Voluntary participation of companies in monitoring of energy efficiency networks: Practice in Germany from the past 5 years

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Abstract

Monitoring and evaluating of energy efficiency policies is crucial to understand their impacts. These impacts can be the direct impacts, in particular on energy use but can also cover wider impacts such as changes in corporate culture and decision making. Over the last years, energy efficiency networks have become a successful instrument to integrate energy efficiency into corporate culture and to foster the uptake of energy efficiency measures in companies. An energy efficiency network is a systematic, targeted and unbureaucratic exchange of experience and ideas between usually 8 to 15, but at least five, companies over usually two to three years in order to jointly increase energy efficiency and implement appropriate measures. Building on the leading example of Switzerland where energy efficiency networks were successfully established as part of a voluntary agreement with industry, Germany has become the largest operator of energy efficiency networks worldwide. The German approach is built on a voluntary agreement between the major industrial organisations and the federal government. The monitoring is carried out by an independent institute. As the scheme is completely voluntary (compared to other "voluntary" schemes, which offer counter-values for the participation), monitoring has its specific challenges. For the participating companies, the added value of participation in the monitoring process is often unclear. The motivation to provide detailed data can be rather low. In particular, when it comes to a detailed verification of the implemented measures, significant efforts have to be made to stimulate an active contribution. The Corona crisis with its multiple impact on business has not made the process easier. This paper therefore aims to provide insights into the practical experience with monitoring in the last 5 years in Germany: On the on hand, challenges of the monitoring process are analysed with regard to the specific conditions of a purely voluntary scheme. On the other hand, the impact of the Corona crisis on the operation of the energy efficiency networks are shown on the basis of a survey conducted among participating companies. Furthermore, results of the monitoring process are presented and analysed with regard to the previously mentioned boundary conditions.

What is an energy efficiency network?

An energy efficiency network (EEN) can be described as a structured, moderated and temporally limited (for example, 2–4 years for the German networks) exchange of knowledge and experience between companies, with the aim of facilitating the implementation of energy efficiency measures (Figure 1). The first step typically is to identify the energy saving potentials in the companies, which comprise the energy efficiency network. Individual energy efficiency measures are used to set an individual, nonbinding saving target. Next, internal and external energy professionals meet at regular intervals to discuss energy efficiency and possible measures and, if necessary, involve external experts with specific areas of expertise. This gives the participating companies access to knowledge, good practices and first-hand experience and helps them justify the necessary investments within the company. Different types of EENs have established themselves, for example, regional, sector-internal and for large companies with many sites, company-internal

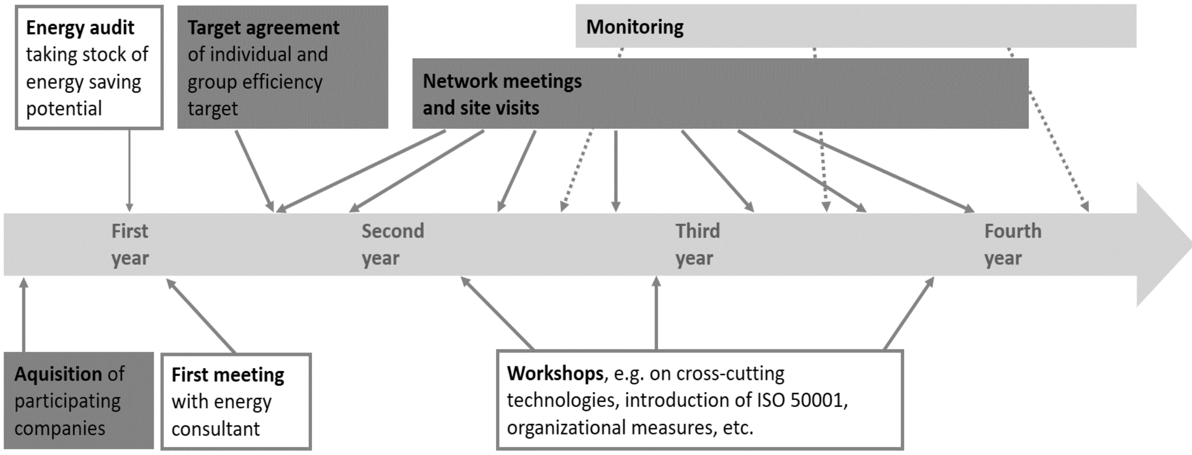

Figure 1. Typical implementation steps of an EEN (including the monitoring in the last year of operation). (Source: Durand and Damian 2019, based on IPEEC 2017).

EENs. The evaluation of previous pilot projects indicates that networks can significantly accelerate the implementation of effective energy efficiency measures in the participating companies.

