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Swedish energy networks among industrial SMEs

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Abstract

Research and policy instruments for improved energy efficiency in industry have historically focused on large and energy-intensive companies, perhaps because a large part of the energy use is concentrated therein. However, small and medium-sized enterprises (SMEs) account for 30 % of Swedish industrial energy use. Research shows that both the relative energy efficiency potential and the cost-effectiveness for implementing energy efficiency improvement measures in industrial SMEs is higher, compared with large and energy-intensive companies. A significant difference between large companies and SMEs is their management capability, i.e. the difference between how energy is governed in-house companies. One way to approach SMEs is through energy efficiency networks, where 10–15 companies work together to improve energy efficiency. The networks are driven in turn by an external actor. The model has been successfully used in 70 networks in Switzerland and more than 50 in Germany, and is now emerging as a means to improve energy efficiency in Swedish industrial SMEs as well. While energy audit programs, nationally and internationally, is a thoroughly researched subject with developed methods, etc., this is not the case with networks, and in particular the Swedish networks. The aim of this paper is to study the current Swedish energy network activity in industrial SMEs. Results show that a large potential for improvement still exists in these networks, i.e. methods and tools used are still to be developed, as well as a more structured methodology on how the network are to be managed. Including experience from other country's networks could contribute further to more effective Swedish industrial SME energy networks.

Introduction

Improving energy efficiency in the industrial sector is an important step towards reaching the EU's 20-20-20 climate and energy targets. The attention, speaking about both research and policy instruments development, has historically been paid to large, energy-intensive companies due to the higher energy saving potential found therein. In Sweden, SMEs account for the 30 % of industrial energy use (SCB, 2010) and thus, the accumulative energy saving potential for SMEs can be quite high as well (Thollander et al., 2013). According to EC (2006), it is possible to achieve 25 % reduction of industrial energy use. Furthermore, the relative potential for energy efficiency and cost-effectiveness of measures are often greater for SMEs than large enterprises (IPCC Working group, 2013), (Shipley & Elliot, 2001). This is partly due to SMEs have not done so much in the area of energy efficiency yet in comparison with large enterprises. Also, the majority of the energy efficiency improvements at industrial SMEs can be found in support processes and are relatively easy to implement.

Nevertheless, the potential is not always realized due to the energy efficiency gap caused by different barriers to energy efficiency (Sorrell, 2000). The examples of barriers to energy efficiency at SMEs are lack of time or other priorities and lack of access to capital (Thollander & Palm, 2012). SMEs have limited possibilities of introducing energy management because of their economy and insufficient knowledge to launch the activities (Kannan & Boie, 2001). Also, SMEs pay less attention to

energy efficiency as they often do not have a dedicated person able to take care of energy issues, as well as due to a rather small energy saving potential found at a single company (Shipley & Elliot, 2001). Moreover, because of a big variety of branches and processes, it is hard to allocate which activities use most energy (Shipley & Elliot, 2001).

One example of a way to overcome these barriers is an energy audit program aimed at increasing awareness on energy efficiency improvement measures available at SMEs (Thollander & Dotzauer, 2010). Another possible way to increase energy efficiency is through energy networks between SMEs. This method has not been as thoroughly researched as energy audits despite the fact that it has been effectively used for several decades in Switzerland and Germany. Swiss and German experiences proved higher rate of energy efficiency measures implementation as well as investments in energy efficiency. The reported electricity-efficiency improvement was 2,5 % in the German case (Jochem & Gruber, 2007) while there are no such data for Switzerland. The average energy-cost reductions were reported to be €110,000 in Switzerland after the 3–4 years operational time and €120000 for German networks. The concept of energy efficiency networks has not been as widely used in Sweden and there is no common standard for how the network should be organized. In other words, different kinds of projects that focus on energy efficiency and are built as networks can be seen as energy networks. Therefore, in order to create successful energy networks it is important to learn from other countries' experience as well as the experience obtained from existing networks in Sweden.

The aim of this paper is to study the current Swedish energy network activity in industrial SMEs.

Methodology

To gather information about energy efficiency networks in Sweden, a mapping of current network activities was performed. Coordinators of energy efficiency networks were contacted and through these correspondences, new contacts were recommended. This iterative process is referred to as the snowball methodology (Aktinson & Flint, 2001). Based on that exploration, seven coordinators were chosen for interviews. One of them coordinated two networks and that is why the study comprises of eight networks in total. Five of seven interviewed coordinators work at energy agencies in counties and two other coordinators represent private energy service companies.

