Evaluation of on-site energy consultations concerning energetic modernisation of private homes in North Rhine-Westphalia (NRW), Germany

Dr. Reinhard Loch, Martin Steinestel
& Udo Sieverding
Verbraucherzentrale NRW e.V.
Consumer Association of North Rhine-Westphalia
Bereich Energie
Mintropstrasse 27
40215 Düsseldorf
Germany
reinhard.loch@vz-nrw.de

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Abstract

The energy renovation of residential buildings is an important part of the German 'Energiewende'. Energy consulting plays a prominent role, along with governmental subsidies, in motivating landlords to take refurbishment actions. The Consumer Association of North Rhine-Westphalia (NRW) performed a new project 'KEK'[1] promoting initial on-site energy consulting, starting in 2012. A final evaluation in 2014 assessed the success of the consultations, the implementation level, the triggered energy savings and the obtained CO_2 reduction, by interviewing 500 participants.

Most of the participants were people older than 60 years, who were looking for general advice and useful information on how to reduce individual energy consumption of their dwelling. The evaluation shows an average reduction in energy consumption of about 4 %, which can be related to the effect of the consultation process. Additional and important effects of the consultation are the avoidance of wrong choices of measures and the improvement of the specifications of measures implemented, leading to higher energy performance.

Improving and enhancing energy consulting for private house owners is one important part of the national strategy in the German NAPE (National Action Plan for Energy Efficiency) started in December 2014.

1. 'Klimaschutz und Energiewende konkret (KEK)', period 2012-2014, funded by EU-ERDF programme, the government of North Rhine-Westphalia, and the participating cities.

Introduction

About one third of the whole final energy consumption in Germany[2] is related to space heating and domestic hot water. Therefore in the concept of the German Government in September 2010 (BMWi 2010) the importance of the renovation of the existing building stock is highlighted as one of the main challenges on the way to a nearly CO_2-neutral society. Both in the plans of the German Government as well as in the concept of the Climate Protection Plan of North Rhine-Westphalia[3], an important goal is the increase of the energy renovation rate from about 1 % to a minimum of 2 % per year. The German government recently reported the national renovation strategy in the building sector (BRD 2014) in order to meet the requirements of Article 4 of the EED (Energy Efficiency Directive) 2012/27/EU, and announced in December 2014 the National Action Plan NAPE (BMWi 2014)[4] as a roadmap for all sectors of energy consumption. The NAPE roadmap addresses several main objectives for improving the energy efficiency of existing buildings, such as:

- development and improvement of energy consultation
- financial incentives by tax reduction and extension of the KfW[5] funding programme

2. See chart no. 7 in https://www.bmwi.de/BMWi/Redaktion/PDF/E/energiestatistiken-energiegewinnung-energieverbrauch,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf.

3. For a detailed description of the climate protection plan, see for example http://www.klimaschutz.nrw.de/fileadmin/Dateien/Download-Dokumente/Arbeitsgruppen_Klimaschutz/AG_3/AG_3_Zusammenfassung_der_Sitzungsergebnisse.pdf.

4. NAPE (Nationaler Aktionsplan Energieeffizienz), December 2014, http://www.bmwi.de/DE/Themen/Energie/Energieeffizienz/nape.html.

5. KfW (Kreditanstalt für Wiederaufbau) is a national public bank, administrating the larger incentive programme for energy efficiency in buildings in Germany among other missions. See https://www.kfw.de/kfw.de-2.html.

- introduction of a check for existing heating systems
- development of methods for individual renovation roadmaps for the building.

In most of the renovation roadmaps and national strategies for reducing energy consumption of buildings, the instrument of direct counselling for homeowners plays a key role.

In Germany the most important programme to promote on site consulting is the BAfA[6] programme, which gives incentives up to 60 % for assessments by experts with specified qualifications. Because of the high reporting standards required by the BAfA programme these on site assessments are rather expensive and the approach to this programme (registration process) is complicated.

Therefore there is a high demand for an easier and cheaper type of on-site energy consultation. The regional government of North Rhine-Westphalia funded a new project 'KEK' performed by the Consumer Association of North Rhine-Westphalia (Verbraucherzentrale NRW e.V.) in the period from 2012 to 2014. It tried a different approach: on site consultation with standardised reports at a lower cost than BAfA assessments, but still performed by experts of high qualifications.

The paper first describes details of this energy consulting programme. Then it presents the evaluation and its results based on a survey of a sample of the participants, especially looking at the implementation of refurbishment measures after the consultations.