Monitoring process of the IEEN

Within the framework of the Integrated Energy and Climate Programme (IEKP) and the Energy Concept adopted in 2010, the German government has set itself ambitious long-term energy and climate policy goals. By 2050, for example, greenhouse gas emissions are to be reduced by 80 to 95 % compared with 1990. Energy productivity is to be increased by an average of at least 2.1 % per year. In addition to further expansion of renewable energies, increasing energy efficiency will play a central role in achieving these long-term goals. With the adoption of the National Energy Efficiency Action Plan (NAPE) in 2014, the German government has put together a comprehensive package of measures and declared energy efficiency to be the second main pillar of the energy system transformation.

With a target contribution of 75 PJ primary energy consumption and emission reductions of 5 Mt CO_2-eqv. per year by 2020, the Initiative Energy Efficiency Networks (IEEN) is one of the key measures of the NAPE. Designed as a voluntary instrument that relies on participating companies implementing economically viable energy efficiency measures, the German Federal Government and the 22 leading trade and industry associations agreed on the goal of establishing a total of 500 EEN by 2020. The joint agreement between the Federal Government and the associations stipulates that the EENs operated within the framework of the IEEN will undergo an independent monitoring, including random checks to verify whether the reported energy efficiency measures have indeed been implemented by the companies. Each EEN is monitored only once.

IEEN expired on 31 December 2020 and would move into the second phase with an expanded content spectrum, the Initiative Energy Efficiency and Climate Change Networks (IEEKN). All networks registered as of 1 January 2021 belong to the second phase, IEEKN. Accordingly, the last IEEN networks are expected to run in parallel with the first IEEKN networks by the end of 2024. This report refers exclusively to the networks and achieved savings from the first phase of the IEEN. The final number of networks registered under IEEN is 290. Thus, the overall target of 500 networks has not been achieved.

While in general, different formats of EENs (for example, regional, sector-internal, company-internal) exist with regard to the number of participating companies, duration, the target set (energy savings and/or CO_2 reduction) etc. (Durand and Damian 2019), there is a set of minimal requirements that an EEN has to fulfil in order to be able to register with the IEEN (BMWi 2014):

1. It was founded after December 3rd, 2014;
2. It has a duration between 24 and 36 months (deviations upwards are possible);
3. It consists of at least 5 companies located in Germany;
4. It is supported by qualified moderators and internal or external energy consultants;
5. It has defined a common energy saving target within the first 12 months of operation, and
6. Takes part in the monitoring process.

The stakeholders involved in the monitoring – the Federal Ministry of Economic Affairs and Climate (BMWK) as the contracting authority, the independent monitoring institute consisting of adelphi and Fraunhofer ISI as the contractor, and the IEEN Steering Committee – agreed that the monitoring should be conducted at an advanced stage of the respective network in order to be able to better assess the results, including the energy efficiency measures implemented. Accordingly, it was decided that every network is to be monitored in the last year of its duration. By the end of 2021, five monitoring rounds have been conducted (one round per year, i.e. round five included all networks that ended in 2021). In order to accommodate the challenges posed by the complex real-life environment in which the EENs operate, they can ask for the monitoring to be moved into the next round if necessary.

The monitoring is intended to verify if the respective EEN fulfils the minimal requirements of the IEEN and can therefore be recognised as having participated in the initiative and contributed to fulfilling its energy saving and emission reduction targets. It also determines the effectiveness by documenting and assessing the plausibility of the reported energy savings and greenhouse gas emissions reductions. It further gathers additional data on the participating companies and energy efficiency measures implemented to enable the insights into the operation of EENs. Finally, it enables Germany to fulfil its reporting obligations within framework of national and international commitments to climate protection.

Challenges and success factors in the monitoring process

As the initiative is completely voluntary (compared to other "voluntary" schemes, which offer counter-values for the participation), monitoring has its specific challenges. There is hardly any leverage with which the monitoring institute can motivate companies to participate in the monitoring process. Apart from the prestige (and an official certificate of participation), there are few direct advantages of being recognised as a participant in the initiative. While monitoring measures the overall effect of the initiative, the added value of participating in the monitoring process is often unclear for the individual companies. Experience from the past five monitoring rounds has shown how an active contribution to the monitoring can be ensured by motivating companies to provide detailed data on the measures they have implemented. From the perspective of a potential monitoring institute, three success factors for the design and successful implementation of a voluntary monitoring process can be identified based on the experience of the last 5 years/rounds of IEEN monitoring. The experiences presented here are based on the day-to-day working experience with the monitored networks. In a further step, a detailed survey could be helpful.

1) Early announcement of the monitoring and on-going support

The main focus of the initial phase of every monitoring round is the exchange with the networks. Early announcing and explaining the details of the monitoring process by the monitoring institute and sending the necessary monitoring forms to the networks at an early point have proven to be effective in order to sensitise them to the process and the associated effort of providing data. Potential questions could thus be clarified at an early stage. At an advanced stage, ongoing contact with the networks also proved important. This includes personally contacting the networks due for monitoring to clarify questions about the monitoring process and/or forms, as well as providing support material such as FAQs, webinars, etc. In this way, the monitoring institute succeeded in communicating the importance of monitoring for achieving the savings targets set in NAPE. In order to take into account the voluntary nature of the programme, deadlines are handled flexible. If necessary, the accompanying trade and industry associations involved in the IEEN are consulted to support communication with the networks.

