach ambitiously set targets. They started up a ten year long program with the aim to together decrease energy use with 20% compared to the starting year 1987. According to Energie-Modell Zürich's homepage the total energy use had decreased 34% without inhibiting the growth of the companies when the results were evaluated in 1995 (Energie-Modell Zürich n.d.).

The good results shown from the first period lead to the start of a second network period in 1997. Due to the large saving potential the network group got the possibility to sign a deal with the canton (i.e. region), where the companies promised to together decrease their energy use by 15% until 2007. In exchange the companies would be freed from some of the cantonal energy reduction requirements. The cooperation with the canton led to a more regulated network model with stricter target agreements. In 2000 Energie-Agentur der Wirtschaft (EnAW) wanted to spread the concept of energy efficiency networks all over Switzerland and Energie-Modell Schweiz was started (Energie-Modell Zürich n.d.). Five years later EnAW started a less costly and simpler model for SMEs called KMU-Modell. (STREKS 2012)

When a CO₂ levy was introduced in Switzerland the Energie-Modell started to grow and develop faster, since saving energy became more economical. When a written regulation to get money back from the CO₂ levy if you take part in a network was introduced a couple of years later it was another boost for the Energie-Modell. In January this year the CO₂ levy was increased from 30€ to 50€ per ton CO₂, which lead to even higher saving potentials for the companies if they were taking part in Energie-Modell (EnAW n.d.)

In 2013 a third period was started that will run until 2020. Today 70 energy efficiency networks are working in Switzerland and around 2,000 companies are involved (Köwener et al. 2011).

4.1.2 Characteristics of the network

The aim with the Energie-Modell and KMU-Modell is to reduce CO₂ emissions and optimise the energy use by implementing energy efficient measures. Another objective is to increase the knowledge and implementation of energy management in the companies (EnAW n.d.).

Companies taking part in Energie-Modell are middle and large companies with energy costs over €415,000 (500,000 CHF) (EnAW n.d.). The number of employees in the company can vary from just a few hundred to thousands of employees all over the world (Schlöpfer 2014, pers. comm., 2 July). A network group optimally consist of 8 to 15 participants from the same region but from different sub-sectors within industry, service and retail (EnAW n.d.). In Energie-Modell Zürich the three sectors have meetings both separated depending on sector and together (Schlöpfer 2014, pers. comm., 2 July).

Around 12 companies in a network group has been seen to be most fruitful for the sharing of knowledge. Larger groups lead makes it hard for everyone to take part in the discussions, while smaller groups generate fewer subjects for discussions. A smaller group might also not be profitable (Eberle 2014, pers. comm., 7 October).

In Switzerland it is inevitable that the participants' headquarters are in the same region since there are different demands depending on the canton. There is also a language barrier making it hard to put together companies from all over Switzerland. In addition, it is timesaving and appreciated by the companies if the traveling distance is short.

On one hand it is positive for the exchange in the network meetings when companies come from different sectors, it opens up for a larger width of experiences and there is no risk for competition between the companies. On the other hand when the companies are more similar and come from the same sector it is easier to get more depth in the discussions and find more specialised measures, such as new process technology. (Eberle 2014, pers. comm., 7 October). Since energy is not a key issue for most companies there is usually no problem with competition between the companies even though they come from the same sector. The participants in the network meetings are often facility managers and environmental managers and there is no competition between them. They face the same difficulties and are looking for similar solutions for making their companies more energy efficient. Nor is it a problem that companies differ in size, similar energy efficiency issues occur in smaller and larger companies and they are dealing with the same concerns regarding for example pay back periods (Schlöpfer 2014, pers. comm., 2 July).

The KMU-Modell is suited for SMEs without complex production processes and with a maximum energy cost of €832,000 (1 million CHF) per year and a minimum of €166,00 (20,000 CHF) (Burtscher 2014). It is foremost suitable for companies without an own energy manager and instead the KMU-consultant will bring knowledge about energy efficiency to the company (EnAW n.d.). Often it can be the director of the company that is participating in the network and it is therefore not possible to have frequent meetings since it would be too costly and too time consuming (Eberle 2014, pers. comm., 7 October).

All data is treated confidentially within the network and usually there are no barriers for the companies to reveal the data needed. (Eberle 2014, pers. comm., 7 October).

For the share of companies participating per sector see figure 6.

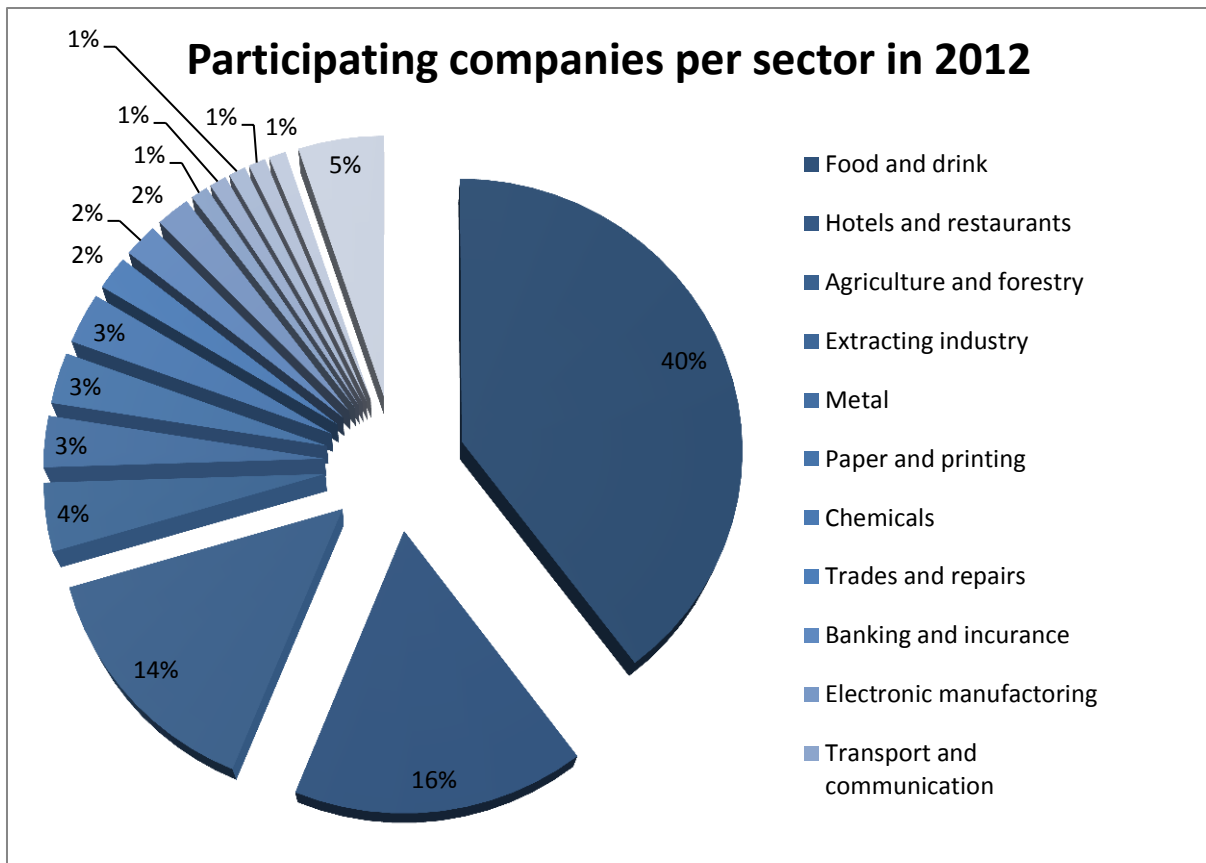


FIGURE 6. PARTICIPATING COMPANIES PER SECTOR IN 2012. SOURCE: ENAW

4.1.3 Roles in the network

4.1.3.1 EnAW

EnAW is a non-profit service agency that consults and supports companies in reaching targets for energy efficiency and CO₂ reduction. Since 2001 they are in a partnership agreement with the Swiss Federation to implement the provision of the CO₂ law (reduce CO₂ emission by 10% until 2010 compared to 1990) and the law on energy for the industry-, crafts- and service sectors. 85% of EnAW's funding came in 2010 from companies using their services. 6% were financed by the Federal government and the rest was paid by other partners, for example; the Cantonal Governments, the Swiss Foundation for the Climate, the Climate Cent Foundation, Electricity Suppliers and Zurich Cantonal Bank (EnAW 2012c).

EnAW has 40 independent moderators across Switzerland specialised in different fields to help companies achieving energy efficiency in the best way (EnAW 2012c). They offer three main products for the companies; Energie-Modell, KMU-Modell and the Transportprogramm, where of the two first are of interest in this report. In the Energy-Modell and KMU-Modell the following is provided by EnAW to help the companies reach their aim (EnAW n.d.):

- Energy audit with analysis of the status and potential in the company
- Suggestion for definition of a target for energy efficiency and CO₂ emission
- Support in finding and implementing measures
- Monitoring and controlling

- Feedback and reporting.

It is also EnAW's job to maintain tools and see to that they are up to date as well as moderating the network meetings and providing a senior engineer for information lectures at meetings (EnAW n.d.).

4.1.3.2 Companies and organisations

It is the participant's task to supply the EnAW consultant with the necessary information for constructing the list of measures. It is also the participant who must implement the found measures (EnAW n.d.). The EnAW moderator is usually working with mid-level management at the company such as Head of Environment, Head of Safety or Head of Production. However it is important to anchor the top management in the project especially in the target agreement (EnAW 2012c).

4.1.3.3 Network host

According to A. Eberle (2014, pers. comm., 7 October) the most suitable host for a network is varying with the region and companies taking part in the network, but it is positive if the host is local and knows the companies that will participate. In Switzerland the moderator is the host and usually come from an engineering office, while a moderator from an energy utility is more uncommon. A reason is that EnAW wants avoid having the networks associated with sales of electricity.

4.1.3.4 Moderator

The moderators chair the network meetings and are technical consultants for the companies. They have to be certified by EnAW and the tools accessible to them are provided by EnAW (Schlöpfer 2014, pers. comm., 2 July). Their knowledge is proven by a detailed multiple choice test and the first three times they have someone going with them to teach them how to use the tools (Eberle 2014, pers. comm., 7 October). The moderator's main tasks are presented in figure 7.

Moderator's tasks:

- Coordinating the network meetings, bring up new topics about energy efficiency and help with the knowledge exchange
- Helping the companies setting up targets, action plans and to develop a contract for target agreements with the canton and Federal office for environment
- Helping the companies with the monitoring and reporting of data to EnAW
- Helping with the initiating energy audit

FIGURE 7 MAIN TASKS OF THE MODERATOR IN THE ENERGIE-MODELL. SOURCES: (ENAW N.D.) (EBERLE 2014, PERS. COMM., 7 OCTOBER)

The moderators are quite free to implement the guidelines and information they get in the way they found most suitable. The network groups differ quite a lot and the moderator should find the way that works best for the specific group (Eberle, 2014).

The interviewed companies all agreed that a competent moderator is important for the success of a network. To find a good moderator that can make the network run smooth and keep it interesting year after year is seen as one of the biggest challenges in the Energie-Modell. In figure 8 the most important qualities, pointed out by the companies, for a moderator are presented.

Important qualities for the moderator:

- High knowledge of energy efficiency subjects combined with good moderating skills
- Being able to keep discussions alive
- Choosing topics relevant and interesting for all companies for the meetings
- Keeping companies updated on technical and political developments
- Helping with administrative work
- Helping especially the smaller companies doing the energy audit

FIGURE 8. MAIN QUALITIES OF A MODERATOR IN THE ENERGIE-MODELL.

To support the moderators in their work there are also more experienced top consultants. A top consultant is responsible for around 10 moderators and helps them with the know-how and other questions they might have to insure the quality of the moderators work (Eberle 2014, pers. comm., 7 October). A network also has a president that organises seminars and every second year the president gives out a price to the best performing company. The president is also taking care of most of the legal work and contact with governmental bodies (Schlöpfer 2014, pers. comm., 2 July).

4.1.4 Motivations to join networks

In EnAW's brochure for the Energie-Modell a list of what they are providing to the company is presented together with a list of expected benefits with joining a network. In figure 9 these lists can be seen translated into English.

A big advantage when it comes to motivate companies to take part in Swiss energy efficiency networks, is that companies with annual energy use over 500 MWh have the pressure from the government to actively work on reducing CO₂ emissions and improve energy efficiency. One way for the companies to fulfil the government's demands is to take part in an energy efficiency network. (Schlöpfer 2014, pers. comm., 2 July). The companies interviewed agreed on that the law is a good way to make them work more with energy efficiency and being part of a network gives the companies a freedom to work with it in the way most efficient for them.

Provided to the company by EnAW:

- Energy audit of the company
- Customised solutions and energy efficiency measures
- Development of a target agreement
- Target suggestion to fulfil laws
- Yearly monitoring and reporting
- EnAW energy efficiency label and certificate; “CO₂ & kWh reduced”
- Support and counselling for the implementation
- Membership and exchange in a Energie-Modell group

Benefits of taking part in a network:

- Optimized energy use and reduced costs
- More knowledge in energy management
- Basic refund of the CO₂ tax of the state
- Fulfil the detailed provisions of the canton
- Input from a third party

FIGURE 9. LISTS OF WHAT IS PROVIDED TO THE COMPANY FROM ENAW AND THE MAIN BENEFITS FOR THE COMPANIES TO TAKE PART IN A NETWORK. SOURCE: (ENAW N.D.).

Another effective way to make companies join a network is by the use of subsidies. In Switzerland the network companies can be exempted from the CO₂ levy as well as from a canton’s detailed provisions if they agree to set targets for energy efficiency and CO₂ reduction (EnAW n.d.). Since the companies are freed from the canton’s detailed provisions a lot of complicated paperwork can be avoided. In a network it is also more flexible how you optimise the energy efficiency compared to the detailed provisions. One interviewed company brings up these two facts as very important for participating in the network.

Another advantage with being part in EnAW’s networks is that the tools and monitoring system are compliant to DIN EN ISO 50001. This makes it easy for the companies to fulfil the demands to get DIN EN ISO 50001 certified (EnAW n.d.). The participants also get a label from the EnAW to show their engagement in environmental protection “CO₂ & kWh reduziert” (EnAW 2012b).

The economic gain from being more energy efficient is also a motivation for the companies as well as the transaction costs saved when knowledge is gained from other companies. The possibility to get know-how from companies with similar problems is often seen as the key benefit (Eberle 2014, pers. comm., 7 October). The technical staffs at a company may face many pressures e.g. from top management to save money and from employees who are dissatisfied with the work environment. It is therefore a valuable help for them to be able to hear how they have solved the problems in other companies. Working together in a group for this long a period builds up a trust between the companies where information of every kind can be shared freely (Schlöpfer 2014, pers. comm., 2 July). According to previous case studies taking part in the networks also contributes to making energy efficiency a regular topic within executive management discussions and put pressure on the management to take more action (EnAW 2012c).

A list of the main success factors are presented in figure 10.

Success factors:

- Moderators and management with high industry and process knowledge
- Structured and efficient approach
- Understanding of the industries and communication in their language
- Individualistic and flexible approach
- Mutual trust relationship with all stakeholders
- Mandatory targets

FIGURE 10. SUCCESS FACTORS IN THE ENAW NETWORKS. SOURCE: (ENAW 2012c) (EBERLE 2014, PERS. COMM., 7 OCTOBER)

4.1.5 Recruit companies to the network

The start is usually to invite companies to a general meeting (Schlöpfer 2014, pers. comm., 2 July). Companies to invite are with advantage found through already existing associations. When the leader of an association informs the companies about the possibility to take part in an energy efficiency network, companies are usually more trusting of the concept and more willing to join. If companies want to work together it is easier to get a well-functioning network. An example of this is a group of hotels that started to work together and then formed an Energie-Modell network group. Both with companies from associations and independent companies it is most effective to set up a personal meeting to inform about how the network functions and what they can offer (Eberle 2014, pers. comm., 7 October) (Schlöpfer 2014, pers. comm., 2 July).

The higher the energy costs of a company are the easier it is to motivate them to take part, since they more easily see energy efficiency as a way for the company to save money. On their homepage EnAW therefore have a calculation tool where companies can see what their saving potentials are. Hotels are examples of companies that usually are easy to motivate. Their energy costs are comparably high and they can also use the participation as a way to tell their costumers that they are working sustainable (Eberle 2014, pers. comm., 7 October). In the SMEs the top management has a greater influence and will be more involved in the network and it will be up to the director if the company will take part. (Eberle 2014, pers. comm., 7 October).

What has worked less well is advertisement. EnAW did some advertising in the newspapers and similar but it was not very fruitful. It has to be realised that companies' energy costs are usually only 1% to 2% of the companies' total costs so it will never be their highest priority (Eberle 2014, pers. comm., 7 October). It can also take a long time before companies decide to join, up to two years is not unusual. It is therefore important not to give up even though a company does not join immediately (Schlöpfer 2014, pers. comm., 2 July).

A conclusion of what should be thought about when recruiting new companies can be seen in figure 11.

To think about when recruiting new companies

Works well:

- Have personal meetings with companies to tell them about the network concept
- Go through already existing associations
- Do not give up if it takes time to get the companies to join

Works less well:

- Advertisement

FIGURE 11. THINGS TO CONSIDER WHEN RECRUITING NEW COMPANIES TO A NETWORK.