The 'Energieberatung bei Ihnen zu Hause' on-site consultation

Since 2012[7], the Consumer Association of North Rhine-Westphalia (NRW) offers a programme for initial 'on site consulting' funded by the government of North Rhine-Westphalia, the EU as well as the participating municipalities. Its focus is to give on site consultation in an independent and cost-effective way to interested homeowners.

In contrast to the on-site consultation subsidized by the well-established national BAfA programme, which is the most important programme for on-site consultation in Germany, we created an on-site consultation with low costs and an easy approach for the homeowner (fast registration without application process). The experts have the same qualifications than the BAfA experts, but the assessment reports are not as detailed as required by the BAfA specifications. There is no direct link between this on-site consulting programme and other regional or national programmes promoting energy renovation. In particular, the report delivered is not a requirement for getting a financial incentive (while the BAfA report is required when applying for a KfW incentive).

As an initial assessment, the 'Energieberatung bei Ihnen zu Hause' – abbreviation EZH – is designed to give a short review of the current energy performance level of the building by looking at the particular features of the envelope, heating system and actual annual energy consumption. In addition, the report includes recommendations about measures for improving the energy performance of the building. This consultation takes approximately 90 minutes at the cost of 60 Euro per session for the customer. The experts are employees of the consumer association or independent experts, who had to apply (for a verification of their qualifications). The external experts got a fixed salary per case.

The advised homeowner receives a standardised report about the actual energy performance of their dwelling, together with a list of the proposed refurbishment measures including estimated prices and saving effects. This information does not include total costs of the measures but average prices per m^2 of the envelope or rough prices for renewing the heating system. The report includes information about public programmes for loans and incentives like the KfW programme.

In the winter of 2012/13 and 2013/14, additional thermographic surveys of the investigated houses were offered in order to increase the number of participants of the project.

A total of about 17,000 on-site consultations were performed during the project from 2012 to 2014. In the same period about 7,300 assessments in North Rhine-Westphalia were subsidised by the national BAfA on-site programme. This shows the attractiveness of the 'Energieberatung bei Ihnen zu Hause' programme.

Evaluation

OBJECTIVES AND METHODOLOGY

The evaluation was designed to investigate the implementation of given recommendations and the effects in terms of energy savings and CO_2-reductions, including findings about the motivation of the homeowners and additional positive effects of the energy consultation.

74 % of the participants of the KEK programme gave their approval for a later evaluative questioning. This agreement is required because of the protection of private data. 500 cases were randomly picked as a sample. Because no data about the participants were available except their address, no check of representativeness of this sample compared to all participants could be done. Nevertheless the sample is assumed to be representative, because there is no evidence for a bias effect caused by the sampling method. Of course a risk of hidden selection bias remains.

An important precondition for the survey was that it had to take place more than a year after the consultations, to take into account the time needed to carry out the proposed measures. No significant 'forgetting' effect was observed, which could have been identified by a significant share of 'don´t know' answers.

In the summer of 2014, the evaluation was conducted by the Institute for Energy and Environmental Research (IFEU) Heidelberg in cooperation with the opinion research institute TNS-Emnid (Bielefeld).The survey was done via telephone (CATI) by TNS-Emnid. The interview guide was pretested in order to optimise the questions. The average interview length was about 20 minutes.

6. BAfA (Bundesamt für Ausfuhrkontrolle) is the Federal Office for Economic Affairs and Export Control, a superior federal authority subordinated to the Federal Ministry for Economic Affairs and Energy (BMWi), and administrating the programme "Local consultations to save energy" which gives grants for consultations with home owners by qualified engineers. (http://www.bafa.de/bafa/en/energy/index.html)

7. Project 'Klimaschutz und Energiewende konkret (KEK)', period 2012–2014.

Figure 1. Year of construction of the buildings.