In addition to experienced energy consultants, the networks also bring together SMEs that are dealing with energy efficiency issues for the first time. This "learning from each other" in turn reflects exactly the network idea. Due to the heterogeneity of the networks, however, the increased need for personal counselling and exchange with networks in the case of individual queries on creditable measures, delays, etc. also poses a challenge and should not be underestimated in terms of the capacities required on the part of the monitoring institute.

2) Simplified data acquisition & visualisation

The monitoring process has been designed in such a way that the companies need as few resources as possible. A standardised data collection procedure was developed that enables companies to automatically calculate primary energy and CO_2 savings. Particular attention was also paid to ensuring anonymous data collection. In this way, data protection concerns could also be eliminated. Within the monitoring forms, the results of each network are summarised graphically for internal and external presentation, which is highly appreciated by the networks. In addition, the networks are also offered to use their own data collection documents, which are then transferred by the monitoring institute.

Overall, data collection in a voluntary programme tends to be more complex, since, for example, in comparison to funding programmes, no structured data is collected by a central funding body. Simplified and "decentral" data collection, as in IEEN monitoring, also has its limitations: The quality of the data can only be guaranteed to a limited extent. For example, the baseline calculations made can often only be checked superficially by the monitoring institute and are therefore more the responsibility of the networks themselves.

3) Continuous exchange between stakeholders and involvement in accompanying activities

The close cooperation with all stakeholders involved during the monitoring rounds has turned out to be another success factor. Even before being contacted by the monitoring institute, the respective accompanying trade and industry association has established a first contact with the network. In addition to a steady exchange between the monitoring institute, the associations and the political stakeholders with the networks/companies, the networks are also actively involved in accompanying activities (beyond the initiative's annual event): This includes working groups, workshops and the further development of the monitoring documents. Additional webinars on the regulations of the monitoring, which were well received by the participants, contributed to familiarity with the process. Although close cooperation with all actors strengthens networking and thus also the commitment to a successful monitoring, the effort involved must also be emphasised here.

On the side of the participating companies, based on additional observations and individual feedback from the networks, certain behaviour-related factors can be identified that contribute to successful monitoring (some of which are closely related):

- Commitment and conviction with regard to the topic of energy efficiency both on the side of the participating companies and on the side of the moderator has a strong positive effect in various aspects of the networks, including with regard to the monitoring, where such networks typically provided data of higher quality (in terms of completeness and accuracy);
- Provision of the necessary time and material resources by the companies and moderators;

- Actively engaging with the topic of energy efficiency even before the network was officially established, which contributes to building up the necessary expertise;
- Familiarity with and understanding of basic principles of the concept of energy efficiency networks, such as the involvement of external experts, the importance of regular meetings, thoughtful planning, etc.;
- Intensive exchange between the different networks. For example, some networks jointly implemented the monitoring in the first round.

On the other side, factors were identified which typically pose challenges to the networks and can contribute to delays in gathering data or even failure to successfully complete the network and/or monitoring process:

- The typical operational problems associated with the business environment, for example, lack of necessary resources or expertise, longer absence or change of key staff, insufficient documentation etc.;
- On a few occasions, it has also been pointed out to the monitoring institute that participation in the initiative is voluntary and that value creating activities always take priority in the company;
- The high effort required to complete the monitoring documents mainly affects networks that are strongly characterised by small and medium-sized enterprises with a lack of the necessary capacities.

The particular challenges posed by the Corona crisis are addressed in the following section.

Monitoring results of the IEEN

RESULTS AT THE LEVEL OF NETWORKS

A total of 224 networks were identified for the first five monitoring rounds on the basis of the outstanding term. 182 data sets have been available to the Monitoring Institute for the current evaluation. By the deadline of the 5th round (31 November 2021), monitoring could be completed for all 33 networks from the first round and all 39 from the second round. However, two networks from the 3rd round, 10 networks from the 4th round and 13 from the 5th round will be postponed to the 6th round. The reasons for the postponement are in most cases an extension of the network duration or the fact that some networks from the current round will not be completed until the end of 2021. For a total of eight networks, a failure of the network and the discontinuation of the associated activities was noted. For a further nine networks, it was not possible to collect the data required for monitoring for various reasons. They could only confirm that the respective network was operated according to the specifications of the initiative. One such network still counts as a participant in the initiative, but does not contribute to the primary energy and CO_2 savings target set by the initiative.

The 182 networks evaluated in the five rounds of monitoring on average saved 29.4 GWh of final energy, 37.3 GWh of primary energy (taking into account only the non-renewable part) and 10.7 kt of CO_2 annually (Table 1). Companies base

Table 1. Reported savings per network.