4.1.6 Network phases

A network period lasts ten years and can be divided up into six phases, which can be seen in table 4. The CO₂ levy and the canton's detailed provisions are drivers for how the networks are designed. Because of the pressure from the state it is not seen as a problem by the companies to have a binding agreement with a network for ten years. Instead it is considered positive that you can work and plan for a longer period. If the network period is shorter there is a risk that only measures with a very short pay-back time are implemented. This is due to that companies do not see the point in implementing measures if the effects do not have time to contribute to fulfilling the targets.

TABLE 4. PHASES DURING THE NETWORK PERIOD FOR ENERGY-MODELL (ENAW N.D.A) AND KMU-MODELL. (WEISSKOPF N.D)

Phase	Description
Site Inspection Phase 1	<ul style="list-style-type: none"> • Done with the EnAW-moderator or KMU-consultant for SMEs • All relevant energy data collected • Energy saving potentials evaluated and rated
List of energy efficiency measures Phase 2	<ul style="list-style-type: none"> • Catalogue of company specific energy efficiency measures is made together with EnAW-moderator or KMU-consultant for SMEs
Target agreement Phase 3	<ul style="list-style-type: none"> • The target agreement can be voluntary or binding • When binding they have to meet the target of the state and canton • Set for a period of ten years but a specific target is defined for every year • A contract is signed with an agreement on the target
Implement the measures Phase 4	<ul style="list-style-type: none"> • Measures are implement by the company step by step • The EnAW-moderator attend the process and set up network meetings for knowledge exchange • In the KMU-Modell there are no regular meetings but advice and help can be received from the KMU-consultant
Yearly monitoring Phase 5	<ul style="list-style-type: none"> • The companies decide how detailed it should be • Carried out once a year • Check if the targets are reached
Energy efficiency label Phase 6	<ul style="list-style-type: none"> • When the yearly goal is reached the company will get an efficiency label from EnAW “CO2 and kWh reduced”

4.1.6.1 Phase 1 and 2 – Site inspection and List of energy efficiency measures

In the first phase the potential for improving energy efficiency is analysed in the companies by a site inspection. The site inspection is carried out by an experienced EnAW-moderator together with the company’s energy manager in the Energie-Modell and a KMU-consultant in the KMU-Modell. Analysis of the operating data show where the possibilities for

improvement of energy use are. Depending on size of the company it can take up to one day in the KMU-Modell and several days in the Energie-Modell.

The site inspection leads to a list of measures for possible energy efficiency improvements. It shows the management of the company what potential there is, how to implement the measures and how much can be saved, but the company decides themselves when to implement the measures (EnAW n.d.).

It is considered something positive by the interviewed companies to have the first site inspection done by a certified moderator or consultant. In some of the SMEs the competence might not be there to do it themselves. In the larger companies and companies with more experience in working with energy efficiency having a certified consultant doing the first site inspection is also important because they easily get “home-blind”.

4.1.6.2 Phase 3 - Target agreement

Based on the list of energy efficient measures an energy efficiency and CO₂ reduction target are agreed on. The targets are promised to the canton Zürich and the state (if the company has a binding target) and the group targets have to be reported to the government (Energie-Modell Zürich n.d.). The individual target depends on how much potential is found during the site inspection, in the KMU-Modell there is only an individual target (Eberle 2014, pers. comm., 7 October). For example, one of the interviewed companies has a much higher target than the group target because they are rebuilding one of their largest buildings and therefore they have a high saving potential. Another company has a lower target due to that they had very high gains in the past and therefore are allowed a lower target the following years.

The base year for calculating both the target for energy efficiency and CO₂ emission is the starting year of the network and the calculations should take the growth into account. For calculation of the energy efficiency target a relative measure is used and for CO₂ absolute tonne. Equation 1 shows how energy efficiency is calculated and equation 2 shows the calculation for CO₂ intensity (Eberle 2014, pers. comm., 5 December).

$$\text{Energy efficiency} = \frac{\text{BEC} + \text{SavedBEC}}{\text{BEC}} \cdot 100 \quad (\text{eqn. 1})$$

BEC = Balanced energy consumption

SavedBEC = Balanced energy saving of measures

$$\text{CO}_2 \text{ Intensity} = \frac{\text{CO}_2 \text{ Emission}}{\text{CO}_2 \text{ Emission} + \text{SavedCO}_2} \cdot 100 \quad (\text{eqn. 2})$$

If a company with a binding target does not reach its targets for two years they will get forced to implement measures to fulfil their targets immediately or pay a penalty. If a company with a voluntary target agreement do not reach the targets three years in a row they will not be allowed to participate in the network anymore (Eberle 2014, pers. comm., 7 October).

If a company overachieves its target it can sell the additional work to an organisation that deals with CO₂ and earn extra money in this way. It was invented as an extra incentive to do

more even when their targets were reached (Eberle 2014, pers. comm., 7 October). One of the interviewed companies says that they do not use this opportunity since there is not a lot of money to earn from it and it feels like a betrayal towards the other companies in the network group.

The companies' opinions about the targets can be seen in figure 12.

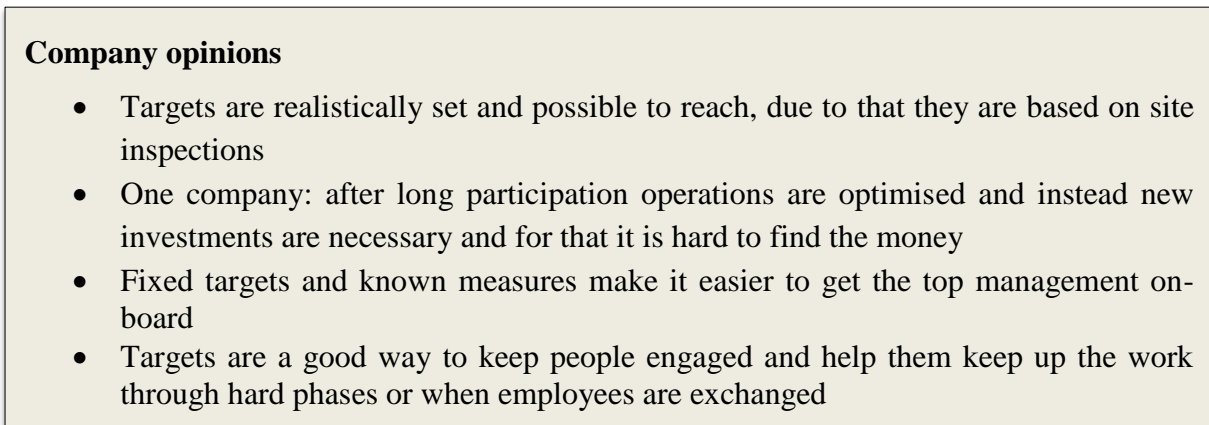


FIGURE 12. INTERVIEWED COMPANIES OPINIONS ABOUT THE TARGETS.

Contract

The participants in the network have to sign a contract with EnAW. They can also have a binding target with the canton. If this contract is signed they are bound to meet the target (EnAW n.d.). Companies with yearly CO₂ emission levels between 100 and 1,500 tonne can also sign a contract with the Bundesamt für Umwelt (BAFU), where they agree to lower their CO₂ emissions, to be exempted from a surcharge of fossil fuels, the CO₂ levy and the detailed provision of the canton (EnAW n.d.).

Seen from experience in both EnAW and Energie-Modell Zürich the contract is an important part in the network to make sure that results are reached. It makes the work with energy efficiency binding for the company and it is easier for the person in charge of energy management issues to get the top management to approve to changes. The contract can also be used to prove the importance of work with energy efficiency in the company if the management is exchanged (Eberle 2014, pers. comm., 7 October) (Schlöpfer 2014, pers. comm., 2 July).

4.1.6.3 Phase 4 –Implement the measures

Network meetings

The people attending the meetings are usually facility managers and environmental managers, which have little competition between each other and share similar problems within their organisations (Schlöpfer 2014, pers. comm., 2 July). For the smaller companies taking part in the KMU-Modell there are no regular meetings. If participants in the KMU-Modell want to take part in moderated network meetings an extra cost of €500 (600 CHF per year) must be paid (Burtscher 2014).

The meetings have the purpose to exchange knowledge and experience between the companies. All networks in the Energie-Modell have 3 to 4 regular network meetings a year where they share knowledge and report their progress. Depending on the region and who is in charge in the network the design of the meetings can vary and additional meetings can be held (EnAW n.d.). An example of the meetings they have in Energie-Modell Zürich will be given below. There are four different kinds of meetings for the companies to take part in:

- Regular meetings
- Focus meeting
- Working groups
- Award

Regular meetings are held four times a year and are organised by an EnAW-moderator (Jochem et al. 2012a). A meeting is usually half a day long and held at the premises of the companies. In one of the meetings all companies are together but for the remaining three they are divided up into sub-groups; service, retail and industry. When the companies are divided up into sub-groups focus can be on more sector specific energy topics. For each group there is a group leader from one of the companies who has a bit more responsibility during the meetings. The group leaders belong to a steering committee together with the moderator and the president of the network and they meet two times a year (Schläpfer 2014, pers. comm., 2 July). According to the interviewed companies the group leader's role is mostly administrative and nothing that affects the knowledge to be shared equally between all companies.

The regular meetings usually contain the following elements:

- Reporting of progress
- Presentation and discussion of a topic

Reporting progress of implemented measures and further planned work takes up a significant part of the meeting. This part was appreciated when starting up the networks, but during the later years companies have started to feel that it does not give as much anymore and it is taking up too much time to go through every implemented measure for every company. At the moment they are trying to find a new way to make the reporting more rewarding for the companies.

What topic to focus on in the meeting is decided either by companies or by the moderator, who then decides on something he or she wants to bring up inspired from site-visits at the companies (Eberle 2014, pers. comm., 7 October). Either the moderator holds a presentation about the chosen topic or an external expert is brought in. Examples of topics that are discussed during the meetings are: LED-lights, renewable energy, photovoltaic, natural refrigerant, computer centrals, "green" IT or if there are updates about the politics concerning energy efficiency or CO₂ emission reduction. A tour of the hosting company to look at implemented measures is only done when there is something of special importance to see, but it is discussed if this should be done more often.

Focus meetings are held once a year when an expert is invited to speak about a certain topic. The meeting is organised by the president of the network. Here the directors of the companies are also invited. In the start-up of the networks they were easy to motivate to come to these meetings because they were interested in knowing what the contract they signed would bring, but today the interest has decreased a bit (Schläpfer 2014, pers. comm., 2 July).

Working groups are special groups formed if some companies want to go deeper into a subject. This could for example be lighting, contracts or air-conditioning. This group is voluntary and formed by the companies themselves and it is up to them how often they want to meet.

An award is handed out to a company that has achieved good results every second year. To these meetings someone from the higher managements of the companies usually attend (Schläpfer 2014, pers. comm., 2 July).

Between the meetings there is also the possibility to call the moderator with any questions. The interviewed companies also say that they often call other companies from the network groups since they usually have similar questions and problems. The companies' general opinions about the network meetings can be seen in figure 13.

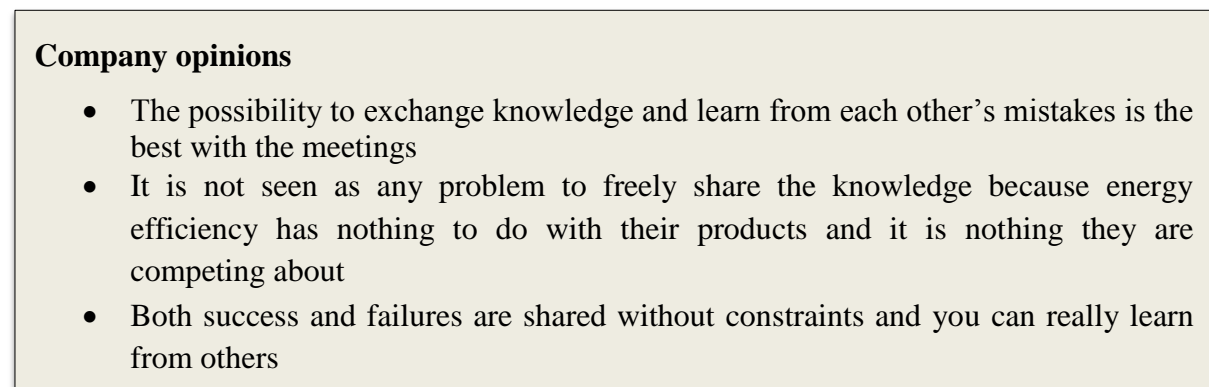


FIGURE 13. GENERAL COMPANY OPINIONS ABOUT THE MEETINGS.

Tools

There are three main tools provided by the EnAW (Eberle 2014, pers. comm., 7 October):

- Check-up tool: it is used by all companies in the energy audit to find the measures and to calculate the potential of the measures
- Tool for target setting: there are two different ones, a less comprising for the KMU-Modell and a more advanced one for the Energie-Modell
- Monitoring tool: used to ease for the companies to collect data needed to monitor the results. Also here there are two different ones for the KMU-Modell and the Energie-Modell

Two of the interviewed companies say that they only use the tool for monitoring to report their results. They have been in the network so long that they have developed their own tools that work better for them.

In Energie-Modell Zürich the network also started using a tool at the meeting that makes it easier to see how far a company has come with implementing different measures and what they should put focus on. It is an excel system where measures are marked with green, yellow or red light. Green means it is done, yellow that it is on the way and red that it is not started yet (Schläpfer 2014, pers. comm., 2 July).

4.1.6.4 Phase 5 - Yearly monitoring

Monitoring of results

The monitoring should be carried out on annual bases. For the companies in Energie-Modell the monitoring system is according to ISO 50001 (EnAW n.d.) and is supported by the EnAW. The bottom-up method is mostly used, but larger companies can sometimes use the top-down method if they have a high amount of implemented measures (Eberle 2014, pers. comm., 7 October). The improvements in energy efficiency are measured both for the individual company as well as the total for the network group (EnAW n.d.). It is important that the monitoring is standardised to make it as easy as possible for the companies. All companies have to fill out all implemented measures in an online tool and in the Energie-Modell it is also important to get the energy consumption and production data (Eberle 2014, pers. comm., 7 October). The information collected in the monitoring is the document used for showing the cantons and other partners if the targets are reached (EnAW 2012b).

Only numbers and measures are reported in the monitoring. However, most measures are not implemented only to improve energy efficiency. The ultimate goal is often to lower the company's operation costs (Schläpfer 2014, pers. comm., 2 July). On the other hand there can be benefits additional to the energy efficiency (ECEEE 2014). An exchange of light or windows for example often leads to better work conditions for the employees, but is often not reported in the monitoring.

The most important things to think about in the monitoring phase can be seen in figure 14.

Most important to think about in the monitoring

- Carry out annually
- Have a standardised method to keep it easy for the companies

FIGURE 14. THE MOST IMPORTANT THINGS TO THINK ABOUT WHEN PLANNING THE MONITORING.

4.1.7 Costs to participate

The networks are mainly funded by the fee paid by the companies. The fee varies with the companies' energy costs and can be seen in table 5. (EnAW n.d.).

TABLE 5 ANNUAL NETWORK FEES FOR THE ENERGIE-MODELL AND KMU-MODELL

Companies energy costs per year	Network fee per year
KMU-Modell <€415,000 (500,000 CHF)	€430-€2,530 (520-3,050 CHF)
Energie-Modell <€2.1 million (2.5 million CHF)	€5000 (6,000 CHF)
Energie-Modell €2.1-€16.6 (2.5-20 million CHF)	<€29,000 (35,000 CHF)

The first year in the network the participating fees are higher as well as the time you have to put into participating in the network. This is because of the extra costs for the moderator when the site inspections are carried out and the targets are set. In the KMU-Modell the average time put in the first year is one work day and the following years a bit less (EnAW(a) n.d.).

The participation fee covers a basic package including analysis, management tools for site inspection, setting of targets and monitoring, consulting support, monitored meetings and EnAW's energy efficiency label. If a company wants to do any deeper analysis beyond the initial site inspection and yearly monitoring they have to finance it by themselves (Eberle 2014, pers. comm., 7 October). Some of the companies that have been taking part in the networks for a longer time have developed their own management tools and are not using EnAW's moderator for the site inspections any more. In these cases it can sometimes be questioned if the participant fee is too high in relation to what they get back.

4.1.7.1 Funding

By taking part in the Energie-Modell or the KMU-Modell there is the possibility to get government subsidies. Some of the subsidies are on a federal level and may be obtained by taking part in all of EnAW's networks, other depend on what is offered in every individual canton.

Federal level: On a federal level there is a possibility for all companies to get back the money paid for the CO₂ levy if they reach the negotiated mandatory targets and undergo yearly evaluations (EnAW n.d.). From 2014 onwards, the tax on CO₂ emissions was raised from €30 to €50 (36 to 60 CHF) per tonne. This means an increase in the advantages of taking part in a network, since the participants will still get back the money paid for the CO₂ levy (Köwener 2014).

Local level: If the companies reach their targets promised to EnAW and the Swiss Federation they can also be exempted from the cantonal energy reduction requirements. Other benefits and subsidies are depending on the canton. An example is canton Zürich who offers a 10% cash-back on the electricity bill if a company is taking part in a network and reaching their

targets (EnAW 2012c). For the interviewed companies in Zürich this is the main motivations to take part in the Energie-Modell.

Foundations: There are also non-profitable foundations supporting the companies. The SMEs taking part in the KMU-Modell are supported by the Swiss Climate Foundation (established by the Energie-Modell Zürich), who is paying 50% of the membership fee. (Eckert n.d.).