The interview subjects were chosen based on that their network experience fit well with the chosen area of interest and they can be considered a good source of information on how the existing networks function in Sweden. Thus, a comprehensive picture of the network activities can be obtained. At the time of the interviews, all interviewees functioned as coordinators in energy efficiency networks aimed towards SMEs.

The interviews were conducted either in person or over the phone and all the interviews were recorded and transcribed for the analysis. The purpose of the interviews was twofold, partly to gather information about how the networks function and partly to gather subjective experiences and opinions about energy efficiency networks from the coordinators. For attitudes and subjective experiences, interviews are well suited and therefore, the conversations were semi-structured, to allow the respondents the freedom to develop arguments and add the aspects that the study had not originally formulated (Kvale, 2009). The open structure of the interviews was intended to allow respondents to give new input that might lead to new research questions for future studies. A schematic structure of the interview guide is presented in Table 1.

Theory

The main idea of the network method is that several companies form a group coordinated by an external actor and meet regularly to exchange their experiences in the field of energy efficiency. A coordinator has an administrative role and leads the work within the network. The companies can use the help of external specialists in order to identify possible energy efficiency measures. Thereafter, they set a mutual goal for the network and work together to achieve it, and at the same time improve energy efficiency at their own sites. The performance of the network in general and at each company in particular is monitored annually. Collaboration helps to reduce high transaction costs, minimize risks and raise the awareness to energy questions (Koewener, et al., 2011). In Sweden, a similar approach

Table 1. The interview guide's structure.

Area of interest	Sub questions
Initiation phase	How were the networks initiated? By whom were the networks initiated? What was the purpose of the initiation?
Organization of networks	The availability of contracts What is the role of the coordinator? Organizing the meetings The use of external competences
Activities and management	Activities within the networks Energy audits Action plan
Goal	Goals in the network The effect of having/not having quantitative goals
Follow up	Are the activities in the networks measured/presented/evaluated? How are they measured/presented/evaluated? What is the purpose to measure/present/evaluate the activities?

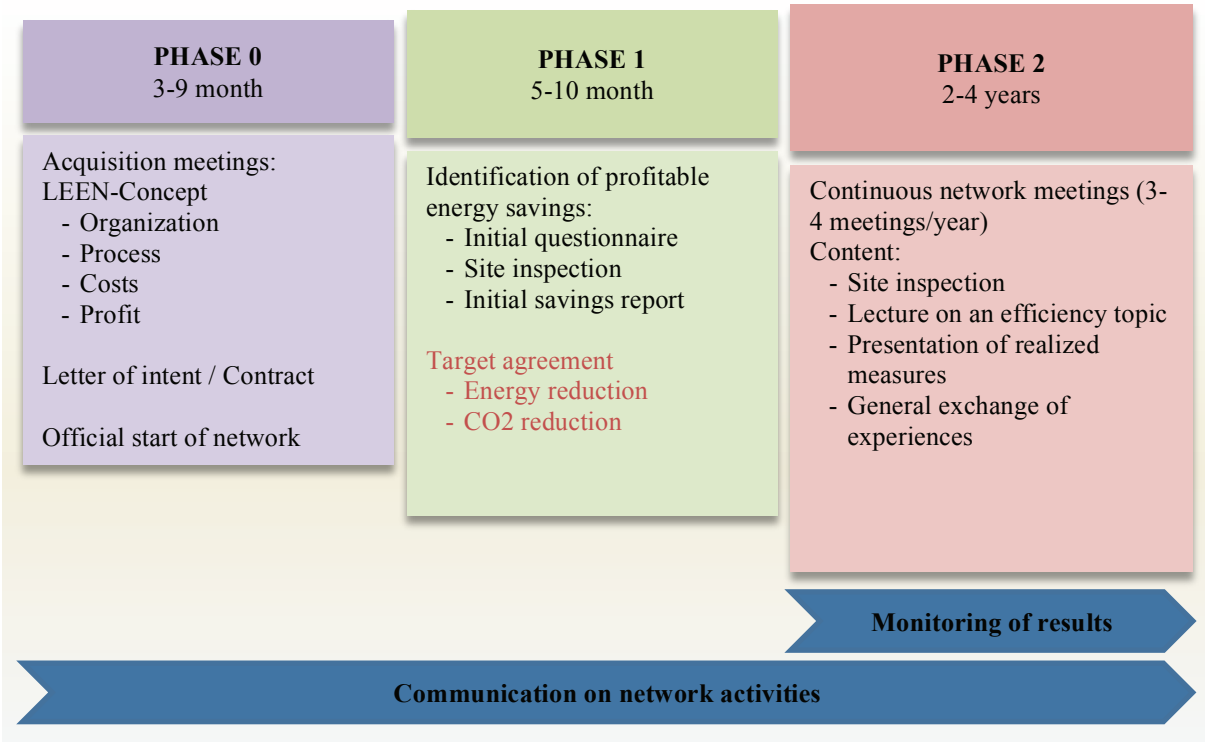

Figure 1. The LEEN-concept, (LEEN, 2013).