Savings [MWh/a or t CO_2/a]	Total – all networks	Mean value per network	Standard deviation
n = 182			
Final energy saving	5.360.783	29.466	71.119
Primary energy saving	6.717.722	37.321	84.037
GHG savings	1.934.144	10.745	23.824

(Source: Barckhausen 2021).

their reported energy savings on the calculations performed during the savings potential analysis,[1] , which also serve as the basis for decision on which energy saving measures will be implemented.

The savings are unevenly distributed among the networks: the difference between the 10th and the 90th percentile corresponds to a factor of more than 500. The median and mean values for final energy, primary energy and CO_2 savings differ by a factor of about 6. The ratio of final and primary energy savings derived from the individual measures stands at 1.26. This means that for every kilowatt-hour of final energy, 1.26 kilowatt-hours of primary energy are saved. This value is plausible and corresponds to the value expected in the various projections and ex-ante estimates. Over the last monitoring rounds, this value has stabilized.

The distribution diagram (Figure 2) shows a wide range of savings achieved at the network level. The distribution is clearly right-skewed – a relatively small number of networks achieve comparatively very high savings.

On average, the 182 networks evaluated in the five rounds of monitoring achieved 86 % of the targets reported to the monitoring institute (Table 2). The reported network targets of the 182 monitored networks averaged 31.5 GWh of final energy saved per year.

The 86 % relative target achievement already takes into account the correction factor, which describes the development of the average network target during the network operation. This development can be observed by comparing the target submitted to the IEEN administrative authority (operated by dena, the German Energy Agency) within the first 12 months of the network operation and the value reported during the monitoring to the monitoring institute. Individual networks did so in order to respond to the changed circumstances, for example, if the duration of the network had been extended or if one of the participating companies decided to leave the net-

1. One of the requirements that an EEN has to fulfil in order to be able to register with the IEEN is the savings potential analysis, which non-SMEs can carry out in the context of their regular obligatory audits. Alternatively, the savings potential analysis can be carried out with support of internal or external energy consultants.

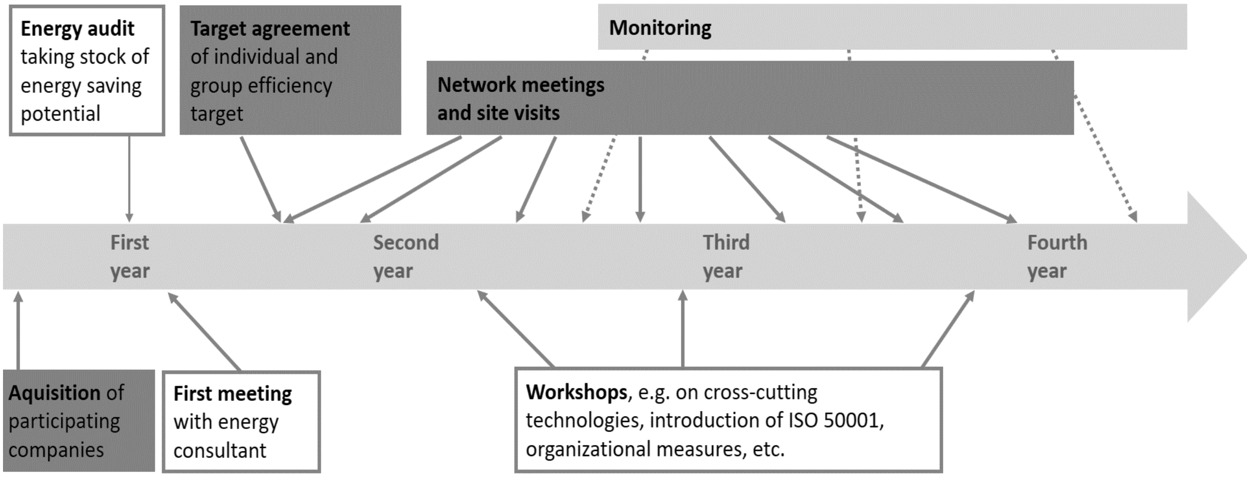

Figure 2. Distribution of savings at the network level. n=182. Illustrated range: 0–100 GWh or kt CO_2/a. Seven (final energy savings), five (primary energy savings) and one (CO_2 savings) upwardly deviating observations fall outside the diagram area. (Source: Barckhausen 2021).

Table 2. Relative target achievement.

[MWh/a]	Total – all networks	Mean value per network	Standard deviation	Fractile values				
n = 182				10%	25%	50%	75%	90%
Network Target	5.724.275	31.452	71.939	278	1.297	5.278	24.393	98.736
Relative target achievement	94%	94%	1.329%	16%	49%	100%	154%	304%
Deviation between objectives and initial report			92%					
Adjusted achievement of target			86%					

(Source: Barckhausen 2021).

work. Altogether, four networks have updated their targets to a degree deemed substantial.