4.1.8 Results

For the period 1990 to 2010 the Energie-Modell signed a contract with the state of 15% reduction in CO₂ emission to help contribute to Switzerland's obligations to the Kyoto protocol. This target was easily reached and exceeded and in 2010 they could show a 25% reduction in CO₂ emission compared to 1990. In total in 2012 it has been estimated that the implemented measures had led to a reduction of 102,000 ton CO₂ from which 98,000 ton are fuels used in the companies' processes and 4,000 ton were fuels for transportation (EnAW 2012a).

Also the voluntary target set for energy efficiency was easily met and surpassed by almost 10%. In 2012 it was estimated that implemented measures had also led to a decrease in energy use of 1,288 GWh (EnAW 2012a). In average the companies have had annual energy cost savings of €120,000 per company after 4 to 5 years (Köwener et al. 2011).

The participation in EnAW's networks continues to grow, in 2012 it increased by almost 4%, mainly due to the rising popularity of the KMU-Modell (EnAW 2012a). The KMU-Modell has shown improving results with an acceleration in number of implemented measures per year of 1.6% to 1.8% (STREKS 2012).

Another important effect since the energy efficiency networks were introduced in Switzerland is the raised awareness of the importance of energy efficiency and CO₂ reduction. The continuous monitoring and reporting has led to higher prioritisation of these topics in the corporate agenda of Switzerland (EnAW 2012c).

4.1.9 Planned further work

After the last successful period the Energie-Modell is just in the beginning of a new period running between 2013 and 2020 (EnAW 2012a). To further grow it will be looked for new fields to expand within, an example of a sector which has been seen to have a lot of potential in the last years is mountain rails and ski lifts (Eberle 2014, pers. comm., 7 October).

Moderators believe that even though a lot of the basic measures have been implemented by now it is still much left to do within the companies, especially due to improvements in technology. During this third period the focus will move from looking at the site level to the process line level and electricity efficiency will become a more important topic (EnAW 2012c).

The KMU-Modell will be further developed especially with more focus on energy efficiency than CO₂ emission and more consultants will be educated and employed (EnAW 2012a).. It is also important to find more ways to motivate them to join the networks. To motivate the

companies in the KMU-Modell to exceed their targets, EnAW is working on the possibility for SMEs to have the same possibility to sell the excess of CO₂ emission savings as the companies in the Energie-Modell. (Eberle 2014, pers. comm., 7 October).

Energie-Modell Zürich has now been running for 25 years and, thus, it has become somewhat repetitive for the participating companies. The sharing of knowledge has also slowed down as the concept has matured. It is therefore important to try to have some variety in activity and to keep improving and make slow changes in the model. Companies' opinions from meetings and follow-ups should always be taken into account when developing and making changes in the network. The working groups are also something that will be further developed (Schläpfer 2014, pers. comm., 2 July). The interviewed companies all see themselves continue to take part in the network.

In the industry group a method is tried where a main topic that interests everyone is decided on for each meeting. The focus of the meeting is then for every company to contribute with process or planned work to this topic. The interviewed company from this group has found it improves the quality of the meetings. In the service group they are also working on developing a new system for reporting and at the moment it is looked at the possibility of having the companies only reporting their top three topics. An interviewed company is saying though, that it can be difficult to pick out the top three topics.

4.2 Germany

If no other source is given the information is taken from LEEN's homepage (LEEN 2014).

4.2.1 Background

The development of LEEN networks can be seen in figure 15.

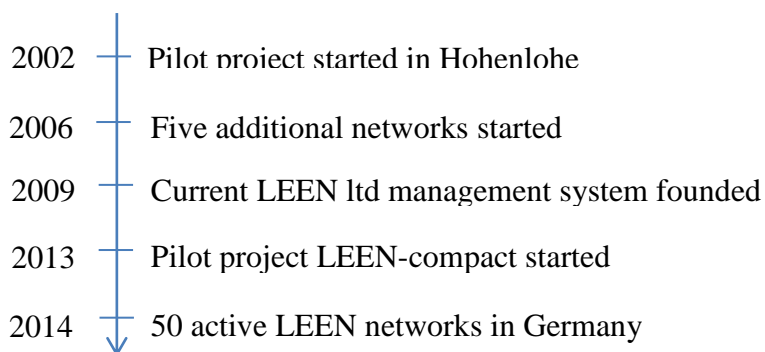


FIGURE 15. TIMELINE OVER THE EVOLUTION OF LEEN NETWORKS.

Inspired from the successful Swiss energy efficiency networks that have been running since 1987, Germany started a pilot project in the Hohenlohe region in 2002. The first German network ran between 2002 and 2006 and set the basis for what today is called LEEN networks. Between 2006 and 2009 five additional networks were started. During these years the positive and negative experiences were evaluated and a functional management system and other supportive tools were created (Köwener et al 2014).

In December 2009 the current LEEN Ltd management system was founded and launched as the 30 pilot networks project in cooperation between Institut für Ressourceneffizienz und Energiestrategien (IREES Ltd), Energy Baden-Württemberg Sales Ltd. and Fraunhofer Society e.V.. The purpose of the project was to develop a complete management system and develop the investment calculation tools. The moderators and consultant engineers were also trained within the scope of the 30 Pilot Networks project. This scientific project took about 3 years and ended in 2013. During this time 30 networks were set up and around 350 companies got involved.

According to M Krueck (2014, pers. comm., 13 October) the 30 Pilot Networks project showed so good results that Mirko Krueck and Dirk Köwener decided to start a commercial company, called LEEN Ltd.. The aim was to make a profitable product out of the network concept and to help spread the concept of energy efficiency networks worldwide. Fraunhofer Institute for Systems and Innovation Research ISI and IREES GmbH Institute for Resource Efficiency and Energy Strategies are still involved in the scientific part of the process and are working on following-up and developing the networks. The monitoring today also conforms to the terms of ISO 50001 (Köwener et al 2014).

In 2014 there were 50 active LEEN networks in Germany with around 600 participating companies. The network concept is currently being introduced in other countries for example Austria, England, Japan, Vietnam and Singapore.

In 2013 the pilot project LEEN-compact started, which aim to apply the LEEN concept on small and medium sized firms. It is inspired the KMU-Modell used in Switzerland and turns to companies with energy costs under €500,000. At the moment there are five test regions in Germany with around fifty companies involved (STREKS, 2012).

4.2.2 Characteristics of the network

The main aim with introducing energy efficiency networks in Germany was to support an increased rate in energy efficiency improvement by German industry. Over the last ten years the average decrease in industrial energy consumption per unit of GDP (primary energy intensity) in German has been 1%. It is deemed that local and regional networks for medium-sized companies can contribute to an increased rate of industrial energy efficiency improvement of 2% per year on average (IEPD n.d.). Another aim is to spread the know-how from LEEN-management across Germany and internationally (Becker 2012).

A main advantage with using energy efficiency networks as an instrument is that it can be initiated and financed by industry itself. It is a possibility for companies to reduce energy costs and energy related CO₂ emissions, to increase the priority for energy efficiency and to increase the implementation of measures. The main idea with the network is to share knowledge between the companies to reduce transaction costs and at the same time make the company management focus on energy efficiency through social mechanisms (Köwener et al. 2014).

LEEN has three different products: LEEN-classic, LEEN-compact and LEEN-kommunal. They are presented in table 6.

TABLE 6 LEENS NETWORK PRODUCTS SOURCE: (KRUECK 2014, PERS. COMM., 13 OCTOBER) (KÖWENER ET AL., 2011)

	LEEN-Classic	LEEN-Compact	LEEN-Kommunal
Sector	Manufacturing companies	Manufacturing companies	Municipalities
Groups	10-15 medium sized companies	10-15 small companies	6-7 municipalities
Yearly energy costs for participants	€500,000 - €20 million and at least 150 employees	Under €500,000 and minimum €30,000	

In this report only LEEN-classic and LEEN-compact, which focus on companies, will be discussed. The company size and sectors in table 4 are recommendations for when it is most profitable for the companies to take part. However, all companies are welcome to participate if they believe they can benefit. Different sectors and company sizes are preferred within the networks to avoid competition, they must thus overlap when it comes to cross cutting technologies for the sharing of experiences and information to be relevant for everyone participating (Köwener 2013). 55% of the participants are sites that belong to larger companies and 45% are independent companies. The share of companies participating per sector can be seen in figure 16 and the 15 most common sub-sectors are presented in table 7 (Mielicke et al. 2012).

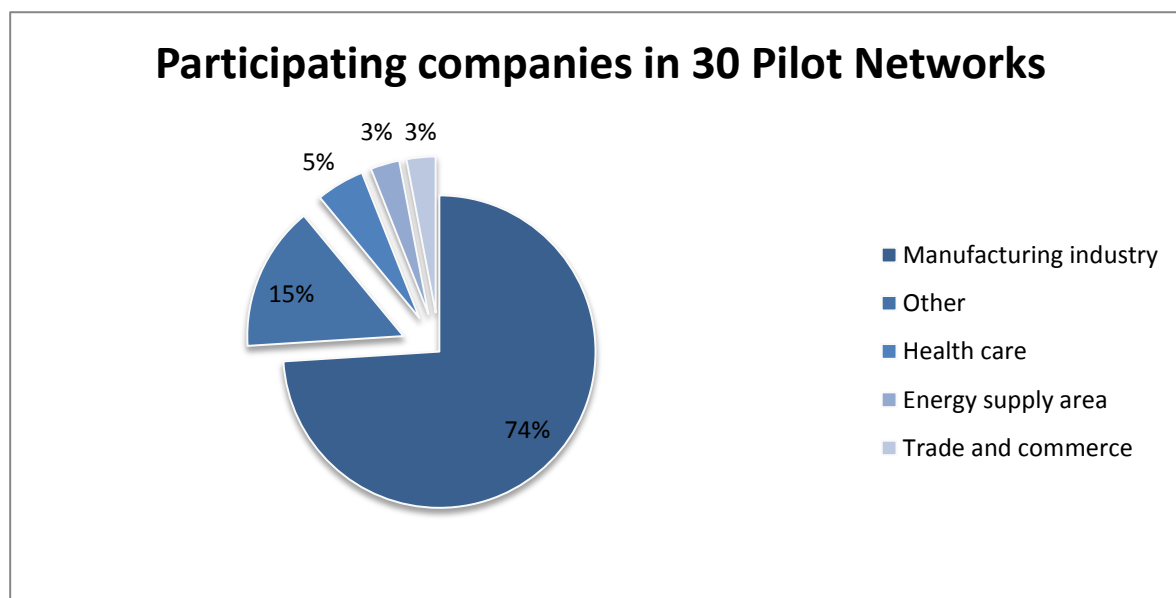


FIGURE 16. SHARE OF PARTICIPATING COMPANIES IN THE 30 PILOT NETWORKS PROJECT PER SECTOR. SOURCE: (KÖWENER ET AL. 2014)

TABLE 7 THE 15 MOST COMMON SUB-SECTORS IN 30 PILOT NETWORKS. SOURCE: (MIELICKE ET AL. 2012)

Sub-sector	Number of participants in 30 pilot project
Production of food and animal feed	34
Production of rubber goods and plastic goods	28
Mechanical engineering	26
Production of cars and car parts	22
Production of metal products	19
Production and processing of metal	18
Production of glass, glass goods, ceramic, processing of stones and soils	15
Production of chemical products	15
Health care (hospitals)	12
Productions of beverages	11
Energy supply	11
Production of data processing devices, electronical and optical products	10
Production of print products; duplication of recorded sound carriers, image carriers and data carriers	10
Production of electrical equipment	10
Production of other goods	8

From experience it has been seen that even with the less rich content in the LEEN-compact approach it is hard to sell the concept to companies with yearly energy costs under €150,000. For smaller companies the energy cost savings that can be achieved does not make up for the time and money (i.e. participation fee) they have to invest. The lowest yearly energy cost is

therefore to be changed to €150,000 for participation in LEEN-compact (Krueck 2014, pers. comm., 13 October).

The participating companies should be located in the same region and not more than 150 km apart to simplify personal meetings. The optimal group size has been found to be 10-15 companies. Smaller groups are hardly profitable for LEEN and give less rewarding discussions, while larger groups are too big for everyone to take part in the discussion equally (Nabitz 2014, pers. comm., 30 September).

Participating companies from different sub-sectors are seen as positive since it takes away the risk of competition within the network, but it limits the knowledge exchange to cross-cutting technologies. Today there are hotels in the same networks as industrial companies and it has worked without limiting knowledge-sharing. A risk with direct competitors in the same network is that the exchange of knowledge can be held back. As the networks look today, there is a “first come first serve” system, so if a second company from a sector wants to join the network it is up to the companies already in the network to decide if it is a competitor or not.

A variety in company size can contribute positively to the exchange of knowledge in the networks but if the difference is too big it is hard for the companies to work on an equal level (Krueck 2014, pers. comm., 13 October). A large size difference might also mean that the participants do not have the same cross-cutting technologies in their companies; hence they cannot learn from each other’s experiences and share discussion topics. These are the reasons for dividing LEEN networks into LEEN-classic and LEEN-compact and setting a maximum yearly energy cost of €20 million. The upper recommendation is set because companies with higher energy costs usually have a lot of know-how in energy technology and a certain department responsible for energy issues (Nabitz 2014, pers. comm., 30 September). To take part in LEEN-classic the company has to have someone responsible for energy or technics, while in LEEN-compact it can be the managing director who is participating (Krueck 2014, pers. comm., 13 October).

4.2.3 Roles in the network

4.2.3.1 LEEN Ltd

LEEN Ltd. is the developer and distributor of the LEEN management system and provides both the LEEN-classic and LEEN-compact services. LEEN ltd. is a commercial profit making company founded in 2009. It is their job to develop and distribute the LEEN-Management system and their main tasks are:

- Implementing new networks together with the network host
 - Support the acquisition of companies
 - Manage the process during the network periods
 - Organise experts for presentations
 - Carry out initial consultancies and monitoring
- Further attend to and develop the LEEN-Management system
- Certify and offer further training to moderators and consultant engineers

- Three day training including a test
- Accompanying the certification process within the framework of ISO 50001
- Training with respect to calculation tools for the energy audit and monitoring

4.2.3.2 Research

Fraunhofer Institute is the scientific partner in the network process. They do follow-ups and evaluate the networks in order to further develop LEEN-Management system. Questionnaires are sent out three times during a network period and the results are presented in a report (Nabitz 2014, pers. comm., 30 September).

4.2.3.3 The German government

The government has the roll of an overall project coordinator for the networks. The first years the networks were operating the German Government also funded up to one third of the operation costs (IEPD, n.d.).

4.2.3.4 Companies and organisations

It is the companies' task to identify energy saving potentials, implement measures and evaluate the results of implementations. This is done by sharing knowledge and cooperating with each other through network meetings. The employee responsible for energy related issues in the company is usually the one that takes part in the network meetings and stay in contact with the consultant engineer. In larger companies this is usually an energy manager, while in smaller companies it can be the facility manager or director of the company. Even in the larger companies it is important that the company's director is involved and positive to the participation in the network. It is therefore important that there is a good relationship between the network host and top management from the beginning as well as that there are fixed target within a set time frame. (Nabitz 2014, pers. comm., 30 September).

4.2.3.5 Network host

One third of the networks in Germany have an energy utility as network host. Since LEEN ltd is a profit seeking company, utilities are seen as good hosts because of their possibility to pay for the network product (Krueck 2014, pers. comm., 13 October). Table 8 presents an overview of the different network hosts in 2012 (Jochem et.al. 2012a).

TABLE 8. NETWORK HOSTS IN LEEN-CLASSIC.

Hosts	Number of hosts
Economic platforms (including the chamber of industry and commerce)	18
Electric supply companies	20
Research facilities or institutes	4
City councils	4
Energy agencies	3

The main tasks for the network host are presented in figure 17.

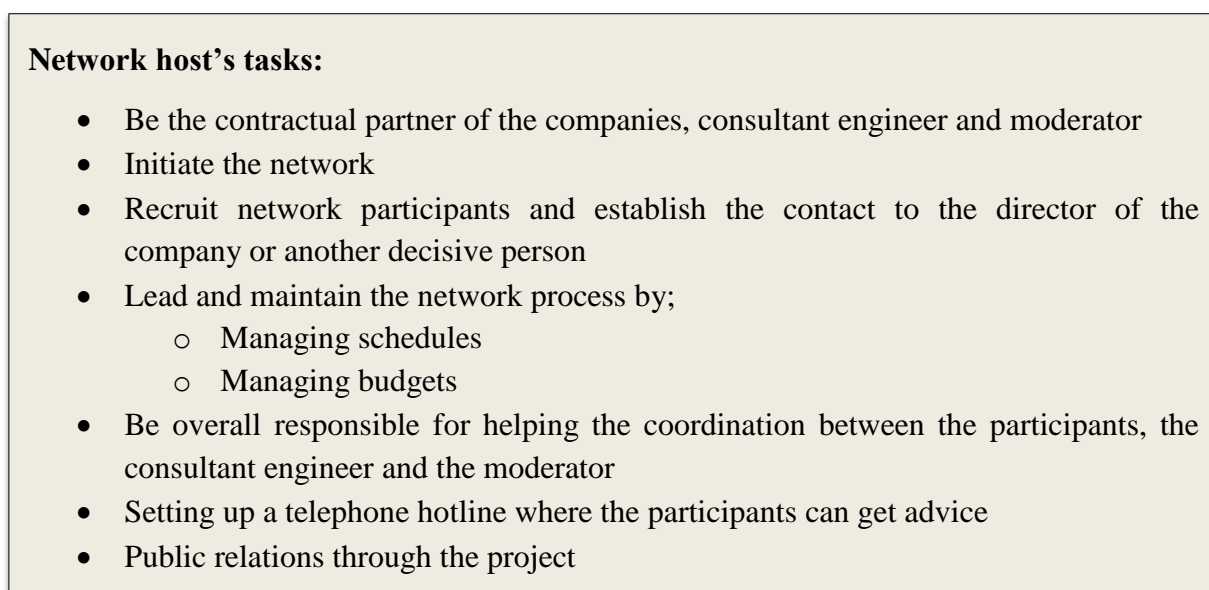


FIGURE 17. MAIN TASKS OF THE NETWORK HOST IN LEEN.