to energy efficiency networks has been used extensively since 1996. The model, named the Hackefors model, is an instrument for implementing joint management systems such as environmental management systems according to the international standards (Altea, 2013). It has been proved by the Hackefors model as well as international energy efficiency network models that the success of a network depends to a high extent on the network coordinator's contribution (Ammenberg, 1999), (Koewener, et al., 2011).

THE SWISS ENERGY MODEL

Switzerland was the first successful example to introduce the concept of energy efficiency networks in the 1987, which was called EnergyModel (Koewener, et al., 2011). The model was supported by the Swiss Energy Agency and all the participating companies were exempted from a fossil fuel surcharge if they managed to reduce their carbon dioxide emissions. The Swiss Energy Agency negotiated the emission targets between the companies and the Swiss government (Jochem & Gruber, 2007). Now there are around 70 energy efficiency networks in Switzerland involving approximately 2,000 companies. The networks run between four and five years and are driven by such targets as energy efficiency improvement or fossil fuels replacement (Koewener, et al., 2011). Now, the networks are financed by the participating companies depending on their sizes and how much they pay for energy annually. The evaluation showed the annual reduction of individual energy costs of €110,000 per company on an average (Koewener, et al., 2011).

THE LEEN-CONCEPT

A first energy efficiency network in Germany was established in 2002, encouraged by the Swiss success. There are more studies published in English about German networks than the Swiss networks, and therefore the German model is presented in greater detail. The German networking model is usually referred as energy table or learning energy efficiency networks (LEEN). A network consists of 10–15 primarily medium-sized companies located in a close proximity and therefore often not presented by the same sector. As well as modern Swiss networks, LEENs are financed by the participating companies (Koewener, et al., 2011).

The first network was evaluated during its functioning and the results showed the positive tendency in reducing energy costs as well as CO_2-emissions, which caused consequent development of similar networks. Now there are more than 50 networks functioning according to the concept presented in the Figure 1 (Koewener, et al., 2011). The LEEN-model includes an acquisition phase, an initial consulting phase and a network phase.

Phase 0, acquisition phase, is a study phase which takes 3–9 months. The basic requirements are that a network should be able to bring profit, that the companies have annual energy expenditures in the range of €0,2–20 million and that a large saving potential lies in common support processes (Koewener, et al., 2011). The companies should not be situated far from each other to ensure a good meeting frequency (LEEN, 2012). On the initial meetings, the hosts of future networks (municipalities, energy offices and energy service companies) hold activities required for the companies' acquisition. (Koewener, et al., 2011).

Phase 1, initial consulting phase, aims to identify potential savings for each company with the help of an experienced and independent consultant conducting energy audits on the sites of participating companies. Prior to site visits, each company has to report how much energy they use and in which processes (Koewener, et al., 2011). After the energy audits, the consultant

writes a report to each company containing the identified energy saving potential and measures suggested (Koewener, et al., 2011). The consultant also presents the results to the management if necessary. After finishing all the reports, a decision on a common objective in the network regarding energy efficiency and carbon dioxide reduction has to be set (LEEN, 2012).

Phase 2, network phase, comprises regular network meetings where representatives from each company gather 3–4 times per year (Koewener, et al., 2011). To begin sharing experience between the participants as soon as possible, this phase starts in parallel with the consulting phase (LEEN, 2012). Each gathering has a defined theme relevant for each participant (heat distribution, electric motors, ventilation, energy management, etc.) and is hosted by one of the companies. Meetings comprise a site visit and a technical lecture offered by an external expert (Koewener, et al., 2011). Performed actions and other experiences are discussed by the participants contributing to mutual learning.

It is the companies' responsibilities to implement the proposed measures themselves, or to use the help of the consultant. The consulting engineer together with the network's coordinator is responsible for writing an annual monitoring report describing the situation from a top-down (overall performance) and a bottom-up (measures and investments to be made) perspective (Koewener, et al., 2011). After the network running time ends, the companies decide whether they want to continue with the network (LEEN, 2012).