Looking at the distribution of the relative achievement of targets across the networks in Figure 3, it is apparent that there are some outliers both upwards and downwards, but the results here are less heterogeneous than for other parameters. The difference in target achievement between the 10^{th} and 90^{th} percentile of networks corresponds to a factor of about 10. Half of the networks achieve at least 99 % of their savings target. A quarter of the networks surpass their target by 54 %. The distribution of goal achievement is relatively symmetrical at the level of the networks compared with other results; a slight right skew is noticeable.

RESULTS AT THE LEVEL OF COMPANIES

1881 companies participated in the 182 networks evaluated in the five rounds of monitoring. Due to the preference for a high degree of anonymity on the side of some of the participants, the networks were given the option of not indicating any link between companies and the individual energy efficiency measures they implemented. This was made use of by 50 networks with 457 companies. Of the 1424 companies to which individual measures could be assigned, 1041 companies (73 %) reported at least one measure; 27 % did not report implementing any measures. On average, 3.8 measures were implemented per company.

The companies saved an average of 3.601 MWh of final energy, 4.442 MWh of primary energy (non-renewable) and 1.253 t of CO_2 per year. This analysis refers to all monitored companies and includes those for which it was not possible to allocate individual measures to companies and for which no individual savings could therefore be determined. Looking at the companies which could be linked to the individual measures they implemented (bottom-up, Table 3), the distribution of savings at company level can be evaluated Table 3. This shows that the range of savings achieved at the company level in the context of network work is significantly larger than at the network level. The difference in savings per company between the 10^{th} and 90^{th} percentile of companies corresponds to a factor of about 800. The mean value is about 10 times higher than the median. The distribution is clearly right-skewed – a few companies

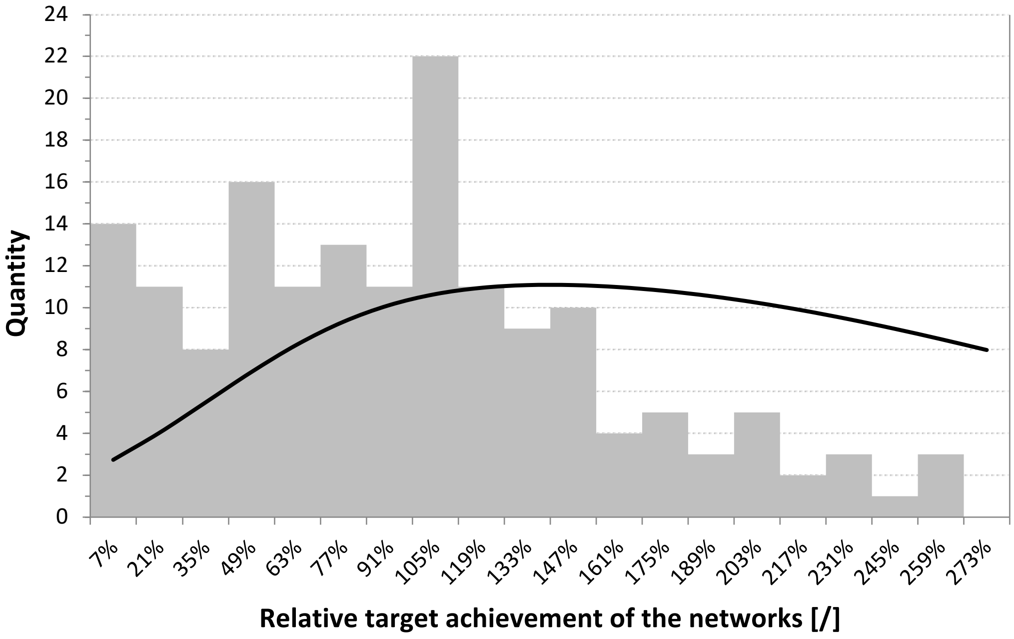

Figure 3. Distribution of relative target achievement at the level of networks. n=182 Illustrated range: 0–280 %. 17 observations deviating strongly upwards fall outside the diagram area. Two of them were not taken into account when drawing the distribution curve as the distortion would have been too strong. (Source: Barckhausen 2021).

Table 3. Savings per company.

Savings [MWh/a or t CO_2/a]	Total – all companies	Mean value per company	Standard deviation	Fractile values				
n = 549, n(n.a.) = 399				10%	25%	50%	75%	90%
Final energy saving	3.719.720	3.601	16.449	8	53	254	1.227	5.738
Primary energy saving	4.588.781	4.442	18.917	13	82	397	1.789	7.492
GHG savings	1.294.191	1.253	5.228	4	26	129	547	2.140

(Source: Barckhausen 2021).

achieve comparably large savings. The wide range of savings achieved reflects the diversity of the participating companies.

In contrast to the distribution in Germany's industry, where SMEs make up the largest share of enterprises in terms of numbers and the share of large enterprises is in the low single-digit percentage range, large enterprises account for 53 % of the companies in the 182 networks evaluated in the five rounds of monitoring (

Figure 5). The share of medium-sized enterprises is comparatively low at 29 %. Small enterprises account for only 18 %. The distribution by company size class has remained stable over time.