According to M. Krueck (2014, pers. comm., 13 October) at LEEN ltd. the most important part of the network is a good host. Qualities of significance for a host are presented in figure 18.

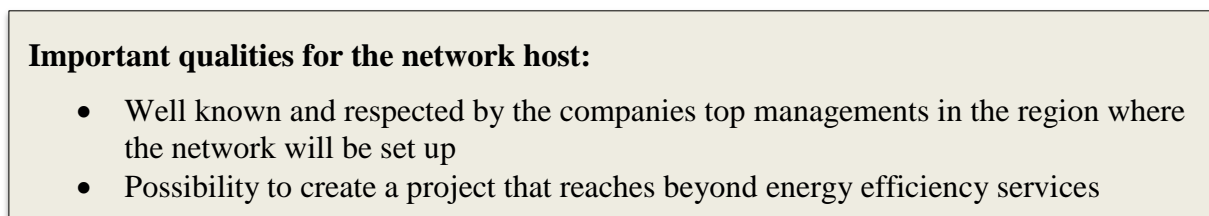


FIGURE 18. MAIN QUALITIES OF A LEEN NETWORK HOST.

In the beginning when new networks were started, LEEN accepted every host. Now the host is chosen more carefully since the wrong host, that is not respected and known in the area, was seen to lead to the network failing. If the host lacks the right contacts one possibility is to try to get someone important in the region onboard to recommend the network to the companies for example the mayor of the city. Another possibility is to get a well-respected manager at a big company onboard that can recommend the networks to other companies (Krueck 2014, pers. comm., 13 October).

4.2.3.6 Moderator

The moderator is an important actor in making the network successful. The moderator's main tasks are presented in figure 19.

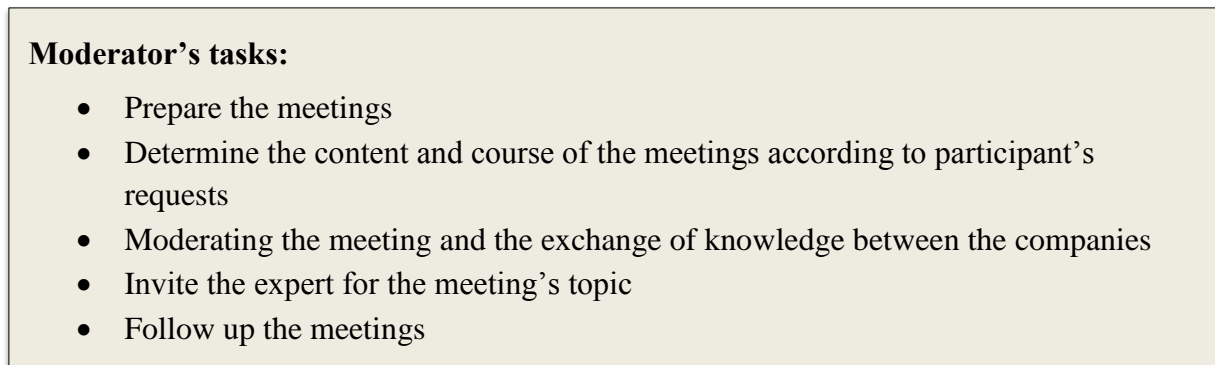


FIGURE 19. MAIN TASKS OF THE MODERATOR HOST IN LEEN.

Important qualities for the moderator can be seen in figure 20.

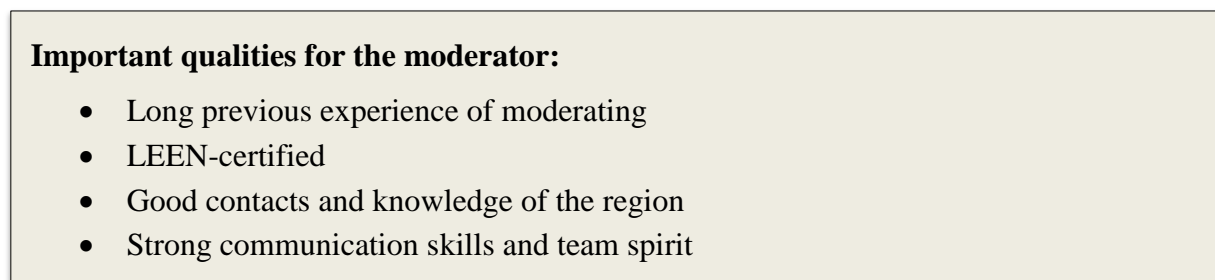


FIGURE 20. MAIN QUALITIES OF A LEEN MODERATOR. SOURCES: (KRUECK 2014, PERS. COMM., 13 OCTOBER) (NABITZ 2014, PERS. COMM., 30 SEPTEMBER)

4.2.3.7 Consultant engineer

The consultant engineer is a senior engineer with long experience in carrying out energy audits and working with energy efficiency issues. The consultant engineer can be selected before acquisition phase or chosen by participating companies, and normally the same person stays with the network during the whole period. Like for the moderator LEEN-certification is essential for the consultant engineer (Köwener et al., 2011). The consultant engineer's main tasks are shown in figure 21.

Consultant engineer's tasks:

- Carry out the initial energy audit
- Conduct the annual monitoring
- Set the basis for the common energy efficiency and CO₂ reduction targets
- Support the moderator with technical questions and find experts for the technical lectures
- Help the companies setting suitable priorities for the implementation of the measures

FIGURE 21. MAIN TASKS OF THE CONSULTANT ENGINEER IN LEEN.

Important qualities for the consultant engineer are shown in figure 22.

Important qualities for the consultant engineer:

- LEEN-certified
- Experience of consulting in industrial companies and knowledge of business administration
- High level of expertise within cross-cutting (energy efficient) technologies
- Methodological and social skills, strong communication skills and team spirit
- Enough experience to do the energy audit in the companies that have already implemented basic energy efficiency measures
- Resourceful: Engineering consultancy firms have to be of certain size (at least five engineers) and have broad enough experienced to do energy audits and support companies from all sectors. They must be able to conduct energy audits in all participating network companies within a reasonable time period. If the energy consultant is smaller it needs to have a network of engineers to work with.

FIGURE 22. MAIN QUALITIES OF A LEEN CONSULTANT ENGINEER. SOURCES: (KRUECK 2014, PERS. COMM., 13 OCTOBER) (NABITZ 2014, PERS. COMM., 30 SEPTEMBER)

4.2.4 Motivations to join networks

In Germany there are no laws to motivate the companies to join an energy efficiency network. Instead it is important that the network product is something the companies feel it is worth being part of from a profitable point of view and for the PR of the company and the region (Köwener et al. 2014). Subsidies can also be part in motivating the companies (Köwener et al. 2014).

The list of benefits of taking part in a network seen in figure 23 is taken from LEEN's homepage and interviews with one of LEEN's managers.

Benefits of taking part in a network:

- Reduction of transaction costs through the reciprocal access to “colleagues’ knowledge” and the joint attendance at expert lectures
- Public image improvement through credible climate protection
- Complete assessment of the savings potential in cross-cutting technologies and economic evaluation of the savings potential (internal rate of return, net present value, payback)
- Independent valuation of the measures is provided through the energy audit
- Development of a target agreement
- Annual monitoring of the implemented measures
- Membership and exchange of experiences regarding the implementation of measures in a company network group
- Training of employees
- LEEN-certified moderators, consultant engineers and approved experts
- The creation of a simple energy management system with the option of ISO 50001 certification because the LEEN MS fulfils the essential requirements of DIN ISO 50001 (certificate of conformity issued by the Technical Inspection Agency TÜV Rheinland)
- The attention of the top management is raised with the transparency

FIGURE 23. LISTS OF BENEFITS OF TAKING PART IN A LEEN NETWORK

A combination of several reasons has made the LEEN networks successful, the most important factors are presented in figure 24.

Success factors:

- Moderated exchange of practical experience of implementation of energy efficiency measures
- Long cooperation’s between companies to build up trustful environments for free exchange of experience
- They are built on socio-psychological mechanisms such as; motivation to contribute to joint targets in a group, professional career enhancement and motivation of management to achieve high public reputation as a company striving for a sustainable production status.
- Set targets both for the group and individually for efficiency and decrease in CO₂. The joint target contributes to positive competition between the companies to be the first implementing measures and not failing to reach the targets on time.
- Standardised product with a clear structure and demands to reach the aims
- Minimum quality standard and continuous monitoring

FIGURE 24. FACTORS THAT HAVE MADE LEEN NETWORKS SUCCESSFULL. SOURCES: (KÖWENER ET AL 2014) (LEEN 2014) (NABITZ 2014, PERS. COMM., 30 SEPTEMBER) (KRUECK 2014, PERS. COMM., 13 OCTOBER).

Also in company evaluations it has been seen that the network concept is successful. In an evaluation of the companies taking part in the 30 Pilot Network project 80% of the companies rated the benefits of taking part in a network as “rather high” and 70% said the time required was “rather low”. The network meetings are seen as very popular and the topics and site inspections were seen as good or very good by 90% of the companies. 80% found the identified measures met the expectations and 80% discovered new aspects of energy savings. 60% say that the priority of energy efficiency increased in the company (Köwener et al. 2014).

When EnBW in the role as a network host was asked what the main reason for the success was it was answered; the energy saving potentials. Also the interchange with other companies and the information by experts about important topics and themes was seen as an important part of the networks success (Gruschwitz, 2014, pers. comm., 15 October)

4.2.5 Recruiting companies to the network

Recruitment of network companies takes part during the acquisition phase (phase 0). It starts with an information event, to which the invitations preferably are handed out personally to the companies. During this meeting all participants are handed a letter of intent and a project description. The letter of intent can be handed in at the meeting, but if the companies are not able to decide immediately personal visits with further consultancy should be done. The following should be given during a welcome meeting according to the LEEN Handbook (2012):

- Welcome address by a high ranking representative of the initiating institution
- Introductory talk on the situation in the region with regard to economic aspects as well as energy and climate protection policies in order to strengthen awareness and understanding
- Presentation of the project structure by the initiator or network host
- Report by a participating company on experiences made within the scope of the network activities
- Description of the course of action to be followed and the time frame up to the start of the new network
- Opportunity for questions and discussions

The most important things to think about when recruiting new companies to the network are presented in figure 25.

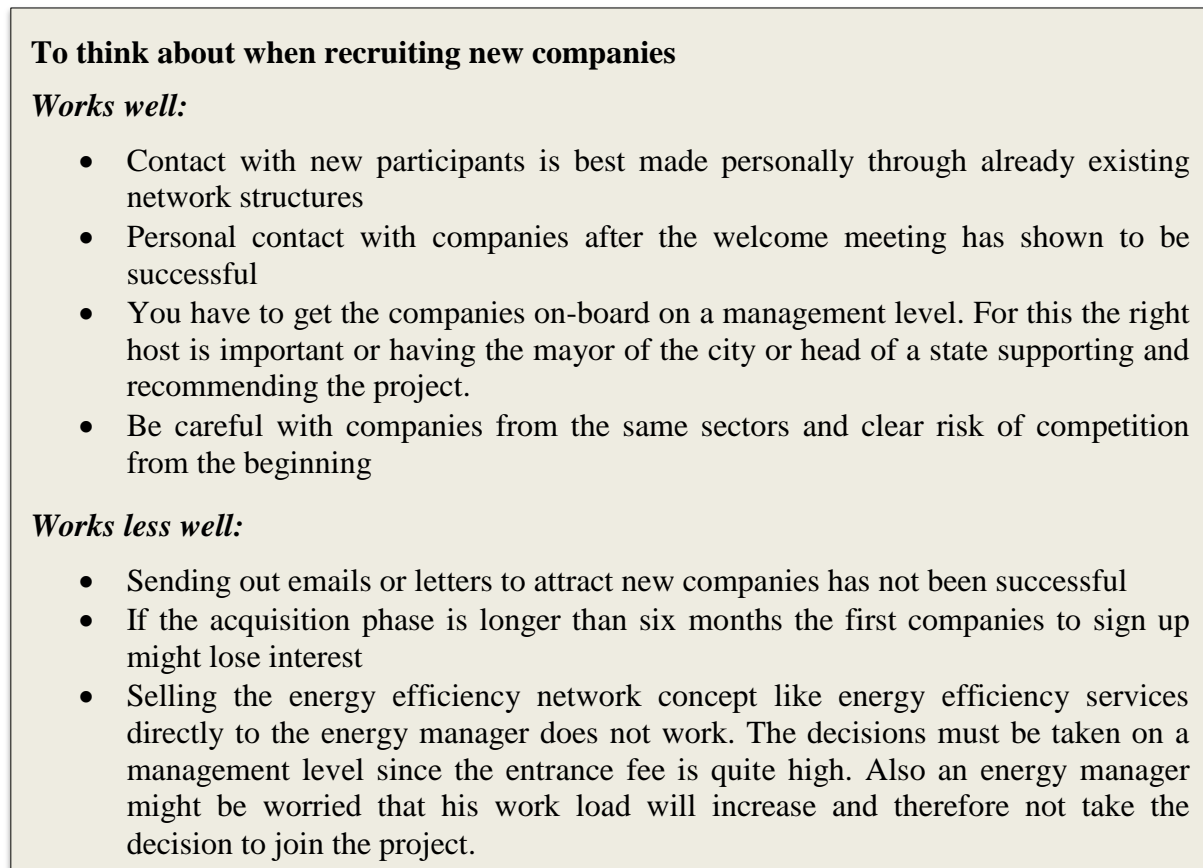


FIGURE 25. WHAT SHOULD BE THOUGHT ABOUT WHEN RECRUITING NEW COMPANIES.

4.2.6 Network phases

A network period lasts 3 to 4 years and can be divided up into 4 phases, which can be seen in table 9. The network period in LEEN-compact is shorter than in LEEN-classic and runs for 3 years, but it is built up from the same phases. After the first period the participants decide if they want to start a new period. So far about 50% of the networks are prolonging after the first period and there are networks that have been running for 10-12 years. A period of 3 to 4 years has been seen as optimal to get as many companies as possible to take part. It is long enough for the companies to have time to implement identified measures and for the monitoring to show result. At the same time the period is short enough for companies to commit to the project (Krueck 2014, pers. comm., 13 October).

The LEEN-Management System applies to all networks, with the same number of meetings and site inspections as well as the same tools and design for the energy audit and monitoring. According to L. Nabitz (2014, pers. comm., 30 September) having a standardised process has been an important part in the networks success.

TABLE 9. PHASES DURING THE NETWORK PERIOD IN LEEN (KÖWENER ET AL., 2011)

Phase	Description
<p>Acquisition phase Phase 0 (3-9 months)</p>	<ul style="list-style-type: none"> • The initiator of the network decides to establish and lead the network <ul style="list-style-type: none"> ○ Search for companies to participate ○ Select moderator and consultant engineer ○ Running information meetings ○ Obtaining binding letters of intent from participating companies • Network starts officially
<p>Energy audit Phase 1 (3-6 months)</p>	<ul style="list-style-type: none"> • Identifying energy efficiency potential in a company (8-10 days) <ul style="list-style-type: none"> ○ Questionnaire is completed by companies ○ Site inspection conducted by consultant engineer ○ Initial saving report prepared • Agreement on targets on a 3-4 year horizon for: <ul style="list-style-type: none"> ○ Energy savings / energy efficiency improvement ○ CO₂ emissionreduction
<p>Networking phase Phase 2 (3-4 years)</p>	<ul style="list-style-type: none"> • Determine relevant discussion topics for the network meetings • Annual meetings within the network group (3-4 per year) <ul style="list-style-type: none"> ○ Site inspection ○ Lecture on efficiency topic ○ Exchange of knowledge ○ Presentation of implemented measures • Annual monitoring • During the whole period <ul style="list-style-type: none"> ○ Access to investment calculation help (around 80 tools for energy efficiency measures) ○ A telephone hotline is set up by the moderator and consultant engineer, which can be used the whole network period
<p>Follow up Phase 3 (1-2 month)</p>	<ul style="list-style-type: none"> • Present and eventually publish results • Decision is made if network will be continued

4.2.6.1 Phase 0 –Acquisition phase

This is the initial establishment of the network, the time from when the decision is made to start a network until 10 to 15 companies have signed up for participation. The network host undertakes the acquisition of companies, has information meetings, and chooses the consultant engineer and moderator (Köwener et al. 2014).

A contract is signed between the host and the moderator and the host and consultant engineer with clear specifications of what their tasks and responsibilities are (Krueck 2014, pers. comm., 13 October). When 10 to 15 companies have signed a letter of intent, phase 1 of the network can start (Nabitz 2014, pers. comm., 30 September). The main things that the host should think about during the acquisition phase are presented in figure 26.