The success of learning energy efficiency networks depends to a high degree on the coordinator's ability to organize the meetings, find well-qualified energy consultants and external experts for giving technical lectures as well as maintaining a great level of engagement in the network throughout the whole period. The coordinator has to be educated to be capable to run the network activities (Koewener, et al., 2011).

THE HACKEFORS MODEL

The Hackefors model is a tool for introduction of joint management systems at SMEs according to international standards such as ISO 14001 and EMAS (Altea, 2013). The model is named after the area of Hackefors, Sweden, where a joint environmental management system (EMS) was introduced at 26 SMEs according to ISO 14001 (Ammenberg, 1999). It is designed to be applied to a network of companies located in the same geographical area (Hallinan, 2003). The model has been used in several industrial areas in the Linköping region and some other regions of Sweden as well (Ammenberg, 1999) and has resulted in the implementation of more than 1,800 standardized management system certificates (Altea, 2013).

The organization is built around a central coordinator (Figure 2) who is either chosen from one of the companies or an external expert (Hallinan, 2003). The coordinator produces documentation, identifies legal requirements, creates involvement within the network, organizes meetings, and plans environmental education (Ammenberg, 1999). Furthermore it is the coordinator's task to lead the steering committee which meets twice a month during the implementation stage and once every three months. The steering committee develops the EMS and is responsible for environmental auditing. The steering committee consists of several environmental coordinators selected from the EMS group. The EMS group includes all environmental coordinators (one from every company). Environmental coordinators are the ones responsible for environment at their companies (Ammenberg, 1999). The central coordinator and the steering committee are supported by the support group.

A common non-quantified target is set up for the whole network as well as each company has an individual target which is not mandatory but serves as a guideline (Ammenberg, 1999).

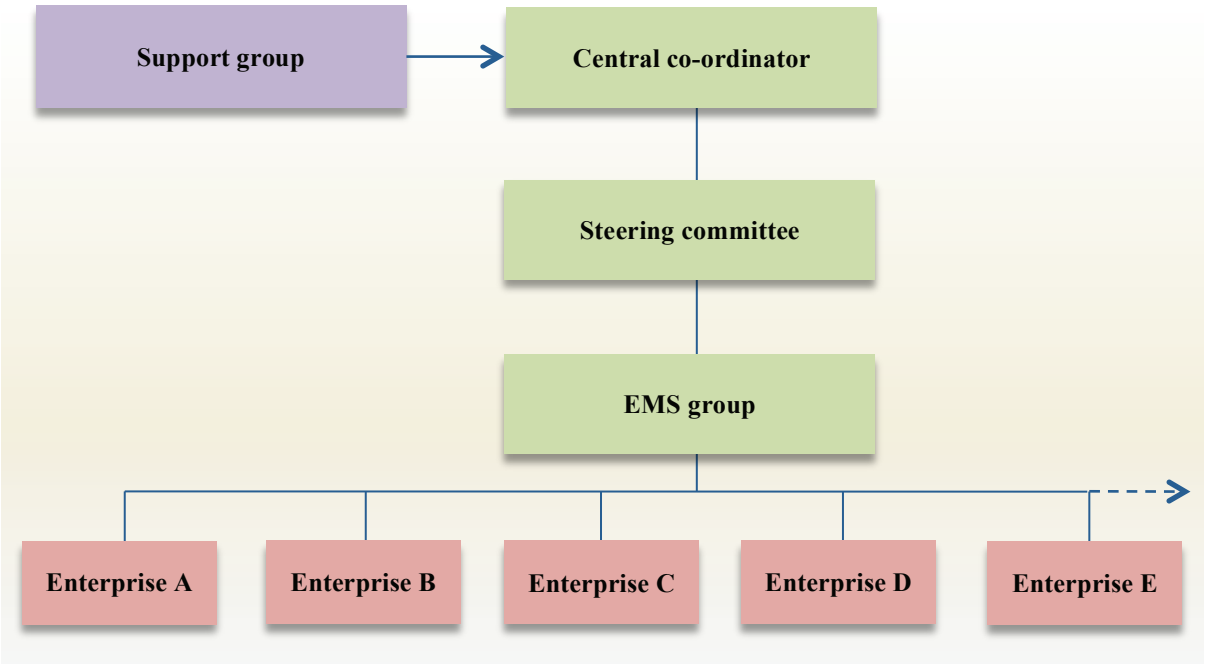

Figure 2. The Hackefors model (European Commission, 2013).

In the Hackefors model, the participating companies finance the work of the coordinator and the support group. However, there were also extra costs for staff training, certification and internal audits which were covered by governmental subsidies by 50 %. The Hackefors model used in some other projects showed to be effective even without subsidies. However, the time for staff training was reduced by half.