The participating companies rate the value of participating in the initiative as very positive (Figure 6). A total of 82 % of the companies rated the cost-benefit ratio as "rather high" or "very high" (a high ratio means a high benefit compared to the costs and/or effort). 11 % of the companies assessed the cost-benefit ratio as "rather low" and 1 % as very low. Reasons given for this were, for example, the uneconomical nature of the identified measures and therefore lack of implementation, lack of time resources, insufficient provision of experts solely through participation in the initiative, or lack of new ideas for savings measures.

RESULTS AT THE LEVEL OF ENERGY EFFICIENCY MEASURES

In total, 7,910 energy saving measures were reported within the scope of the monitoring. Of these, 7,223 were measures for which the energy savings were possible to quantify (Table 4). Most of the remaining measures are organisational measures, such as switching off appliances at night or lowering the heating temperature in offices. The measures with quantifiable savings are analysed in the following section.

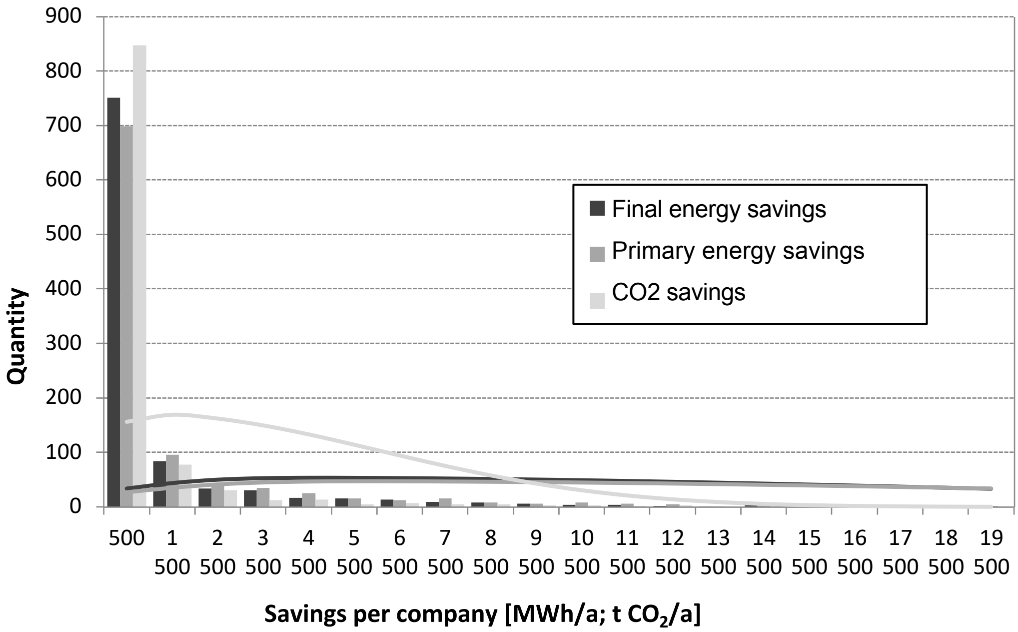

Figure 4. Distribution of savings on the level of companies. n=549, n(n.a.)=399. Illustrated range: 0–20,000 MWh/a or t CO_2/a. 17 (final energy savings), 20 (primary energy savings) or 8 (CO_2 savings) upwardly deviating observations fall outside the diagram area. (Source: Barckhausen 2021).

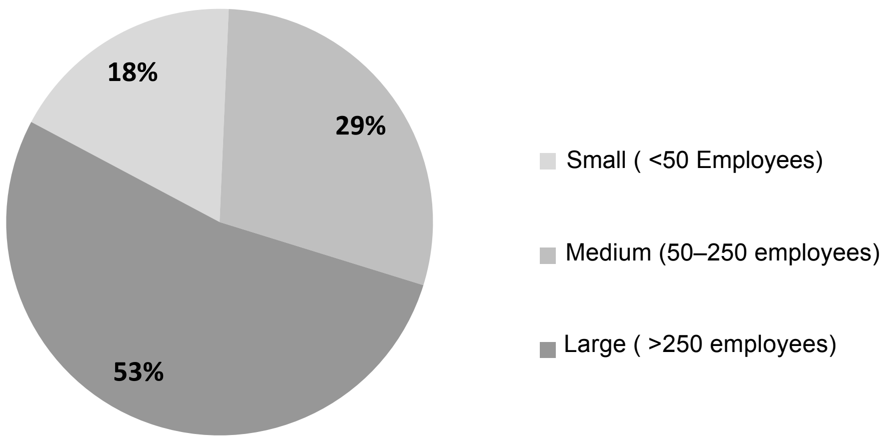

Figure 5. Companies by size. n=628, n(n.a.)=320. (Source: Barckhausen 2021).