To think about for the host in the acquisition phase

- Have an acquisition strategy before start up
- Have patience, it can take up to ten months to gather a group of network companies
- Agree with a suitable consultant engineer and moderator before you start
- It eases the acquisition if it is built around existing structures such as energy or environmental working groups of a Chamber of Commerce or a regional industrial platform

FIGURE 26. WHAT THE HOST SHOULD THINK ABOUT IN THE ACQUISITION PHASE.

4.2.6.2 Phase 1 - Energy audit

The energy audit is carried out by the consultant engineer together with the person responsible for energy related issues at the company. It is one of the central activities in the LEEN-management system, since the quality is essential for the success of the implementation of measures and it sets the base for the target agreement. It is complied with ISO 50001 by meeting parts of the ISO 50001 requirements⁶. The time it takes to carry out the energy audit depends on the size of the company. The energy audit consists of the four following steps:

- Data collection and validation of received data
- Site inspection
- Preparation and presentation of the energy report
- Agreement on targets

Data collection: In the data collection step, a data collection form (see Annex 6) is completed by the company concerning general company and energy data as well as information about the plant and machinery data. Here it is a possibility to implement an energy management system (eg.ISO 50001) if the company wants to have this certification to add extra credibility. These worksheets are used by the consultant engineer to prepare a check list for the onsite inspection.

⁶ How LEEN complies to ISO 50001, parts marked in yellow are the parts the network supports.
http://www.energie-effizienz-netzwerke.de/een-wAssets/docs/DIN-50001_LEEN-Beitrag.pdf

This step is the most time consuming for the companies and hard to plan for the consultant engineer. Depending on the size of the company the time varies from a minimum of three days in a small company up to 30 days in a large company. For the consultant engineer it takes one to two and a half days to analyse the information from the companies.

Site inspection: In the second step a site inspection, which is based on the collected data from step one, is carried out by a LEEN-certified consultant engineer together with the company's energy manager. All technical experts at a company should be available for questions during the site inspection. During the inspection individual measures are identified. This step takes one day in small companies and up to 5 days in a large company.

Energy report: In the third step the energy audit report is written by the consultant engineer and approved by the company's energy manager in a commitment contract. To ensure high quality of the report the following tools are provided by LEEN to support the consultant engineer (Mai et al. 2012).

- Overview of emission factors
- Questionnaire for the energy audit
- Software-based techno-economic calculation tools: The calculation tools are collected in one place and linked together to avoid having to be entered more than ones. They are used for the energy audit and monitoring (for example of the investment calculation excel tool see Annex 6).
- Instruction for how to use the calculation tools⁷
- Minimum requirements for the energy audit report⁸
- Measures overview: putting together a list of all the measures and their data (for example see Annex 7)
- An example of an energy audit report

The report takes between 5 to 15 days for the consultant engineer depending on the size of the company and 1 to 2 days for the company. The following material is comprised (Mai et al. 2012):

- Economic fundamentals from a business perspective (maximum one side)
- General information about the company
- Energy costs and key figures for the base year
- A table presenting the total energy consumption by energy source and source of CO₂ emissions in the base year
- Overview of found energy efficiency measures
- Individual description of found energy efficiency measures

⁷ Instruction for how to use the investment calculation excel tool can be seen in this document: <http://leen.de/wp-content/uploads/2014/09/Investment-Calculation-Instructions-V3.02.pdf>

⁸ Information about the minimum requirements can be found in this document (in German): <http://leen.de/wp-content/uploads/2014/09/LEEN-Mindestanforderungen-V3.01.pdf>

- Figure showing the division of the total need of energy on the different areas in comparison to the calculated savings

The central element of the report is the overview of identified measures. The report should be signed by all parties as a sign of commitment to the network.

Target formulation: The fourth step is to agree on targets for energy efficiency improvement and CO₂ emission reductions for the network period. The targets are decided together by the participants, the moderator and the consultant engineer. For external communication the savings are expressed in percent, but for internal calculation the energy savings are calculated per measure (e.g. in MWh) and later on expressed in relation to energy consumption in the base year (Nabitz 2014, pers. comm., 30 September). It is important that the targets are independent of economic trends and changes in the market. The targets are based on the bottom up method and calculated as seen in eqn. 3 and eqn. 4 (Jochem et al. 2012b). The target is often a saving between 2% and 3% per year under a four year period.

The equations are taken from “Vom einzelnen Betrieb zum gemeinsamen Handeln: Die Netzwerk-Teilnehmer setzen sich ihr Ziel” by prof. Dr.-Ing. E. Jochem at Fraunhofer Institut für System- und Innovationsforschung (ISI) and Dipl.-Ing. M. Mai at Institut für Ressourceneffizienz und Energiestrategien (IREES GmbH). More exact information about how the targets are calculated could not be found.

$$\text{Energy efficiency target}_{(p)} = \frac{\Delta E_{(p)}}{\text{Energy use for base year}} \quad (\text{eqn. 3})$$

$$\text{CO}_2 \text{ reduction target}_{(p)} = \frac{\sum_i [\Delta E_{(i,p)} \times sp \cdot \text{CO}_2]}{\text{Total CO}_2 \text{ emission for base year}} \quad (\text{eqn. 4})$$

(p) = period, ΔE = potential energy saving of identified profitable measures, sp = specific value

The specific value for calculating the CO₂ emission is for heating based on the value for the fuel use. For district heating and electricity the specific value is based on the national value for the fuel mix (natural gas, oil, propane). In the last year the mix changed towards more bio gas which gives electricity and district heating a new specific value. When the energy efficiency target is calculated it is important to be careful when adding the potential energy savings since there is a risk of the measures overlapping or cancelling each other out (Jochem et al. 2012b).

The group target is calculated from the sum of the absolute energy saving potentials of all company sites participating in the network divided by their absolute energy consumption. If the sites have a large variation in energy consumption the arithmetic mean of all individual targets can be used as the group target, to avoid a too large influence from the larger companies. In LEEN-compact there are no group targets, only targets for the individual company (Hoffmann 2013).

In case the targets are not reached there are no sanctions, but according to M. Krueck (2014, pers. comm., 13 October) this is usually not a problem. The targets trigger competition

between the companies to contribute to the group target. “What gets measured gets managed” is also an experience many energy managers have and targets are therefore an important way to get higher priority to energy efficiency in the company (Jochem et al. 2012b). Targets ease for the energy manager to get investment money from the top management (Krueck 2014, pers. comm., 13 October) and get the companies a clear aim over a 4 year period (Nabitz 2014, pers. comm., 30 September).

In figure 27 the most important things that the consultant engineer should think about when carrying out the energy audit can be seen.

For the consultant engineer to think about in the energy audit phase

- Even though there is a structure it is important that the consultant engineer can be **flexible** in the energy audit
- The consultant engineer must have a broad and deep enough knowledge to be able to **adjust the site inspection** after how far companies have come with implementing measures
- The companies will be eager in the beginning to start working in the network. It is therefore important that the **energy audit does not take too long**, hence the consultant engineer has to have enough engineers
- Plan it carefully and try to **give the companies a detailed plan at the first network meeting**
- **Companies tend to underestimate the time** it takes to do the data collection so make sure there is enough time and stress the importance of it

FIGURE 27 THE MOST IMPORTANT THINGS FOR THE CONSULTANT ENGINEER TO THINK ABOUT DURING THE ENERGY AUDIT PHASE.

4.2.6.3 Phase 2 - Networking phase

Network meetings

The network meetings are, after the energy audit, the key instrument in the networks. They are held 3 to 4 times per year at the site of a network company. The LEEN-certified moderator, chairs the meeting, helps with exchange of experience about benefits, failures and practical observations between companies (Köwener et al., 2011). The number of meetings varies depending on if the companies chose to have half- or full-day meetings (Nabitz 2014, pers. comm., 30 September). During the first meeting expectations are discussed, rules and schedules are made and the topics for the next meetings are determined. The topics are based on wishes of the companies and what is of interest for them. The other meetings include:

- Site inspections of hosting companies carried out by a LEEN-certified consultant engineer (1h)
- Sharing of knowledge and presentation by the companies about implemented measures
- A presentation is held about energy efficient technology solutions or organisational measures by senior expert. The expert is not committed to the network and is chosen by the moderator.
- Presentation about monitoring results is held once a year

An important aim of the network meetings is the knowledge exchange between the participants and to give them the latest information about energy efficient technology. The knowledge exchange should contribute to new ideas for the companies on how to implement the measures in the best way in their company. Another aim is to reduce the transaction costs since the companies do not have to do all the information and risk research on their own and instead can get help from the other companies.

Examples of topics that are informed about during the meetings are: compressed air, lighting, measurement technology and energy controlling (Gruschwitz 2014, pers. comm., 15 October) and development in the energy politics.

In LEEN-compact there are 3 network meetings per year, a total of 9 meetings during the network period carried out and organised by a LEEN-certified moderator. The meetings consist of sharing of knowledge between the participants and a lecture on a technical topic held by a senior expert. Six of the meetings have ready set topics while the remaining three can be chosen by the participants. The set topics are: Compressed air, Lightning, Heat/Waste heat, Heat supply/ Hydraulic balancing, Electric drivers, Monitoring/ profitability calculations.

All information shared in the meetings is treated confidentially. The data revealed in the energy audit such as energy costs and achieved reduction is not visible for the other participants together with the company's name. This leads to that the companies freely share knowledge about implementation of measures and similar and all companies discuss on an equal level. Sometimes participants that want to go deeper into a topic form smaller working groups, as well as exchange contact details so they can discuss and help each other outside the meetings. The exchange of experience and regular meetings are very helpful to the companies and it helps them to get transparency about their energy consumption (Nabitz 2014, pers. comm., 30 September).

In figure 28 a summary of the most important things to consider, for the moderator and host to get successful network meetings, can be seen.

Important elements for successful network meetings:

- The moderator should **contact the hosting company in good time** prior the network meeting
- Companies usually only suggest technical topics so it is important that the **moderators brings up the less technical topics** such as; cost-benefit analysis, employee motivation and involvement, legal framework/government energy policy and support programmes etc.
- **The moderators competence to lead a discussion** is very important
- The **site inspection at the hosting company** is a good inspiration and is showing the other companies how measures are implemented

FIGURE 28. IMPORTANT ELEMENTS FOR THE MODERATOR AND NETWORK HOST TO CONSIDER TO MAKE THE NETWORK MEETINGS SUCCESSFUL.

Monitoring of results

Monitoring is the systematic recording of the companies' process to reach their targets. The data is collected once a year by the company and assessed by the consultant engineer and compared to the target agreement. All implemented measures shall be reported in the monitoring process even those not planned in the energy audit. Monitoring can be done by bottom-up or top-down methods. In LEEN networks only the bottom-up method is used today since it is a clear indicator of the result of the implemented measures. The base year for calculating the energy efficiency improvements is always the starting year of the network. In the monitoring the sum of all measures is considered, from the base year to the year of analyses. The sum is expressed in energy units per year and the effect of a measure should only be calculated once. The energy savings are also adjusted to change in conditions for each year the measure is in use. This is done by correlating factors that adjust the savings according to for example heating degree day values or change in production. Only measures that are quantified are taken into account with this method. The network period always ends with a monitoring report according to the LEEN-Management system to conclude if targets have been reached and if the network should be continued for another period.

The different methods to calculate the results are described in figure 29.

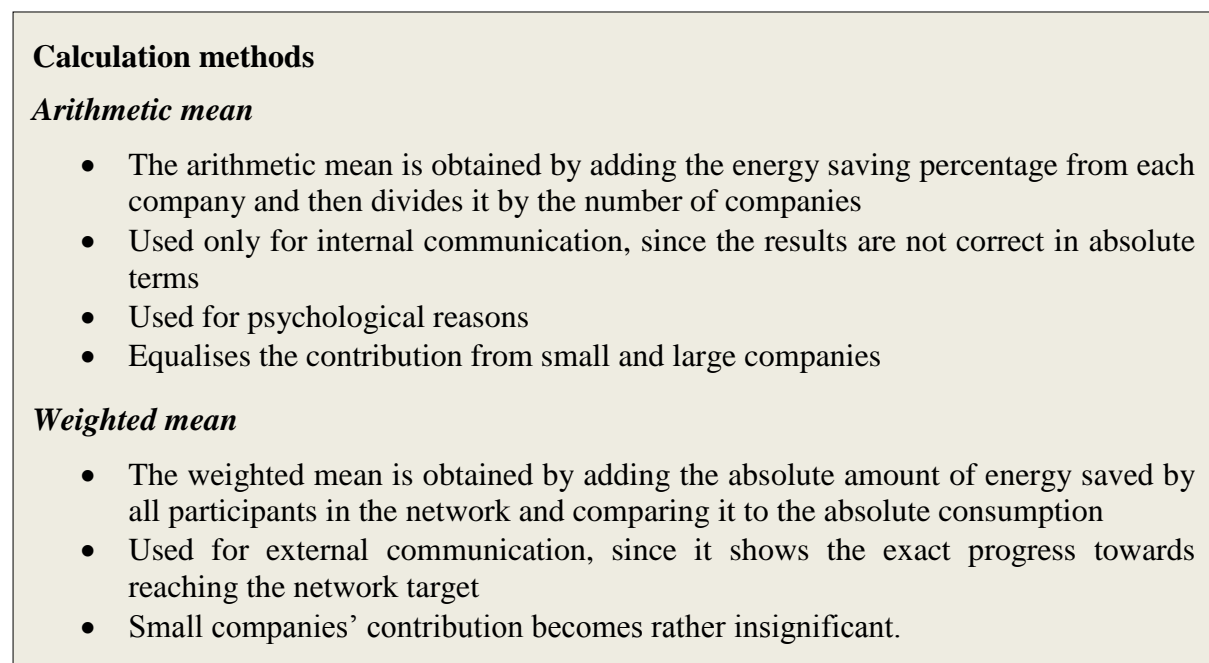


FIGURE 29. CALCULATION METHODS USED IN LEEN NETWORKS TO CALCULATE THE RESULTS. SOURCE: (KÖWENER ET AL 2014)

The monitoring looks at things that can easily be measured with numbers such as: reduction of primary and final energy, reduction of CO₂ emissions, implemented measures and reduction of energy costs. Other potential benefits coming from energy efficiency improvement actions are multiple benefits (e.g. economic growth, enhance social development, advance environmental sustainability, ensure energy-system security and help build prosperity) (IEA 2014b) are not monitored with performance indicators today. However, some multiple benefits are covered by Fraunhofer Institute's questionnaire used to follow up

the networks three times per network period. It is a scientific evaluation regarding the whole process that is presented in a paper in the end of the network period and used to improve the process. L. Nabitz (2014, pers. comm., 30 September) thinks it could be interesting to focus more on monitoring the multiple benefits in the future.

What should be considered for the monitoring when designing a management system and hosting a network is presented in figure 30.

To think about when it comes to the monitoring

- **Companies often find the monitoring time consuming** but it is important that they carry it out based on the measurements
- It is important that the monitoring is **carried out annually with a standardised process** so the results can be measured clearly and easily analysed

FIGURE 30. TO CONSIDER FOR THE MONITORING WHEN DESIGNING A MANAGEMENT SYSTEM AND HOSTING A NETWORK. SOURCE: (KRUECK 2014, PERS. COMM., 13 OCTOBER), (NABITZ 2014, PERS. COMM., 30 SEPTEMBER)

4.2.6.4 Follow up - phase 3

In the last network phase the results are followed-up in a report, which the participants can choose if made public or not. The participants also decide together with the network host if the network will continue for another period.

4.2.7 Cost for participation

The administrative costs for running the LEEN-classic and LEEN-compact networks are foremost paid by the participating companies. Companies pay depending on their size, with a lower fee in LEEN-compact than in LEEN-classic (Köwener et al., 2011). In LEEN-classic a company pays between €35,000 and €40,000 for a four years participation in a network. The fee paid for LEEN network participation covers a 10 to 12-day energy audit, 16 network meetings and three assessments of the monitoring results over a period of 4 years (Köwener 2014). In addition to this a license fee of €700 is also paid to the Fraunhofer Institute for the energy audit and a fee of €100 is paid per monitoring carried out. The fees are used to further develop the LEEN Management system. The cost of managing a network for four years varies between €240,000 and €440,000 this includes initial consultations with each participating company, the moderation of annual network meetings, the annual monitoring of each company, and project management (LOCSEE 2014). In table 10 an overview of the costs per year can be seen.

TABLE 10. COSTS IN THE NETWORKS.

Costs in the networks	per year
Managing a network with 10 companies	€60,000-€80,000
Managing a network with 15 companies	€85,000-€110,000
Fee paid per participant	€8,750-€10,000

4.2.7.1 Funding

Some of the costs can be reduced or covered by public or private funding (Köwener 2014). The initial 30 pilot project was funded to one-third by the government, the rest was paid by the participating companies (Nabitz 2014, pers. comm., 30 September). In LEEN's new project, to start 100 networks, the first 10 networks will get a similar funding of €4,000 per participating company. This will cover some of the costs for the energy audit (Krueck 2014, pers. comm., 13 October).

In LEEN-compact the initial energy audit is sponsored with up to 80% by different investments and financing programs. The companies get help from the network to find the right funding for their company.

According to the managing director of LEEN M. Krueck (2014, pers. comm., 13 October) the funding is not decisive for if the companies join the network.

4.2.8 Results

Evaluation of the first test period of 30 pilot networks has shown good results. On average has the energy efficiency doubled in the participating companies compared to the autonomous energy efficiency of 1% in German industry as a whole. The monitored results show an average increase of 2.1% per year in energy efficiency and a 2.3% decrease per year in CO₂ emission. The average internal rate of return (IRR) of the implemented measures was found to be 30%, which gives an average static payback period of 3.2 years (Köwener 2014).