The evaluation studies showed that costs for introduction of the joint EMS are half compared to if the system would have been introduced individually at each company (Ammenberg, 1999). The companies that cooperated in the environmental network also began to cooperate in other areas. Further, it was concluded that the coordinator involvement was crucial to the project's outcome. The coordinator can decrease the administrative burden which is common when introducing the EMS at an individual company. The coordinator has to have leader abilities, be good at maintaining communication and motivation within the network and be able to persuade the companies about the importance of environmental issues from an environmental and business perspective. It is believed that the coordinator's central role in the network can be seen as the model's weak point (Ammenberg, 1999).

A major study including several industrial sites that have implemented ISO 14001 by using the Hackefors model has also been conducted (Hallinan, 2003). The results obtained from the evaluation of the joint management systems implementation in the industrial area of Hackefors were similar for other networks. Some interviewees mentioned also some negative aspects with joint EMS approach. They mentioned difficulties when companies within a network have different motivation and that this kind of project takes too much time for small businesses (Hallinan, 2003).

Results

In this section the results of the interviews with the networks' coordinators are presented.

FORMATION OF NETWORKS

Initiation

The idea to build a network for energy efficiency came from an initiator (a regional energy agency or energy service company) in seven of eight cases. Only one coordinator was contacted by companies which wanted to start a network for improved energy efficiency. Their idea was accepted and the other participants were found through the energy service company's internal channels. Other coordinators obtained a required number of companies via such communication channels as business associations, chamber of commerce, and workshops (Åslund, 2013), lists of existing cooperation (Ragnarsson, 2013), municipality's channels (Sundquist, 2013). One Coordinator attended the companies' meetings in order to gain their interest. One more way proved to be not as efficient was to send out the information (Petersson, 2013).

Coordinators believe that it is easier to build a network on already existing connections: branch or local cooperation. It can be easier to introduce energy related questions to the cooperation agenda if the companies are used to communicate on some other issues. Some of the networks investigated here are sector-specific whereas some are built based on their geographical location. The coordinators agree that both options, geographically close located networks and sector-specific networks, have advantages and disadvantages. If companies come from the same sector, they have more in common and can share their experiences; however, the informational exchange can be limited by unwillingness to provide knowledge to the competitors. The companies located in the same area have not so much in common; however, they have more opportunities to meet each other and have informal visits.

Two coordinators said that having international standards such as ISO 14001 at the companies can simplify the work since they get used to work in a structured way and can apply the same routines when working with energy efficiency. Furthermore, the fact that companies have EMS points out their environmental ambitions.

Goals

The reasons behind building the networks were different. The companies which contacted the coordinator themselves wanted to share the knowledge among each other as well as to buy services together in order to minimize costs. A coordinator from a private company working with minimizing companies' energy use mentioned such reasons as increasing knowledge, providing methods and networking in order to initiate a systematic work on improved energy efficiency. The energy agencies often provide more general goals as to facilitate climate and energy strategies on a municipality or county levels (Ragnarsson, 2013), (Åslund, 2013), however, they mentioned information dissemination as well. One coordinator said that they initiated the network because there was financing from the government as well as the county's support (Eriksson, 2013).

Not all the networks had defined goals by the moment of network acquisition. Svensson argues even that the participants did not have a clear idea about the network during the acquisition phase, which was the reason that the companies did not understand what was expected from them, and what they should expect from the network. Often, those coordinators whose networks had goals mentioned the national and the EU climate and energy commitments, the 20-20-20 target (Åslund, 2013), (Sundquist, 2013), (Ragnarsson, 2013), (Svensson, 2013) as a basis.

Representatives

The number of companies within a network varied significantly in the investigated networks (Table 2). Most often the range was 4–10 companies; however, there was a network comprising 268 member companies. Networks were formed of the companies which showed their interest and there were no requirements about the number of participants. One coordinator mentioned that their network is still growing, although the companies are further divided into smaller groups (Ragnarsson, 2013). Two coordinators agreed that it was better to get as many companies as possible (Ragnarsson, 2013), (Eriksson, 2013). However, most of the coordinators think that what is important is to get a good discussion within the group. Too many participants is not good for the network because not everyone can participate in discussions (Petersson, 2013), (Sundquist, 2013). In turn, if there are less than five-six participating companies, the discussion would not be as fruitful.

Table 2. Details of the Swedish energy networks.