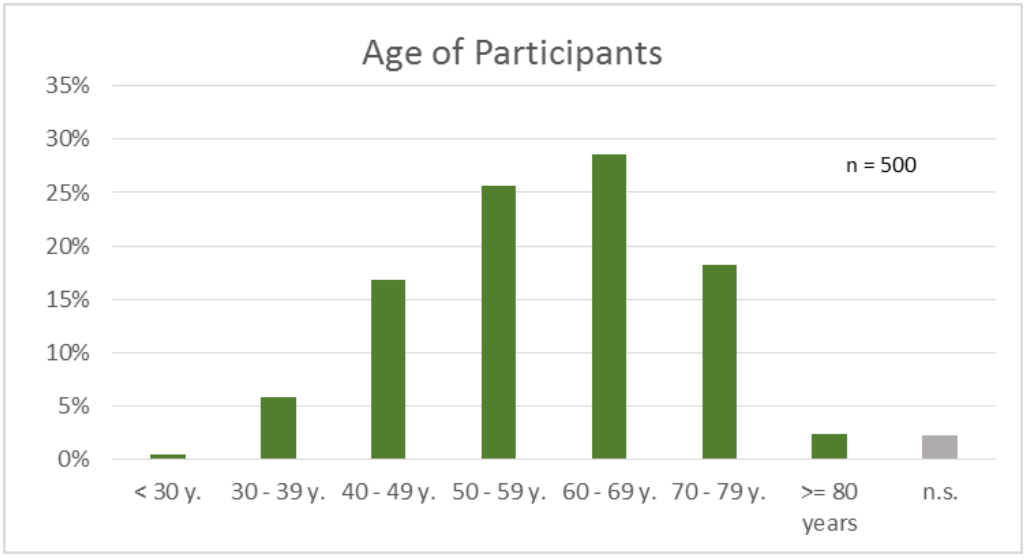

Figure 2. Age of participants of the sample.

CHARACTERISTICS OF THE PARTICIPANTS AND THEIR BUILDINGS

Age of Buildings

More than 70 % of the houses of the sample were built before 1977 (Figure 1). Being constructed before the first ordinance of thermal insulation, these buildings have a very high potential for savings. The distribution of the age of the buildings for our sample only differs slightly from the distribution of all buildings in NRW (Zensus 2011) with the exception of buildings after 1995 (which is expected, as this latter category includes recent buildings not needing renovations nor energy consultations). Therefore our sample can be assumed to be representative of the building stock in North Rhine-Westphalia, as regards building ages.

Age of participants

The average age of the participants in the sample was 58 years. About one half (48 %) was 60 years and older (Figure 2). This is in agreement with other sources determining the age of homeowners in Germany (age 60 and above: dena 2012: 51 % [Dena 2012], ISOE et al 2010: 45 % [ISOE 2010]). However, official statistics about the age of private house owners in North Rhine-Westphalia were not available.

The high proportion of customers over the age of 70 years (over 20 %) in our sample is striking, as this age group is commonly thought not to be interested in expansive investments in comprehensive renovations of their homes. The survey results have shown that this age group is interested in receiving information about energy renovation.

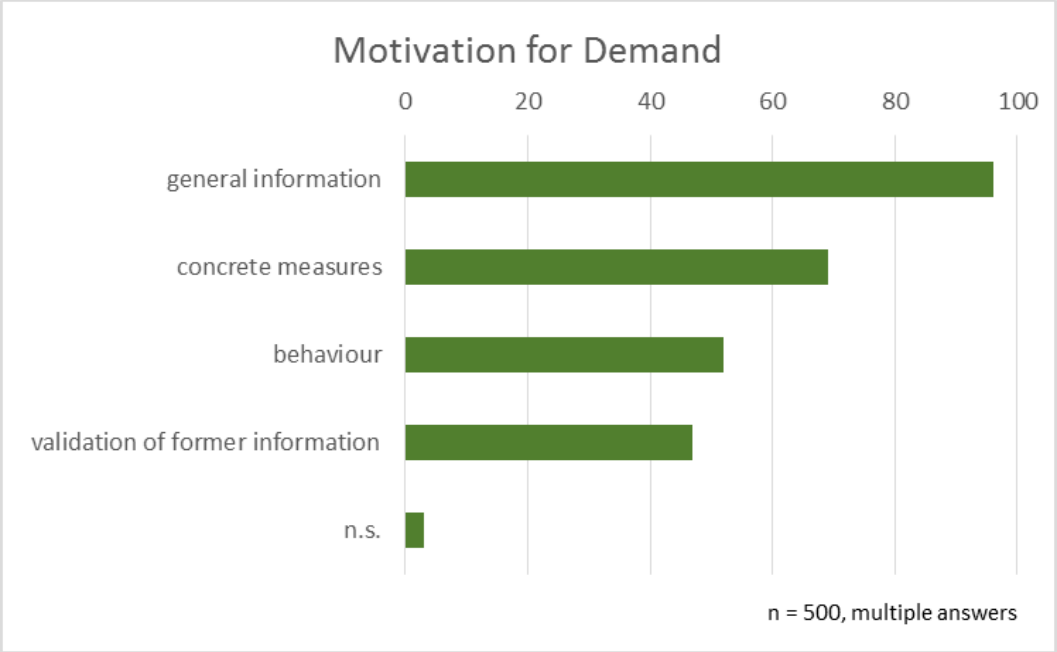

Figure 3. Motivation for demand.