Based on 366 reports from participating companies altogether 7,000 measures were identified in the first energy audit from which 3600 were deemed profitable (had an IRR over 12%). This result can be expressed as an average of nine profitable measures per company at an IRR of 12%. If all profitable measures were to be realised by all companies the estimated average energy savings per company would be 2,700 MWh/year, corresponding to CO₂ emission reductions of 940 tonne/year. The most cost-efficient potential was found in compressed air systems and electrical devices with a potential IRR of 40%. Lightning systems had a lower IRR but also a low risk (Köwener et al., 2014).

In Köwener et al. (2014) monitoring results for nine of the networks are presented. It shows an average increase in energy efficiency of 2.35% per year compared to the starting year of the network, varying between 1.5% and 3.5% between the networks. CO₂ emission was reduced between 1.73% and 3.4% per year with an average of 2.63% per year.

Networks have also contributed to a higher demand for new and more energy efficient technology and materials (LOCSEE, 2014). This contributes to decreasing costs for products for higher efficiency such as ventilation and motor driven systems as well as development of new products and systems on the market. It also has the positive effect of putting more focus on energy efficiency during procurement procedures (Köwener et al., 2011).

Since the LEEN-compact pilot project started in 2013 no results have been reported yet. There are still no macroeconomic effects analysed of LEEN (LOCSEE, 2014).

4.2.9 Planned further work

The success of the networks shows there is potential for further national and international dissemination of the LEEN network concept. Development and scientific research of the standard will therefore be continued (Köwener et al. 2014). This will come about in LEENs latest project “LEEN 100”, with the aim to start 100 networks in Germany (Nabitz 2014, pers. comm., 30 September). At the moment they are also experimenting with setting up networks within larger companies between the different facilities as well as starting up sector specific networks (Krueck 2014, pers. comm., 13 October).

If the German laws and policies continue to look like today it is believed to be a potential of starting 200 LEEN networks nationwide by 2020, but if an additional tax relief would be introduced, it is thought possible to start up 700 LEEN networks, according to Köwener et al. (2014). This would mean a reduction of CO₂ equivalents in the German industry with five to ten million tonnes and profits of €100 million after taxes for the 10,000 companies that would be involved (Köwener et al. 2014)

LEEN ltd is not only trying to spread the concept in Germany, an important part is also to start up networks abroad. At the moment they are working on starting up networks in Austria, Japan and Great Britain and investigating the possibilities in Thailand, Singapore and Vietnam. In Serbia, Montenegro, Kosovo and Macedonia they are cooperating with an organisation in order to help them try to set up networks across borders (Krueck 2014, pers. comm., 13 October).

LEEN ltd has lately started experimenting with sector specific networks since it can present the possibility to share process knowledge and go deeper into more sectors specific energy issues (Krueck 2014, pers. comm., 13 October). The problem with competition was seen to be quite small since energy is not the main topic in the company and nothing they compete about (Nabitz 2014, pers. comm., 30 September). The exchange of knowledge can even be eased since the interchange and the special themes in the companies fit better (Gruschwitz 2014, pers. comm., 15 October).

Analysis

5.1 What can be learned from the Swiss and German energy efficiency networks?

The findings of this study confirm the hypothesis that a strictly structured management system, which is often missing in the Swedish networks today, is a significant part of the success of both the German and the Swiss networks. In both countries this includes having regular moderated meetings, annual monitoring of the companies' progress and to set clear targets. Also seen to be important to think about when starting and running energy efficiency networks, is to carefully plan the acquisition phase since it is the base of a successful network. Even though the structure of the phases in the two countries is rather similar, the motivation and execution of the steps differ in some aspects. It can be seen for example when it comes to the length of a period, the design of meetings, the roles in the networks and how the companies are motivated to fulfil their targets.

Based on what was seen when studying the Swiss and German experiences, there are four key factors to think about when starting and running a network. These are necessary elements to make a network successful and extra time and effort should be spent on planning and executing these steps.

- Have a well planned acquisition strategy
- Set clear targets
- Have regular moderated meetings
- Carry out annual monitoring

The Swedish conditions for starting up an energy efficiency network can be seen as a mixture of how it looks in Germany and Switzerland. On one hand it is not possible to offer an exemption from the CO₂ tax as in Switzerland, due to EU laws, there are also no laws requiring companies to reach a certain percentage increase in energy efficiency. On the other hand it is likely that Swedish networks' will be financed by subsidies and ran by a non-profit agency.

5.1.1 The acquisition

In the study it was seen that the easiest way to motivate companies to take part in an energy efficiency network is by having laws and exceptions from steering taxes for CO₂ as in Switzerland. The assumption is based on that the acquisition phase seems to be easier in Switzerland than in Germany. Also in German interviews it was pointed at that an exemption from a steering tax or other law would be a welcomed help to further disseminate the networks, which contributes to the theory that it is the best way to motivate companies. Since these incentives do not exist in Germany today, a well planned acquisition strategy was believed to be of utter importance.

Even though the circumstances differ between the countries Germany and Switzerland pointed out the same factors as the most important parts of the recruitment process: go

through an already existing structure and contact the companies personally. Dr. Cooremans (2014, pers. comm., 4 December) also points out the significance of that someone from the network have access to the upper management. The interviewees in Germany and Switzerland also pointed out the same factors for ways to recruit companies that did not have any effect; advertisement and sending out letters or emails to the companies. If there should be a possibility that the companies join a network a personal phone call is the lowest requirement, but personal meetings should always be preferred.

Funds are also a way to motivate the companies extra in the beginning and were used in Germany mainly during the pilot project, which was also partly funded by the government. According to the interviewed in Germany funding was not seen as the most important way to motivate companies to join the networks, though. Instead, the interviewees said it is dependent on finding the right host, a host that is well known and respected in the region and by the top management of the companies.

Since the acquisition phase is more difficult when there is no pressure from the government on the companies to work with energy efficiency, the manager of LEEN emphasises the significance of letting the process take its time and develop a good acquisition strategy. The moderator and consultant engineer that will be part of the network should also already be found and have signed a contract with the host.

As long as a motivating law is missing in Sweden, it can be looked at the motivations and strategy used in Germany with advantage (an example of the German recruitment process can be seen in section 4.2.5). A possible help when it comes to the recruitment process could be to make it a requirement to be part of a network to be allowed to apply for certain funding for the energy audits (eg. the Energy Audit Check). This would motivate the companies to take part and increase the chances of measures found in the energy audit to be implemented.

5.1.2 Clear targets

As expected, the targets were seen as a very important way to put pressure on the top management and get energy efficiency measures implemented. In both countries the starting year of the network was set as the base year for the targets. It was also seen as important that the targets were based on a relative measure that takes growth into account. Pointed out by most was also the importance of having this target set in numbers for the progress to get easily monitored. To get the best results it was seen as important to set one individual company target and one group target. A benchmark model was tried in Switzerland in the beginning but it did not lead to good results. In this model the objective of each company resulted from a reference value, which was determined by the energy-efficient companies.

However, one difference was seen between Switzerland and Germany when it came to how mandatory the targets are. In Switzerland the companies can choose between a binding and a non-binding target. Since the binding target gives them a refund on the CO₂ tax and exemption from cantonal demands, a contract has to be signed between all involved parts, the consequences for not reaching the targets are also very strict. In Germany the participation in the networks is voluntary and with no restrictions from the government, therefore no contract

is signed for the target. Instead, a letter of intent is signed and it is up to the moderator to motivate companies who are falling behind with the target. However, the absence of a contract was not seen to lead to the situation that companies do not fulfil their targets; the letter of intent was still seen as a promise to the other companies to contribute with their part to the group target. The group target also created competition between the companies and the fact that they have paid to take part makes them motivated to get something out of the participation.

In Sweden the target setting can also be believed to be influenced by the fact that there are no laws from the state forcing companies to reach a certain increase in energy efficiency. This means it is difficult to have a binding contract where the companies commit to fulfilling the targets. Nevertheless, a letter of intent should with advantage be signed by the companies where they commit to fulfilling their targets. Setting a group target will also be necessary to create a competitive feeling between the companies. Another possibility would be to put pressure on the companies to fulfil the targets in order to get to keep a funding for the energy audit.

5.1.3 Regular moderated meetings

The meetings are one of the key parts of the energy efficiency networks and the sharing of knowledge and experiences is often what are most appreciated by the companies. Both in Switzerland and Germany the managements have come to the conclusion that it is optimal to have regular meetings every three to four months and that you need groups of 10 to 15 participants to get fruitful discussions. The importance of the group size was also enhanced when talking to companies in Energie-Modell Zürich; in the industry group they are at the moment only three companies which was seen as a problem for the sharing of knowledge, while the service group was very satisfied with their 10 companies.

Many common factors were seen in the design of the network meetings in the two countries:

- Exchange of experience between the companies
- Reporting on progress with implementing measures and fulfilling the targets
- Presentation of a topic concerning energy efficiency

In Germany, a site inspection is also a regular part of the meetings, while in Switzerland it is dependent on if something special has been implemented in the hosting company. The site inspection is seen as interesting and motivating and something contributing to the meetings in both countries. One of the interviewed companies in Switzerland mentioned that it would be a positive thing if it became a regular element in the meetings there too. Another noticed difference between Germany and Switzerland is who is presenting the topic. In Switzerland, new information is usually presented by the moderator except for once a year at a focus meeting where experts are invited, while an expert is present at most meetings in Germany to hold a presentation. The difference can be traced back to the fact that the moderator in Switzerland often comes from an engineering office while the skills of the moderator in Germany is focused on his ability to lead the meetings. Another factor that could play a role

in the difference is the fact that the companies in Switzerland can be divided into three groups depending on their sector (industry, retail and service).

Today, formations of working groups that goes deeper into a topic are not very common in any of the networks but it was seen by the interviewees as an upcoming addition to the regular meetings. If the companies in the network groups are very varying in sectors and size it might be a possibility to get into more detail about topics that are of special interest for their processes.

From what was seen when studying the two networks a constant struggle is to get the top management involved and at the same time it is highly relevant for getting the measures implemented. In both countries an aim was to achieve a better contact to the directors of the companies by having them attend at least one of the network meetings every year. In Switzerland this is done during a focus meeting where experts are invited to talk about energy efficiency topics, while they in Germany are invited to one of the regular meetings.

An advantage with the network meetings according to Dr. Cooremans (2014, pers. comm., 4 December) is that meetings can also contribute to making energy efficiency measures more strategic. The meetings could be a way to support the companies with the first three steps (initial idea, diagnosis and build up solution) in Dr. Cooremans' model over how a measure is made strategic. For the model see figure 1 section 3.2.1.

Looking at the two models the conclusion can be drawn that the three factors found in both networks are necessary to have also in a Swedish network, as well as the site inspection of the company hosting the network meeting. Also it is necessary to put in effort to make the company director attend one of the meetings by having them attend a meeting where the topic presented is adjusted to his interest. Dividing up companies in three sector groups require enough companies and is therefore maybe not something that should be done when starting up a new network. Instead, the possibility of voluntary working groups should be introduced to the companies. This would give the companies a chance to get deeper in to a subject if they feel the need.

5.1.4 Annual monitoring

From the interview answers it was concluded that the monitoring usually is the part of the process where the companies have to get the most motivation from the moderator. Together with the collection of data for the energy audit this is the part that requires the most effort from the participating companies. It is therefore very important to have standardised easy tools for the companies to use in form of excel sheets. The excel sheets should all be gathered in one data base connected to the tools for the energy audit so no information has to be filled out twice.

From reports assessing Swedish energy efficiency networks as well as from interviews carried out in Sweden it was made clear that monitoring was sporadic or non-existent in all existing networks, the reason is believed to be the lack of time. However, from my study of the Swiss and German networks it is seen to be crucial that this step is carried out annually. Without this

step there is no purpose in setting targets and the top management cannot see the profitability of implementing energy efficiency measures.

In an interview done with Dr. Cooremans (2014) other possibilities with the monitoring was pointed at. Through the monitoring there is a possibility to make energy efficiency seen as a more strategic question in the companies by including multiple benefits. This is something that is done to a very limited extent in all networks today and then mainly by an extra questionnaire. According to Dr. Cooremans (2014 pers. comm. 4 December) a more favourable way is to use the three dimensional concept “value-costs-risks” and list benefits under each topic that is then turned into financial terms, to show the top management the positive impacts of energy efficiency. This will mean a little bit more work for the companies but the financial department is often happy to help and it will pay off when energy efficiency measures become more strategic and the interest is raised in the top management.

5.1.5 Additional recommendations

The length of a network period differs between Germany and Switzerland, mostly when it comes to the networking phase where the measures are implemented. In Germany this period last three to four years while it in Switzerland can last up to ten years. The longer period is considered to be positive by the interviewed companies and managers of the Swiss networks and was said to motivate companies to focus on measures with a longer pay back time. However, in Germany it was believed that a period longer than four years would make it very hard to recruit companies. A period of three to four years was though considered necessary for measures to be implemented and for monitoring to show results. As long as there are no laws for reaching an energy efficiency percentage or exceptions from CO₂ taxes in Sweden, a period of four years is believed to be the best alternative. The interviewees in Sweden also answered that a period of four to five years is most suitable for a Swedish network.

When comparing the models in the two countries differences were also seen when it comes to actors of the network. The network host in Germany is often a utility while engineering offices are more commonly used in Switzerland. In Germany the moderator and the consultant engineer are never the same, since the communication skills are considered very important for the moderator as well as being a strong driving force in the network process, while the consultant’s technical experience is more important. In Switzerland it is often the moderator holding the meetings as well as doing the energy audits. However, both models have in common that they point out that it is very important that the person doing energy audits and holding the meetings is certified. In Switzerland it was also seen as important that an already certified moderator was present during the first energy audits and network meetings. The best option for Sweden should be to follow the German example and separate the network host, moderator and consultant engineer in order to get the most out of their capacities. When choosing the network host focus should be on its reputation in the region.

The definition of SMEs is usually based on the number of employees in the company. When it comes to energy efficiency networks this number was not considered relevant in Germany nor in Switzerland. Instead it is chosen to look at the yearly energy costs of the participants. Both countries excluded energy intensive companies from the networks since they often have

different processes and conditions. Also, if the energy costs are too low the studied networks were seen as too rich and not profitable for the companies. The main models in Germany and Switzerland therefore have their focus on companies with energy costs between €500,000 and €20 million respectively over €415,000 (500,000 CHF). However, in later years both countries have started elaborating with networks for companies with lower energy costs. In Switzerland this in companies with a minimum energy cost of €17,000 (20,000 CHF), while Germany has set the lower recommended energy costs to €150,000. Inspired by Switzerland Germany first set the minimum recommended energy cost to €30,000, but it was not seen as profitable for the companies or LEEN Ltd.

The recommendations made for a Swedish energy efficiency network in this report are mainly based on the models for the companies with energy costs higher than €500,000 respectively €415,000 (500,000 CHF). If the model should be used for companies with lower energy costs the lessons learned in Germany and Switzerland should be kept in mind and the model should be simplified with for example a shorter period and fewer meetings. These simplifications were considered important by the interviewed due to that smaller companies usually do not have an energy manager and it is therefore often the managing director who is attending the meetings. Also, it was said to be even more important that paperwork for the energy audit and monitoring is easy and standardised since the companies often have a limited amount of time.

5.1.6 Limitations and further research

E-mails were sent out to the participating companies in Germany and Switzerland with requests of contribution to the research through interviews or questionnaires. These emails were responded to negatively or not at all from most companies. Therefore only three interviews with companies were held and all companies were participants in Energie-Modell Zürich. These interviews were organised by the manager of the network and therefore the companies can have been chosen from how committed they are to the network process. Thus, more research is needed to get a quantitative and qualitative view of the companies' views of the networks.

Further research should also be done when it comes to the economic analysis of the network. The economic information and equations given in this report are taken from the Swiss and German networks' own sources but more details are needed for which methods should be used in a Sweden.