Network	№ of companies	Timespan/Meetings	Fee	Contract	Sector-specific
Network A	9	2011–present/4–5 times/year	3,000 SEK	No	No
Network B	30	2011–2013/1–6 months	No, governmental support	No	Yes
Network C	80 (10 smaller groups)	2006–present/3 times a year	1,500 SEK	Informal explanations of goals	Yes
Network D	268	2 years/2 times a year	No, Energy Agency support	No	No
Network E	5–10	8 months/1 time a month	No, Energy Agency support	No	No
Network F	6–10	10 months/1 time a month	Yes/No, depending on the local financing	Contract for attendance of the meetings	No
Network G	4–8	1–several years/1 time a month–1 time a year	Yes, insignificant fee	Contract or agreement	Yes/No depending on a project
Network H	4–7	6 months/1 time a month	Yes, costs for consultant	Only verbal agreement	No

Some companies can also leave the network under the time it runs or skip the meetings because of other priorities (Svensson, 2013). That is why the optimal number is around ten companies (Sundquist, 2013).

The study showed that the companies' representatives had different occupational positions within their companies but most often it was the same person throughout the network lifespan. Several coordinators mentioned that it is important that companies are presented by someone who can deliver the message to the rest of the personnel. If someone from the company's management could participate at the meetings it would raise the interest within the company as well as inside the network (Petersson, 2013). Also, it can be hard to achieve a positive result if the one participating in the network is more motivated than the company's management (Svensson, 2013).

Lifespan

The lifespans of the investigated networks vary as well. Three networks were operating for 6–10 months, the rest for one to several years. One coordinator stated that half a year is a sufficient time for a network to obtain good results, and the network can be extended if there is a need for this (Petersson, 2013). Several coordinators said that the lifetime often depends on a specific project (Åslund, Ragnarsson, 2013). One network had been running for three years and the finishing time was not set (Cronvall, 2013). The idea was to have the network as long as the companies were interested and as long as there were positive outcomes from the network.

Costs and contracts

Several networks were financed by the government and several covered the costs required for the organizational needs by themselves. According to one coordinator, if the companies pay the fee, it would be a good motivation for them to take actions (Åslund, 2013). Another coordinator whose network was financed by the Swedish Energy Agency pointed out anyway that the fee could force the companies to implement the energy efficiency measures (Svensson, 2013). There is also a network which when it became mature enough, created its own union with a membership fee which can fund the network now (Ragnarsson, 2013). One coordinator who has been working with different networks (subsidized and not), stated that the fee does not affect the motivation among the companies (Sundquist, 2013).

The majority did not use any contract for the network initiation which was not good according to several coordinators. One coordinator said that the contract is an important means to make the participants appear at the meetings and secure their commitment. There was a contract in one network, however, it was not a legal binding but served as a help, and the participating companies could develop it and introduce necessary changes (Ragnarsson, 2013).

ORGANIZATION

Structural organization

The investigated networks did not have such a structured organization with clear division on phases as, for example, in the LEEN-model. For instance, in one network there was not even a requirement to conduct an energy audit. Some companies did it, some had done it before the network initiation, and some did not conduct it at all. There was also no common approach on how the companies commit to work within the network. The companies chose themselves which measures they implemented, and how to control energy flows on their sites depending on what they had time for (Cronvall, 2013).

One coordinator said that energy audits were not always done due to differences between the companies; however, a simplified paper template was used to register energy use within the companies. If some companies chose to make energy audits, they were performed by an external consultant provided by the Swedish Energy Agency or found by companies themselves. However, it was hard to judge the consultants' jobs quality. The only similarity of this network with the LEEN-concept was that the members met regularly and had a specific technical topic for every meeting (Åslund, 2013).

One coordinator, the owner of the energy service company, said that his first network's idea was to conduct energy audits; however, there was not enough pressure from the initiator's side and audits were not performed. There were meetings hosted by one of the companies, the respective hosting companies' facilities visit and theoretical sessions. In their second network they implemented the lessons learned from the first network and performed energy audits with the help of an external consultant. The coordinator mentioned that different measurements of energy use were a necessary part of energy audits in order to assure transparency.

In four other networks energy audits were a common routine. In one network, they also decided to go further than just energy audits and helped the companies with the implementation of the proposed measures (Ragnarsson, 2013). In this network, the similarities with the LEEN-model were apparent with regular meetings and working on improving energy efficiency together. One positive outcome with the network was the creation of the database with the results of energy audits. The database could be used by the companies not able or not willing to make audits by their own.