Looking at the number of measures implemented per network, the average number of measures implemented per network was 39,7 (Table 4), which is a slight increase compared to the second round of monitoring. The median is slightly lower with 31 measures per network, that is, 50 % of the networks have implemented less than 31 measures and 50 % of the networks have implemented 31 or more measures. This indicates a slight right skew, that is, the deviation upwards tends to be slightly larger than deviation downwards. The highest number of measures implemented per network is 214; on the other hand, one network has not reported any implemented measures. The network at the 90th percentile has implemented about 15 times as many measures as the network at the 10th percentile; on the other hand, the range for the middle 50 % of the networks is rather slim, with 18 and 53 measures per network.

As depicted in Table 5, on average, each measure has resulted in 755 MWh of final energy, 971 MWh of (nonrenewable) primary energy and 279 t of CO_2 annual savings. The measures are very heterogeneous with regard to the technologies used, types of measures (new procurement, replacement, expansion, optimisation) and operational conditions. As expected, this results in a wide range of savings. The median is above 15 times higher than the average value; the difference between the 10th and the 90th percentile corresponds to a factor of about 500. Furthermore, the distribution is – just as this is the case at the level of networks and companies – right skewed. A small number of measures achieves relatively high savings (Table 5).

Even among the measures using the same technology, the picture is still heterogeneous (Table 6). The individual measures with the largest final energy savings can be found in the area of combined heat and power. The median of final energy

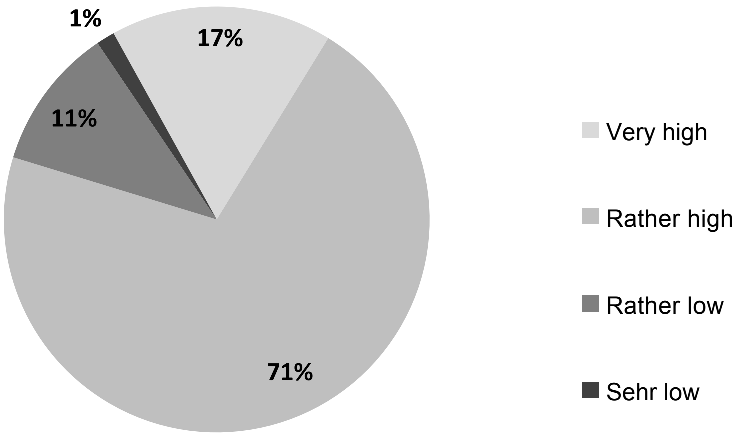

Figure 6. Evaluation of the cost-benefit ratio of participation in the initiative (n=1,382, n(n.a.)=499) (Source: Barckhausen 2021).

Table 3. Savings per company.

Savings [MWh/a or t CO_2/a]	Total – all companies	Mean value per company	Standard deviation	Fractile values				
n = 549, n(n.a.) = 399				10%	25%	50%	75%	90%
Final energy saving	3.719.720	3.601	16.449	8	53	254	1.227	5.738
Primary energy saving	4.588.781	4.442	18.917	13	82	397	1.789	7.492
GHG savings	1.294.191	1.253	5.228	4	26	129	547	2.140

(Source: Barckhausen 2021).

Table 4. Number of measures per network.

Number of measures	Total – all networks	Mean value per network	Standard deviation	Fractile values				
n = 182				10%	25%	50%	75%	90%
Quantity	7.223	39,7	36,2	6	15	31	50	88

(Source: Barckhausen 2021).

savings for CHP measures is 520 MWh final energy savings per measure and year. In contrast, the measures on the electricity side (lighting and motor-driven systems), but also building measures, show significantly smaller savings per measure.

CORONA IMPACT

During the fourth monitoring round in 2020, Germany was forced to introduce the first lockdowns in March. Especially at the beginning, this represented a wide set of challenges for the companies. The Monitoring Institute responded by extending the deadline by which the networks had to submit the monitoring data until November. Contrary to expectations, the pandemic did not seem to affect the number of networks that managed to submit their data in time – 27 out of 59 (along with 18 originally slated for monitoring in the previous rounds), which is comparable to 29 out of 53 the year before.

Upon analysing the results in December 2020, it however became clear that the onset of the corona pandemic has coincided with a substantial drop in the average goal attainment of the 2020 networks. After the first three rounds of monitoring, this parameter stood at 111 %. On their own, the networks from the fourth round only achieved an average goal attainment of

Table 5. Savings per measure.

Savings (MWh/a or t $CO_{2/a}$)	Total – all measures	Mean value per measure	Standard deviation	Fractile values				
n = 7.223				10%	25%	50%	75%	90%
Final energy saving	5.592.116	755	5.095	2	10	47	200	947
Primary energy saving	7.009.356	971	5.749	4	16	74	315	1.322
GHG savings	2.017.142	279	1.618	1	5	23	99	385

(Source: Barckhausen 2021).

Table 6. Final energy savings per measure by category.