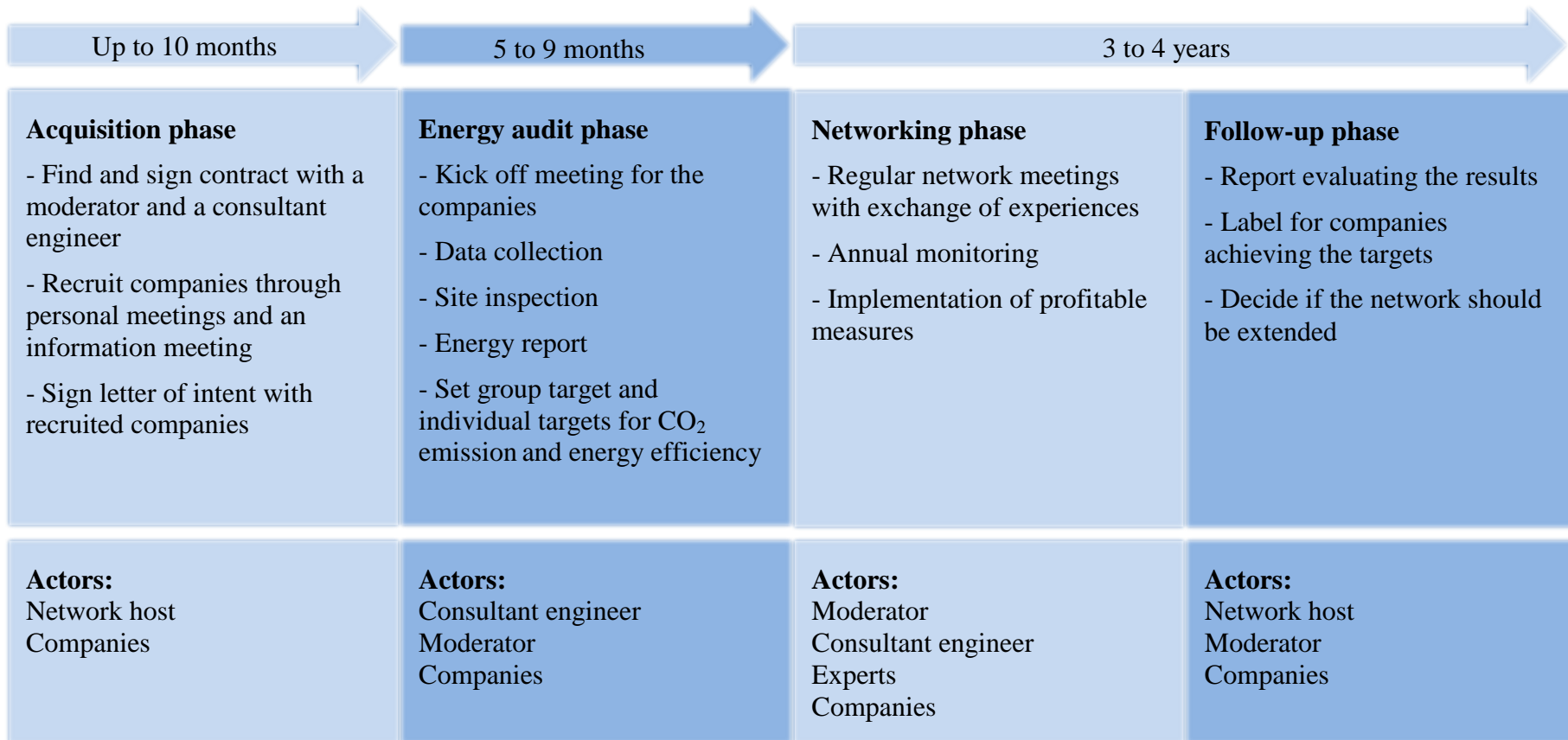
The descriptions of the Swiss and German networks are based on the same headings but the sources of knowledge differ a bit. The Swiss network is more based on interview answers than the description of the German networks. This is due to that information was easier accessible for the German networks, since LEEN is a commercial company more focused on disseminating the concept.

The research in the report is foremost focused on the German and Swiss networks and the suggestion made for a Swedish network is based on their experiences. Interviews and literature studies were carried out to gather information on what is needed in Sweden and what circumstances there are, but more research must be done of how the suggestions from

this report are implemented in Sweden in the best way. An important next step is to test the ideas and knowledge in a pilot project.

5.2 Suggested model for a Swedish network

5.2.1 The model



5.2.2 How is this achieved in Sweden?

5.2.2.1 Acquisition phase

- The developer of the management system (eg the Swedish energy agency) should **find a network host** that is well known and respected by the top managements of the companies in the region. The origin of the host can differ between the regions; it could for example be a regional council (eg. Region Skåne), an energy selling company (eg. Kraftringen), an already existing network (eg PROEFF) or a research institution (eg. SP Sveriges Tekniska Forskningsinstitut). It is the host's job to find the moderator, consultant engineer and to recruit companies.
- The host should **take the time to make a good strategy** before starting to recruiting companies. The host should also find the consultant engineer and moderator and sign them to the network before starting looking for companies.
- **Certify the moderators and the consultant engineers.** This should be done with a three days education and a test. The engineers should have an already certified engineer walking next to them the first times they carry out the energy audits.
- The **consultant engineer** should have long experience and enough engineers to be able to carry out all the participants' energy audits within nine months.
- The **moderators** should have long previous experience to lead the meetings and coordinate the exchange of knowledge. Further requirements are: good contacts and knowledge of the region, strong communication skills and team spirit to be the driving force the process.
- When **recruiting companies**, have a personal meeting with the energy manager, CEO and head of finance together. After this, an information meeting should be held with all potential participants. Provide the participants with a list of the benefits of networks. For example see Annex 8. The easiest way is to go through already existing structures such as an existing network of companies or industrial platforms, for example: Handelskammaren, SBHUB, Rotary or Energiklubbar U-2000. For a more detailed example of how the process can look see section 4.2.5.
- 10 to 15 companies should have signed a **letter of intent** before the energy audit phase starts.
- It should be a requirement to be part of a network to get **funding** (eg the energy audit check) for doing an energy audit.

5.2.2.2 Energy audit phase

- At a first **kick-off meeting** the companies should be provided with a plan for when the energy audits will be carried out, the meeting should also give a general overview of how the networking phase will look.
- The **energy audit** should include:
 - Collection of company data, done by the company
 - Site inspection, done by the consultant engineer
 - A report of profitable measures, done by the consultant engineer
 - Target setting, based on the potential found

A good example can be seen under section 4.2.6.2.

- Examples of **tools** that can be used to support the energy audit in Sweden are: the Energy Agency's Handbook⁹ and ENIG's Nyckeldatabas and Energiledning light¹⁰.
- Set clear **targets** based on numbers for the group and for the individual company for increase in energy efficiency and reduction of CO₂ emission. The base year for both targets should be the starting year of the network and the calculations should take the growth into account. For example see eqn. 3 and eqn. 4 in section 4.2.6.2.
- If a company is not reaching their targets it is important for the moderator to help and motivate them as fast as possible.

5.2.2.3 Networking phase

- The **meetings** should be held every 3 to 4 months. One meeting a year should be focused on getting the managing director to come by inviting experts with topics of special interest for the top management. There should also be a possibility for the companies to form working groups if there is interest in going deeper into a topic. In the regular meetings the following should be included:
 - A site inspection of the hosting company
 - Company sharing of experience and reporting of progress
 - Information from an expert about a topic
- The **monitoring** of the companies' progress on fulfilling the group- and individual target should be annual and based on the bottom-up method. Everything, including multiple benefits of energy efficiency, should be translated into numbers so it can be compared. The process should be standardised so it is easy to carry out for the companies and all the excel sheets should be gathered in one data base. For example of the German excel sheets see Annex 5.
- **Follow-up** the companies' opinions of the networks with questionnaires; one in the beginning, one in the middle and one in the end of the network period.
- It is the companies' own responsibility to **implement the measures** with support from the moderator, the consultant engineer and the other participants.

5.2.2.4 Follow-up phase

- The developer of the management system (eg, Swedish energy agency) should write a **report** to evaluate the network period based on the questionnaires sent out to the companies. Here it should also be reported if the targets are fulfilled.
- Have a **label** for companies that they can put on their homepage showing that they work on improving energy efficiency.

5.2.2.5 Tools

- Excel sheet for **data collection** (for example see Annex 6)

⁹ <https://www.energimyndigheten.se/Global/F%C3%B6retag/kart.pdf>

¹⁰ Nyckeldatabasen and Energiledning light can be reached through ENIG's home page: www.enig.se

- Excel **calculation tools** for monitoring and site inspection (for example see Annex 6)
- Excel sheet for **measures** overview (for example see Annex 7)
- **Red, yellow and green light** excel sheet to evaluate the companies work with implemented measures during meetings

5.2.2.6 Additional recommendations

- It should be **mandatory** for the participants to take part and carry out all parts of the four phases. The standards should be quality checked and similar for all networks.
- Be **flexible** enough to adjust to the participants' wishes and suggestions.
- Limit the amount of paperwork and collect everything in **one data base**.
- The companies should pay a **fee** for participating in the network; the fee should cover the moderators work and give them access to tools. Funding should help to pay for the energy audit.
- The participating companies should have **yearly energy costs** from €400,000 to take part in the network and not be energy intensive.
- Sectors are not of importance but the networks should be **regional** to ease for the companies to attend the network meetings.

Conclusion

The result part of this report shows a detailed description of the structural design and content of the Swiss and German energy efficiency network. From this it was seen, as expected, that a well thought through and structure management system is the key to a successful network. Necessary elements in the network were seen to be:

- The acquisition strategy
- Clear targets
- Regular moderated meetings
- Annual monitoring

To conclude; what it comes down to in the end is that if a company wants to get more measures implemented they need to get the managing director of the company to see energy efficiency as important for the company. It is therefore an important part of almost all the steps of the network process to get to the top management. During the acquisition phase the host should be chosen depending on how well respected the person is by the top managements in the region and a personal meeting with the managing director of the company is one of the most important parts when recruiting companies. The targets set for the companies during the energy audit phase are used to put pressure on the top management that energy efficiency measures have to be implemented. Also, in the meetings effort should be put into getting the management involved and at least come to one meeting a year. The monitoring is the possibility to show the top management that working with energy efficiency is profitable and by also monitoring the multiple benefits it can be shown that the implemented measures have other positive effects for the company.

If it is decided that regional energy efficiency networks will be started in Sweden the suggestions presented in this report should be tested in a pilot project. Through evaluation and monitoring a specific management system and tools for Sweden should be developed. The findings should be made into a report and positive results should be used to further disseminate the networks over the nation. More research could also with advantage be carried out to get a quantitative and qualitative view of the German and Swiss companies' views of the networks.

Since Sweden's and Germany's circumstances are quite similar the German LEEN concept could favourably be applied in Sweden. Today, the LEEN management system is sold to other countries as a product. A possibility for Sweden would therefore be to buy the product to be provided with help planning the acquisition, training consultant engineers and moderators etc.. This would decrease the Swedish administrative burden and a logo from an already tested network would increase the credibility of the network concept.

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Annex 1. Interview questions for Fraunhofer Institution and EnAW

1. Background

- a. What was the biggest motivation to start the network project and why did you start it?

2. The Key players

- a. Who has proven to be the best network host and coordinator?
- b. Why have you chosen not to have utilities as hosts as in Germany?
- c. How do you work with auditors, moderators, energy experts and consultant engineers? What education and certifications do they have?
- d. How important is it that they are certified?
- e. Do they follow a standard (for meetings, energy auditing etc) that is common for all the networks in Switzerland/Germany?
- f. Who from the companies are taking part in the networks?
- g. How can you reach out to the directors of the companies? Is the contract of importance here?

3. Attract SME

- a. Do you need to analyze the target group and have a strategic plan before you start requiring the companies? How should it look?
- b. Whose job is it to require companies?
- c. How do you require them (through industry associations, having an information meeting, sending out information, personal visits)? What worked well and what worked less well?
- d. What is usually the main reason for companies to join the networks?
- e. What are the difficulties with the SME compared with the bigger companies?
- f. How important are the advantages, in form of for example the exception from the CO2-levy and subventions, to motivate the companies to take part?

4. The model

- a. What have worked well?
- b. What did you do in the beginning that you have changed now?
- c. What did you learn during these years running the process? What mistakes should not be repeated when starting up the Swedish networks?
- d. What are the positive and negative sides of having regional networks?
- e. Is it important that the companies come from different sectors?
- f. What is the optimal size of a network group? Why?
- g. Are there things that work for the bigger companies but not for SMEs?
- h. What are the reasons for splitting it into two models?
- i. How long should a network period be and does it differ depending on the size of the companies?
- j. What is most important to do and what should be avoided during the meetings?
- k. What subjects are most important to bring up during the meetings?
- l. How often and how long should the meetings be?

- m. Who is holding the lectures during the meetings, why are they chosen?
- n. How do you help the companies setting up energy policies, targets and action plans? Who is helping with this?
- o. Is working groups that go deeper into a topic something you want to work with outside the normal meetings?
- p. Does one company have a leading role towards the other companies?

5. Companies

- a. What do you think the companies feel is most useful of what they get from participating in the network? (Meetings, tools...)
- b. What do you think they find harder to carry out?
- c. Do the companies need to reveal financial data or other data of strategic importance? Are they reluctant to reveal information of any particular type?
- d. What must the companies fulfill to take part? (SME, certain energy use..)
- e. Is there a rule of thumb about the suitable range of percentage cost, for participation, in relation to the overall energy costs?

6. Demands

- a. What are the companies paying for with the participating fee?
- b. Is it important that the companies sign a contract to make them fulfill the targets?
- c. What happens if the targets are not fulfilled?
- d. Why is there a choice between binding and non-binding targets? Have you seen better results for one or the other?
- e. Should there be targets both for the company and for the whole group? Does it differ in the two models? Why?
- f. Why are the targets important?

7. Monitoring

- a. What is most important to think about when carrying out the monitoring?
- b. Is the monitoring process the same for all networks in Switzerland/Germany?
- c. What elements must be in the monitoring?
- d. After the monitoring, do you come back to the companies for follow-ups?

8. Follow-up

- a. What results are analyzed in the continuous follow-up process by the companies?
- b. Could an third party expert in energy efficiency project monitoring and evaluation, perhaps be used to support companies with evaluation?
- c. With whom from the company is the follow-up done?
- d. What are the companies obligated to report to the network?
- e. How often do you follow-up the results?
- f. How are you following up the networks process after it is over, are there standardized tools? What is the purpose of this follow-up?
- g. When do you use the top-down and when the bottom-up method?

9. Tools

- a. What tools do you have as support for the companies and for the moderators/auditors/consultant engineers? What do you think about the different tools?

- b. Where can the companies turn between the meetings for help?

10. Weaknesses and success factors

- a. What is the main reason for success?
- b. Have there been something that you feel was unnecessary or do you miss something in the network?
- c. Do you have a recommendation of what should be done or absolutely shouldn't be done when starting up the Swedish networks?
- d. What weaknesses are you working on improving right now and how?
- e. What more than CO₂ and EE? Which are the other potential benefits coming from energy efficiency improvement actions? Social, productivity, less noise etc.... Do you elaborate with key performance indicators to keep track of such factors?

11. Future

- a. What are the plans for evolving the networks?
- b. What are you doing so that the interest for the networks shouldn't decrease after a few years? Are there enough new topics for the energy experts to lecture about?

Annex 2. Interview questions LEEN Managing Director

1. Motivations to join

- a. What do you think motivates the most a law or subventions?
- b. Are there negative sides of having to high subventions?
- c. Do you need different methods to attract SMEs and bigger companies?
- d. What do you think is motivating the companies the most to take part?

2. Starting up a network

- a. What would you say is important to think about when starting up a new network?
- b. How do you spread the concept of networks to other countries? What are the important factors?
- c. Do you have a recommendation of what should be done or absolutely shouldn't be done when starting up the Swedish networks?

3. Design compared to the Swiss model

- a. What changes did you do from the Swiss model? Why did you do these changes?
- b. Why have you chosen to have a 3-4 year period when they in Switzerland have chosen to have 10 years?
- c. In Switzerland they do not want to have utilities as network host because they want to have a natural approach to the companies. Do you see it as a problem that the companies could see it as if the utilities want to sell them for example their electricity?

4. The model

- a. Do you have any tips beyond what can be read about the meetings, tools, monitoring etc.?
- b. How important is the social competence of the consultant engineer?
- c. How do you get a good balance between a standardized design and listening to the participants wills? Is it more important to be flexible to what the participants want or to have strict design that is easy to follow for everyone?

5. Participants

- a. Is competition in the network between companies from the same sector a problem? What can be done to prevent it?
- b. Can you have SMEs and larger companies together in a network group? Are there any problems if the size difference is too big?
- c. What are the reasons for splitting it into two models, LEEN and Mari:e?
- d. When you divide companies up depending on size what is most important to look at; the energy use, the energy costs, the number of employees or something else?
- e. Do you think it should be consequences if the companies don't fulfill their targets? Why or why not?
- f. What is the reason that there is no group target in Mari:e?

- g. Could the smaller companies that are now taking part in LEEN-compact join LEEN-classic before LEEN-compact existed?
- h. What is included in the contract that they sign in the beginning?
- i. Are all companies that join the network in the startup still taking part? If someone left, what was the reason?
- j. What can you do to get the management involved?

6. Success factors

- a. What do you think is the main reason for the success and that it has spread so much?
- b. What do you think is harder for the companies to carry out of the things they have to do in the network?
- c. Is there something you would do differently if you were to start up the networks today with the experience you have now?
- d. Do you miss something in the network that you want to introduce in the future?
- e. Where do you have to be careful? Where is it easy to make mistakes?
- f. What are you doing so that the interest for the networks shouldn't decrease after a few years?

Annex 3. Interview questions Energie-Modell Zürich

1. Organizational questions

- a. How many periods have you run so far?
- b. How many companies are taking part in the network right now?
- c. How many different companies have been taking part over the years?
- d. Did you ever have more companies wanting to take part than you could accept?
- e. What was the goal when you started up the network?
- f. What are your main tasks as a network host?

2. Participating companies

- a. How do they vary in size? (employed people and energy use)
- b. What different branches are the companies from?
- c. What is positive with the variation in branches and size?
- d. What is negative with the variation?
- e. How long does a company usually stay in the network?
- f. Do everyone involved have to sign confidentiality agreements?
- g. How willing are the companies to be open with information about eg energy use? Do they get access to information about each other?
- h. What must the companies fulfill to take part? (SME, certain energy use..)
- i. Who is usually taking part from the company?
- j. Is it important to get someone from the management to take part in the network meetings and how do you motivate that then?

3. Attract SME to join networks

- a. How do you contact new companies?
- b. What strategies do you use to attract the companies?
- c. How did you promote the network when you first started it up and how do you do it now?
- d. What is usually the main reason for companies to join the networks?