One coordinator said that first they had an initial lecture held by an external expert on how to work with improved energy efficiency and how to perform an energy audit. He mentioned procedures such as check-lists for energy audit provided by their regional energy agency. He also stated that after the energy audit the companies contacted the county board of administration about possibilities to get grants for measures implementation which sometimes was up to 85 % of costs (Svensson, 2013).

A coordinator of one energy service company dealing with several projects said that they never called projects networking. All of them had rather defined structures. First, they educated the companies to see where their internal energy use is found and then worked with them for ten months. Once a month they arranged a half-day meeting when they could see each other's performances. On the meetings they had a technical lecture, presented energy indicators, and discussed energy plans. Every company made a plan of what they would do for the next time which was discussed at the next meeting and checked by measurements. They looked for mistakes and discussed together how to deal with them and then applied the lessons learned in reality. Not all the companies worked with the same motivation and prepared for the meetings; however, after several meetings everyone started doing something (Sundquist, 2013).

Coordinator's role

Several interviewees mentioned the importance of someone who coordinates work within a network. One reason is that it would be hard to make the companies meet without the external help (Svensson, 2013). One coordinator said that they tried to run a network without a coordinator initially, supposing that the companies would be able to manage the meetings themselves but it did not work out well (Cronvall, 2013). Another coordinator expressed the doubts whether the companies would have worked on improved energy efficiency without a network. He even mentioned that the companies did not know that they had such a potential for improved energy efficiency (Eriksson, 2013).

The companies within one network were striving to meet again after the project ended; however, already after the third meeting the attendance was only 5 % (Sundquist, 2013). The coordinator of this network stated that there should be some sort of engine to hold the companies together. One more coordinator mentioned that the companies wanted to continue to run the network but there is a need for a coordinator to make it work (Petersson, 2013).

Consultant's role

Many interviewees said that there is a big difference in the quality of energy consultants' work among them, and it is very important that the network has an experienced consultant. According to one coordinator, the network's success depends on the skills of the energy consultant (Petersson, 2013). There can also be a risk that the companies rely on everything that the consultants say (Ragnarsson, 2013). That is why after implementing the measures, the companies might think that they made everything that was possible and therefore some opportunities could be missed. The Swedish consultancy sector still needs to mature when it comes to improved energy efficiency, and there is a lack of standards in this area (Ragnarsson, 2013). That is why the help from the colleagues who worked with skilled consultants can be appreciated. It can be useful as well to make a list of good-quality consultants. A skilled consultant should be able to also communicate the results and make good relations with the companies as well as to motivate them. The consultant's insufficient communication skills can also affect the success of the network (Svensson, 2013), as has also been found in the research related to the outcome from industrial energy audits (Thollander and Palm, 2012).

Follow-up

Several networks continued functioning after the project ended. One coordinator whose network is still running mentioned that the more the companies met, the more interested they became (Cronvall, 2013). However, none of the networks have a sufficient established follow-up routine. According to one coordinator, there were requirements for follow-up of the

results. However, it was hard to monitor the routine (Åslund, 2013). One reason that it was difficult to follow up the results can be that a too general and hard-to-measure goal, such as 20 % reduction of energy use was set (Sundquist, 2013). Another coordinator said that 20 %-goal was too ambitious for their network and that is why it could not be fulfilled (Ragnarsson, 2013). There was a suggestion to define a goal in kWh in order to make it easier to measure the improvement in energy efficiency (Svensson, 2013). Several companies also mentioned that it was hard to measure energy efficiency due to annual variations in production and product profile and changes in the market (Sundquist, 2013), (Petersson, 2013). One network was not prepared for follow-ups at all (Petersson, 2013).

Concluding discussions

It is quite clear from the study that there is an interest in creating energy efficiency networks from the companies side as well as from the counties' and energy service companies' side. This is confirmed not only by the fact that the companies ask for help in creating networks but also that they are willing to continue to gather after the networks ended. The fact that the majority of the networks that have goals have the 20-20-20 climate and energy target as their goal can be explained that the municipalities see the network activities as a potential contribution to the EU climate strategy. It is mentioned by several Coordinators that performing energy audits is not enough to improve industrial energy efficiency at SMEs. The implementation of measures proposed in the audits should be further supported; otherwise they could be neglected by the companies.