Final energy saving by technology (MWh/a)	Total – all measures	Mean value per measure	Number of measures	Fractile values				
n = 7.223				10%	25%	50%	75%	90%
Process heat	1.244.032	3.446	361	5	39	200	1.298	7.650
Combined heat and power	304.546	2.957	103	6	67	520	2.183	12.704
Industry-specific processes	348.134	2.720	128	10	30	227	1.056	8.271
Heat recovery, waste heat utilisation	581.652	2.434	239	22	88	276	1.314	4.944
Other	692.202	1.617	428	2	10	44	272	1.200
Process technology	1.253.945	1.183	1.061	7	29	124	620	2.765
Ventilation, air conditioning	198.649	537	370	4	12	50	211	705
Adaptation of operational processes	84.861	530	160	3	10	55	255	997
Heating, hot water	252.037	470	537	2	10	50	200	709
Cooling	79.352	261	304	7	25	70	208	600
Training, information campaigns	15.596	236	67	3	4	14	76	211
Compressed air	116.921	224	523	4	14	48	132	418
Motors, drives	83.627	171	490	3	11	45	135	439
Building envelope (insulation, windows)	27.474	161	171	5	12	30	101	288
Lighting	278.230	137	2.037	2	4	17	65	192
Information and communication technology	8.167	87	94	0	1	5	63	289

(Source: Barckhausen 2021).

67 %. While the monitoring institute saw anecdotal evidence for corona pandemic being at least partly responsible for this – reports on various occasions of network members dropping out, of networks being unable to carry out their meetings, of companies being unable to implement planned measures due to unavailability of installers, and of resources shifting away from energy efficiency to more urgent matters – the monitoring process with its standardised and limited scope of data gathering did not provide an opportunity for a systematic examination of causes.

At the start of 2021, it was therefore agreed with the IEEKN Steering Committee to conduct a separate investigation. The monitoring institute reached out to 18 Networks from the 2020 monitoring round that achieved a goal attainment of 96 % or lower. Five of them responded by saying the corona-pandemic played no role in their goal attainment. Nine stated it played a minor part and four that it played the major part. No network stated that corona was the only factor for them missing their goals. Since a network not meeting its own goals can in theory be the consequence of either failing to implement the planned efficiency measures, or implementing the measures but failing to report them to the monitoring institute, the second question focused on this aspect. Seven Networks reported that their missing their goals can be attributed exclusively to their failure to implement the planned measures. Six networks stated that not implemented measures were the main cause, but also that some measures had been implemented but had not been reported. One network stated that its not meeting its goal was about equally due to not implementing and not reporting its measures. Three networks reported that their failure to meet their goals was mostly due to implemented but not reported measures. No network stated it missing its goals was exclusively due to non-reported measures.

In the fifth monitoring round in 2021, the total of 50 networks were monitored (25 ending in 2021 and 25 from the previous rounds). Again, the number of networks that submitted their data in time seemingly wasn't affected by the corona pandemic. On their own, the networks in this round achieved an average goal attainment of 81 %, up 14 % from the year before. This suggests that after the initial shock of the pandemic and the lockdowns, networks have mostly found ways to continue with their activities, including implementing the energy efficiency measures.

The investigation therefore showed that Corona did affect the goal attainment for majority of the investigated networks. The answers provided by the investigated networks suggest that planned but ultimately not implemented measures played a bigger role in networks not meeting their own goals than measures that had been implemented but not reported. The monitoring process itself was affected only at a minor level.

Conclusion

The concept of EENs, where companies share knowledge and learn from each other's experience has become an important part of the international energy efficiency landscape in the past years. The EEN approach proves to be a good catalyst for the uptake of both energy management systems as well as energy efficiency measures.

Regarding the voluntary character of the scheme, it became apparent in the course of the initiative that the networks tended to expect a concrete counter-value such as financial savings or relief from selected legal obligations for participating in IEEN. However, the participants generally assess the network very positively and praise in particular the knowledge gained. The majority of the network contacts confirmed that the participating companies value the cooperation in the network, recognise the benefits and would in some cases like to cooperate with other companies in some form after the network has been officially concluded. Despite the fact that considerable effort is necessary on the part of the companies to collect the necessary data, most of them also see the benefits of an external review of their results and feedback that the monitoring institute provides.

With the onset of the Corona pandemic, a significant decline in average goal attainment was recorded in 2020. However, this recovered in 2021, suggesting that there is no significant Corona-effect on the results of the networks among the participating companies. Over time, the networks seem to have found ways to continue their activities and the implementation of measures. Still there might be a lower dynamic in the formation of new EENs due to the contact restrictions in the various lockdown phases.

The results on the level of individual networks show that the companies implement a substantial number of energy efficiency measures. To what extend this is a direct result of the network operation would have to be clarified in a detailed evaluation.

On the other hand the initial ambitious target of 500 networks until 2020 has not been achieved, therefore the IEEN did not deliver the expected savings. The development of the instrument within the upcoming years – including the extension from energy efficiency to energy and climate issues – will have to be observed carefully.

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