MOTIVATION AND PHASE OF LIFE OF THE PARTICIPANTS

In contrast to the BAfA on site-consulting programme, which is strongly connected to the public funding KfW programme because the BAfA report is required for the homeowner to apply fora KfW loan and/or incentive, the KEK on site consultation doesn't give access to financing programmes. Indeed, only 30 % of interviewees have reported that they received a financial incentive for implementing a measure.

When asked about the motivation for seeking energy advice, 96 % of the interviewees stated that they were generally interested in energy savings, as well as in getting a general assessment of the building. About 69 % were looking for advice on concrete measures or technical details. This shows that the majority of the customers in this project are especially interested in a general survey on possible improvements of their building, and that they had also an idea of possible measures before the consultation (Figure 3).

The survey tried to ascertain whether the participants are more likely to seek for energy advice in a specific phase of their life. Among the various response choices, the survey offered options such as the birth of a child, house newly bought, etc. However, about 46 % of the interviewees identified no specific situation in their life.

From those of the interviewees who agree with one ore more of the possible answers, the most frequent answers were associated with the terms 'transition to retirement phase' (33 %) and 'children moving out' (26 %). This finding is not surprising, as it is in line with the share (48 %) of the interviewees being 60 years and older. It is the period of life in which e.g. the children have left home, financial situation improves and an engagement in the house refurbishment seems to be more possible. Moreover, about 13 % of the people mentioned 'looking for a safe investment' as motivation.

Furthermore, the duration of ownership was examined. About 70 % of the interviewees have already been living in their home for more than 10 years and only 4 % of them have been owning the house for less than two years.

This may be due to the mandatory Energy Performance Certificate delivered when buying a dwelling, which already gives a standardised energy assessment of the building and information about possible measures and their saving potentials.

In conclusion, the majority of the participants in the project were 'older settled ones' who are looking for a suitable modernization of their buildings and request the help of an energy consultant.

RESULTS OF REALISED MEASURES AND COMPARISON WITH A PREVIOUS PROGRAMME

A key objective of the evaluation was the quantitative determination of the energy saving effects due to the assessment (or advice) process. Because the interviewer had no access to the assessment reports, the interviewees were asked for data about building details before the energy consultation and for information about the measures that were implemented after it.

440 of the 500 interviewees had already performed at least one refurbishment measure after the consultation or they were planning to do so within the next two years. On average 2.4 measures were implemented per owner.

This result is similar to the one of the previous project 'Mein Haus spart' also led by the Consumer Association NRW from 2011 (Ifeu 2011), and that showed 2.6 measures per consultation (Figure 4).

In general, these values are significantly lower than the average number of measures implemented in other schemes in Germany (for instance more than 3.5 estimated for the BAFA on-site consultation[8]). This may be due to the strong interac-