The main finding is that a network does not perform well without a driving force which was confirmed by almost all coordinators. The reason for this can be that industrial SMEs, as stated by, for example, Shipley and Elliot (2001) do not always have time and personnel to work with energy issues and someone should coordinate this work on a network level. Another reason is that despite the fact that energy efficiency issues are familiar to everyone, not all the companies are aware about their own energy efficiency potentials. The coordinators did not mention the importance of a coordinator as such but some sort of engine that drives the work within a network, organizes the meetings, invites external experts and creates engagement seems to be needed. This result is backed up by previous studies of factors promoting improved energy efficiency where a person with real ambitions has been one of the highest ranked driving forces in industrial SMEs (Thollander & Palm, 2012). The person with real ambitions does not necessarily need to organize the technical lectures him- or herself but has to be aware of what is interesting for the network members and based on that find an interesting lecturer. One suggestion is that a network can be steered by a group of dedicated persons (a steering group as in the Hackefors model). The coordinator can also be supported by someone motivated from the companies if this person has enough time to devote to the network activities.

The presence of someone from the companies' management team at least once a year (as it is in the LEEN-concept) can assure the interest within the member companies as well as within the network itself. This can also assure the commitment to implement the proposed energy efficiency measures.

It can be stated that it is easier to build a network on an existing management system due to less administrative burden for a network and higher ability to work in a standardized why. This was approved by the LEEN-concept as well as the Hackefors model. However, the availability of management systems should not be a requirement for starting a network. Moreover, a coordinator could be the one who takes upon the necessary administrative responsibilities and thus, unburdens SMEs which often disregard undertaking energy efficiency and related to them activities due to lack of time.

The origin of a coordinator and a network's initiator did not seem to affect the network's success and it is not clear from the study that the regional energy agencies cope with the networks' activities better than the private companies. On the contrary, there is an example that a private company never dealing with energy related projects managed to create engagement within the network and making the members willing to continue working within the network still.

There is also no evidence that the regional energy agencies work in a more structured way than private companies. The lack of structural work, in contrast as it is presented in the LEEN-concept, for example, can be noticed in all networks and the need for some kind of standard or an agreement on how to work within the networks is obvious. As a part of that, the quality of the energy consultants' work should also be approved on a network level and the list of good energy consultants should be available for the network members. This would assure a good quality of the proposed energy efficiency measures and thus, the work of the network as a whole.

Once established, the network should have well-defined goals, i.e. kWh/product. It should be clear for the companies why they are taking part in the network activities which seems to not always be the case. There should be a common goal for the whole network as well as for each company to decide on an individual goal as expressed in the LEEN-model. The 20-20-20 energy and climate target seems to be rather general and unclear for the participants and that is why the goal should be expressed in a specific energy use reduction or a number of energy efficiency measures. Also, it was a common opinion that due to differences in production it was hard to compare annual energy use. This problem can be eliminated by use of different indicators as well as specific energy use (per production unit for example) which can be agreed for the whole network as well. This would also enable the follow up of the network performance in order to evaluate it and estimate the energy savings. The follow up routines should be determined on a network level. Now, it seems rather difficult to follow up routines due to that it requires a lot of time. Also, it seems that the companies did not see direct benefits with follow-up activities.

There were different opinions about how the networks should be financed. Several coordinators agree that some sort of fee is needed in order to assure the members engagement as well as their commitment to participate in the meetings and perform the energy efficiency measures. However, on this early stage of energy efficiency network development in Sweden, it seems quite important to have a governmental supporting scheme as it can be quite difficult to make companies pay for the network

functioning if there is not enough interest in network activities. Later, when the networks become more mature they can probably be funded by themselves but now the engagement should be supported.

This paper has presented a study of Swedish energy networks among industrial SMEs. It can be concluded that in relation to the more mature networks in Switzerland and Germany (Koewener et al., 2011), the Swedish networks need to be developed in several regards. First, a model for the networks should be developed, including a structured way on how to move through the various phases in a network process. Also, goal settings are vague, and could be considerably improved, preferably formulated in efficiency goals, i.e. kWh/product or something alike, rather than saved kWh. The need for improvement also holds for follow-up which today is more or less missing in the networks studied. Due to the lack of follow-up routines, there were no actual results presented for the Swedish networks which makes it rather difficult to compare with the Swiss and German examples. Despite large areas of improvements in terms of structure, goal-setting, follow-up etc., the Swedish networks do fill a gap in industrial SME's need. The networks are appreciated by the participating companies, and they do deliver energy efficiency improvements beyond what a stand-alone energy audit would achieve.

We suggest further research to be conducted in the area of energy network model-creation including formulation of phases, and activities in each phase. Moreover, further research should focus on developing methods on how to follow-up results. An international study reviewing various country's networks is also suggested.

Nomenclature

EMAS	Eco Management and Audit Scheme
EMS	Environmental Management Systems
ISO	International Organization for Standardization
LEEN	Learning Energy Efficiency Network
SME	Small and Medium-sized Enterprise

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