4. The model

- a. What tools do you have as support for the companies and for the moderators/auditors/consultant engineers?
- b. How do the meetings work? How often?
- c. How important is it that a contract is signed for the targets to be fulfilled?
- d. What are your targets?
- e. Is it important to set a target for both the network group and every participant individually?
- f. Must the companies be certified? Eg. ISO 50001
- g. How much can you make the companies pay to participate? Have you found a breaking point between where a fee leads to that they put in more effort and where it is hard to motivate them to take part?

5. Key players

- a. How do you work with auditors, moderators and consultant engineers? What education and certifications do they have?
- b. How important is it that they are certified?
- c. Do they follow a standard (for meetings, energy mapping etc) that is common for all the networks in Switzerland?

6. Follow-up

- a. How do you follow-up the results?
- b. How often do you follow-up the results?
- c. Have you evaluated any other effects of the networks then increased energy efficiency, decreased CO2 emissions and more implemented measures? Does it for example make energy efficient investments more strategic?

7. Success factors

- a. What do you think is the main reason for the success and that it has spread so much?
- b. Have you done something that you feel was unnecessary or do you miss something in the network?
- c. Do you have a recommendation of what should be done or absolutely shouldn't be done when starting up the Swedish networks?
- d. What do you think the companies feel is most useful of what they get from participating in the network? (Meetings, tools...)
- e. What have they been less satisfied with?

8. Future work

- a. How do you plan to develop the networks?

9. SME

- a. What is the difference compared to the network for bigger companies
- b. Are the companies harder to attract?

10. I would like to come in contact with companies to interview them about their experiences, can you recommend someone I can contact?

Annex 4. Interview questions for participating companies

1. About the company

- a. Do you want the company to be anonymous in the report?
- b. If not anonymous: Can you give a short description of the company's work?
- c. When was the company founded?
- d. How many employees does the company have?
- e. Around how high are the yearly energy costs?
- f. How long have you been taking part in the network?

2. Background

- a. How did you work with energy efficiency questions before you joined the network?
- b. What measures would you have done even without the network?

3. Key Players

- a. Who is hosting the network?
- b. What do you think about the moderators, energy experts and monitors that the network provides? What are important qualities they should have?
- c. Who at your company is involved in the network? (going to meetings etc.)
- d. Is the management involved in the networks?
- e. What makes/would make someone from the management involved?

4. Motivation to join an energy efficiency network

- a. Why did you decide to join an energy efficiency network?
- b. What was the biggest motivation to take part, of the things that the network offered?
- c. How did you find out about the network? Did they reach out to you or did you contact them?
- d. Who at the company was the driving force in the question that the company should take part in the network?
- e. What is the company's goal and expectations with taking part in the network?

5. The model

- a. What do you think is the best with the network model today?
- b. Is there something you would like to change? How?
- c. What do you think about the meetings?
- d. How often do you think the meetings should be held?
- e. What should be included in the meetings?
- f. What topic have you found the most useful/interesting?
- g. Does one company have a leading role compared to the other companies?
What do you think about that?
- h. Does everyone share knowledge equally?
- i. How do you see to the mix of companies from different sectors? Is it positive or negative?
- j. Do you think it is important that the network is regional?
- k. What do you think about the size of the network groups?

1. Are you satisfied with the length of a period?

6. Demands

- a. Do you have a target for the network group? What is that target?
- b. What targets have you set for the company?
- c. Did you reach your targets?
- d. How important do you think the targets are to motivate you?
- e. What supports and subventions do you get? Is it enough?
- f. Have any demands from the network been hard to fulfill?
- g. What do you pay to participate? What do you think about the participation fee?
Too high/too low/motivating?

7. Site inspection

- a. What do you think about the site inspection? The person carrying it out, helping tools, time it takes etc.
- b. Do you think you get enough support setting targets and writing action plans? How are you supported? Could they do something more?

8. Reporting and follow-up

- a. How do you follow-up the results: What do you have to report, how often do you have to report it, to whom do you have to report and what tools do you have to help you?
- b. What do you think about it?
- c. Do you think you get enough help following-up the results or could they do anything more to support you?

9. Tools

- a. What tools does the network provide and which do you find most important/helpful?
- b. Is there somewhere you can turn for advice between the meetings? Do you use it?

10. Results

- a. What have changed since you joined the network?
- b. Has the participation lead to more implemented measures?
- c. Have the results been as you expected?
- d. What are other potential benefits coming from energy efficiency improvement actions? (Social, productivity, less noise..etc.) Do you elaborate with key performance indicators to keep track of such factors?

11. General opinions

- a. What has been the best with taking part in a network?
- b. Are you missing something or is there something you want to change or improve with the network?
- c. What is the general opinion at the company about the participation in a network? Does everyone in the company know that you are taking part?
- d. Have the participation lived up to your expectations?
- e. What effects have the company gotten from participating, planned and not planned?

- f. Do you think the networks give you as much now as when you joined? What can they do to keep it interesting?

12. Future

- a. How do you see the company's future in the network?

Annex 5. Interview questions Catherine Cooremans

1. Energy efficiency networks

- a. You mention three competitive advantages; value of the offer, risks and costs. How do you think an EE network affects the different parts?
- b. How do you look at EE networks? Do you think it is a good way to conquer the problems with energy efficiency in SMEs?
- c. How do you think that energy efficiency networks can be of help to get more energy efficient measures implemented?
- d. In what way can EE networks help the company make more strategic decisions about energy efficiency?
- e. Which of the five steps to implement a measure do you think is the hardest for SMEs? Is it the same for larger companies?
 - i. Initial idea
 - ii. Diagnosis
 - iii. Build up solutions
 - iv. Evaluation & Choice
 - v. Implementation
- f. You say that the investment process consists of five steps, which step/steps do you think EE networks would have the biggest impact on?
- g. How do you think EE networks will affect the different steps?
- h. Is there a tool that could be used in an EE network to help make EE more strategic? How should a tool like this look?
- i. How important is it to set targets to help get more EE measures implemented? What should there be targets for?

2. Management

- a. What can the energy manager (or group/person responsible for energy questions at the company) do to make the top management involved and more interested in energy efficiency questions?
- b. What could an EE network contribute with to make the upper management more involved?

3. Other

- a. Do you think it would be useful to follow-up other potential benefits coming from energy efficiency improvement actions? (Social, productivity, less noise.. etc.) Would it add to energy efficiency becoming more strategic?
- b. Do you think auditing and certifying e.g. ISO 50001 is important to make EE more strategic?

Annex 6. Investment Calculation tools

English (eng)	▼
€ (EUR)	▼



Investment calculation

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General information	
Project name	Energy efficiency network
Company	Company Ltd.
Site	City
Date of processing	1/ Dezember 2014

Measure	
ID of measure	MS01
Brief description	This is a discription of a measure

Processor	
Name	Mr. John Doe
Function	Energy manager
Phone	0721 / 12283743
Email	john.doe@company.com

Key	
Input field (required)	Light yellow input fields denote the minimum data required for calculation. Costs and revenues are to be entered as positive values.
Input field (optional)	Dark yellow input fields denote additional information allowing for more detailed calculations.
Output field (locked)	Light blue output fields show calculation results and cannot be edited (red: payable amount).

Disclaimer

Fraunhofer-Gesellschaft e. V. cannot be held responsible for any errors in the program.

Important notes

This software is provided free of charge and must not be passed on against payment.

Calculation

Energy efficiency network | Company Ltd. | City

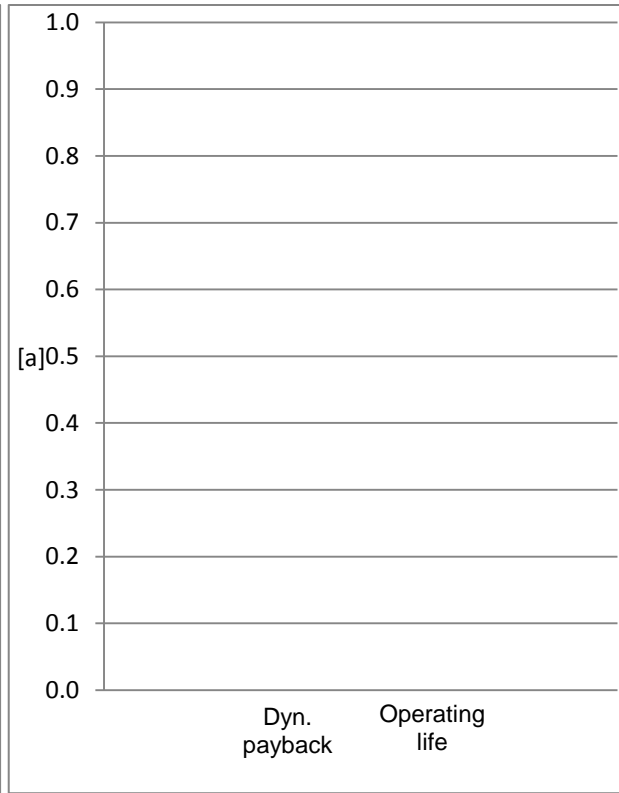
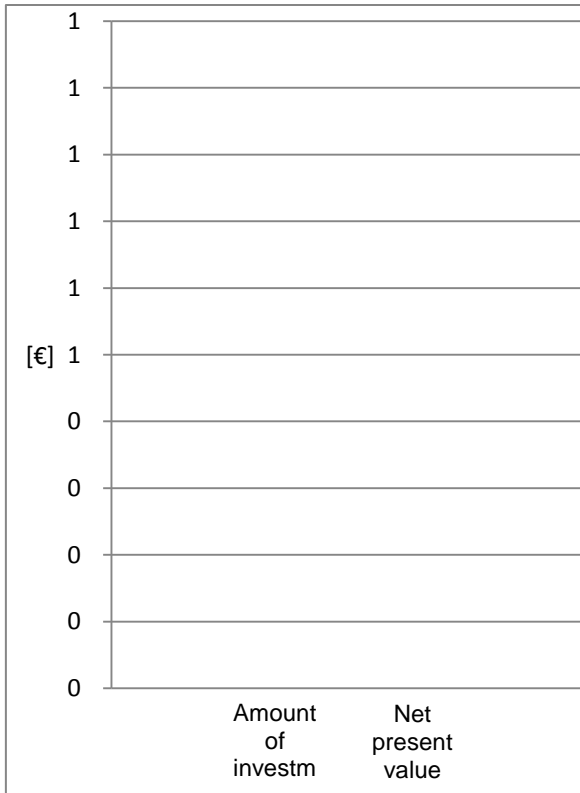
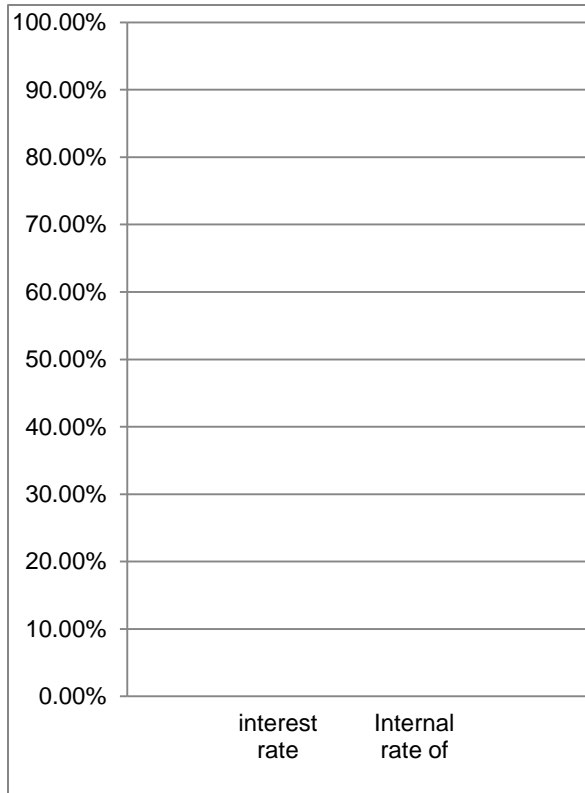
Input	<input type="checkbox"/> Simplified	Unit	Old/new	New eff.
Starting year				
Operating life OL [years, 1-50]		a		
Interest rate		%		
Amount to be invested		€		
Residual value of investment today		€		
Residual value of investment after OL		€		
Energy costs per year		€/a		
Change in energy costs per year		%		
Other costs per year		€/a		
Change in other costs per year		%		
Other revenues per year		€/a		
Change in other revenues per year		%		

Results	Unit		
Net present value, at 0%	€		0
Internal rate of return	%		0.0%
Dyn. payback period, at 0%	a	0.0	0
Static payback period	a	0.0	0
		Old/new	New eff.
Annual costs, incl. annualized investment amount	€/a	0	0
Annual cost savings	€/a	0	

Auxiliary calculation: Conversion of annual payment amounts	Unit		
<input checked="" type="radio"/> Annual payment	€		
<input type="radio"/> Investment	Amount		
	Years		
Annual payment based on and Years	€	0	0

Payment plan for fictitious differential investment	Unit	0	1
Time		Dec. 31	Dec. 31
Loan for investment	€	0	
Annual return	€		0
Interest payments	€		0
Principal repayment (positive if interest payments > return)	€		0
Residual debt	€	0	0
Surplus	€	0	0
Discounted net present value (residual debt or surplus) as at			Dez. 31,
Net present value	€	0	0

Transfer of values (copy -> paste values) to 'Measures summary' (LEEN)					
	Operating life	Total investment eff.	Additional investment (eff.)	Annual costs	Other annual revenues
Unit	a	€	€/a	€/a	€/a
In the case of residual values, a change of the interest rate in the 'Measures summary' after the transfer will lead to wrong results in that tool.					
New measure, eff.	0	0	0	0	0



Annex 7. Measures overview

ID	Title of the measure	Purchased electricity	Fuel oil EL Wood chips		Useful life	Total investment eff.	Fictitious "differential investment"	Annual cost	Other annual revenues	Net present value (10%) "internal rate of return i"	Static amortisation	Dynamic amortisation (10%)	
	Final-energy savings [unit]	[MWh/a]	[MWh/a]	[MWh/a]	[a]	[€]	[€]	[€/a]	[€/a]	[€]	[%]	[a]	[a]
	Present total investment eff. (profitable m.)					110.000							
	Total of profitable measures	289	599	-289	15		118.405	500	3.850	370.910	54,3%	1,8	2,1
	Total of all measures	289	600	-189	15		196.803	500	3.850	304.970	33,1%	3,0	3,7
E03	Reduce basic electricity consumption	65,0			10	2.000	2.000			41.065	350%	0,3	0,3
L01	Factory ventilation with supply air system in summer	15,0			10	500	500			9.438	323%	0,3	0,3
B01	Retrofitting of mirror reflectors/transparent covers	30,0			10	3.000	3.000			16.876	108%	0,9	1,0
E04	Operation of EFF1 motors	70,0			10	7.300	7.300			39.077	103%	1,0	1,1
W05	Lowering the flow temperature in the heating circuit		500,0	-500,0	15	25.000	25.000			126.643	80%	1,3	1,4
D02	Lowering mains pressure/use of boosters	38,0			10	7.000	7.000			18.176	58%	1,7	2,0
E02	Emergency generator to cope with peak loads				10	3.000	3.000	1.700		7.446	56%	1,8	2,0
E01	Reduction of peak load				10	5.000	5.000	2.150		8.211	42%	2,3	2,8
ORG01	Setting up of an energy management system	50,0	14,0	11,0	15	20.000	20.000			29.618	32%	3,1	3,8
W06	Utilisation of waste heat from injection moulding machine			200,0	10	10.000	10.000			9.137	29%	3,2	4,1
D01	Heat recovery from compressor		85,0		10	15.000	15.000			13.158	28%	3,3	4,2
B02	Retrofitting of T5 lighting with electrical ballast	20,0			10	12.000	6.000	500		4.178	25%	3,6	4,7
K01	Insulation of refrigerant pipes and fittings	1,0			10	500	500			163	17%	4,6	6,5
K02	Utilisation of waste heat from refrigeration process		259,0		10	68.000	68.000			17.798	16%	4,9	7,0
W02	Thermal insulation of burner plate and inspection plate		1,0		10	500	500			-169	1%	9,3	27,5
W03	Heat recovery from hot exhaust emissions		16,0		10	10.000	10.000			-4.700	-1	11,6	-1
Geb01	Thermal insulation of outer wall of administration building			100,0	40	150.000	100.000			-83.882	-1	60,7	-1

Figure 3: Outline of the evaluated suggestions for measures (shortened presentation); profitable measures are those with an internal rate of return exceeding 12%.

Annex 8. Benefits for companies to take part in an energy efficiency network

Provided by the network	Immediate effects	Long term effects
<ul style="list-style-type: none"> • Energy review -Carried out by certified consultant engineers -Support in setting company specific and group targets for energy efficiency and CO₂ emission • Network meetings -Exchange of experiences led by a certified moderator -Presentations on energy efficiency topics by experts • Regulated monitoring 	<ul style="list-style-type: none"> • Get a structured energy management system • Good PR for the company • Increased knowledge in energy management and best technology • Best practice examples • More implemented energy efficiency measures • Reduced transaction costs • Targets for increased energy efficiency and reduced CO₂ emission • Results get followed up • Energy review • Access to certified engineers and moderators 	<ul style="list-style-type: none"> • Decreased energy use • Reduced costs • Systematic ways of working with energy efficiency • More strategic energy efficiency measures • Increased competitiveness in the company and towards other companies