8. Information from ifeu (Institut für Energie- und Umweltforschung), 2013/14.

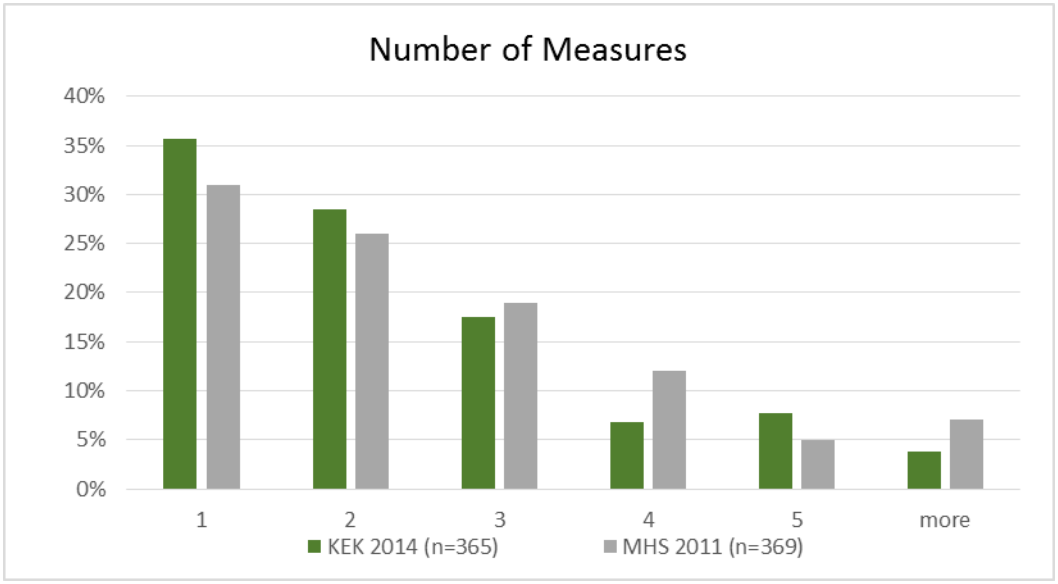

Figure 4. Number of performed measures.

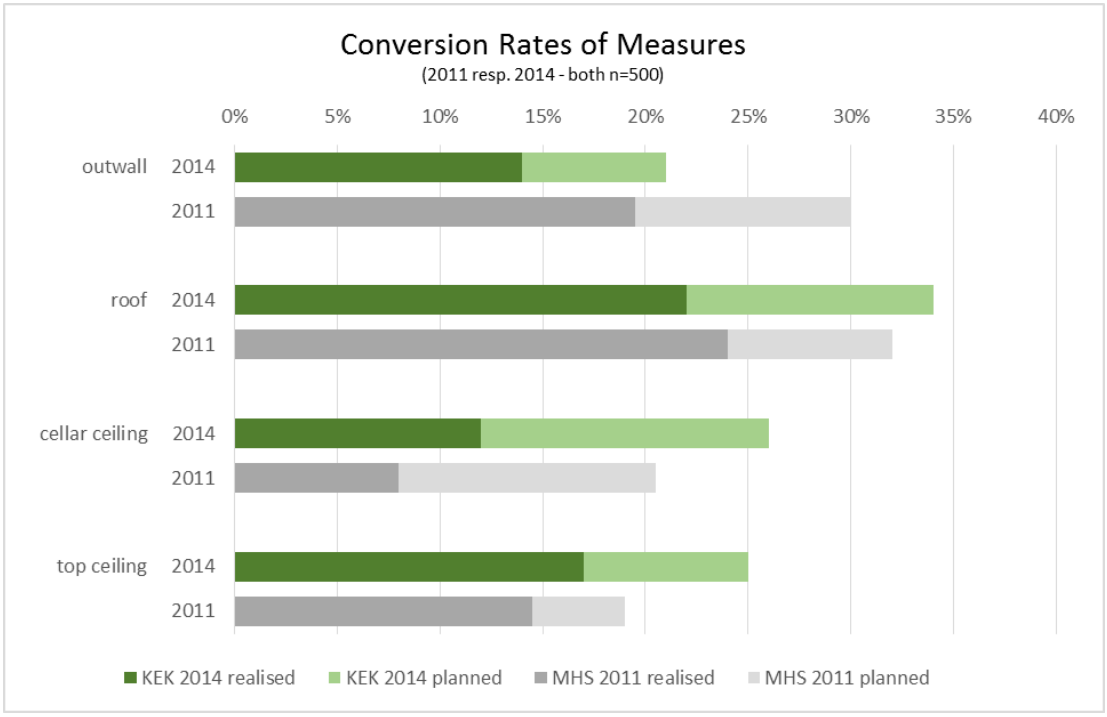

Figure 5. Comparison of conversion rates of different measures 2011 respectively 2014.

tion between the BAfA programme and the KfW programmes (applying for KfW loans or incentives require the assessment of an expert).

Overall, in 308 cases an insulation measure was carried out and in 204 cases the heating system was upgraded. Concerning the building envelope, the action with the highest conversion rate was roof insulation (34 %), while refurbishment of the basement ceiling and top floor ceiling had also a good conversion rate, each in about 25 % of the cases.

The conversion rate of the realized or planned measures on the outer wall was only 21 % of the measures compared to the previous project 'Mein Haus spart' (2011), where this figure was significantly higher (30 %). For the other insulation measures, the conversion rates remained nearly stable or even increased, especially for cellar and top ceiling insulation (Figure 5).

Because there was no significant change in financial subsidies for outer wall insulation, the decrease in the conversion rate may be due to an increasing scepticism with respect to this measure (e.g. due to negative statements made by the media, concerning fire risks of certain materials and doubts about the financial benefits of energy saving measures in general). The influence of media, their changing view on energy efficiency measures may lead to increasing distrust in general (Griechisch

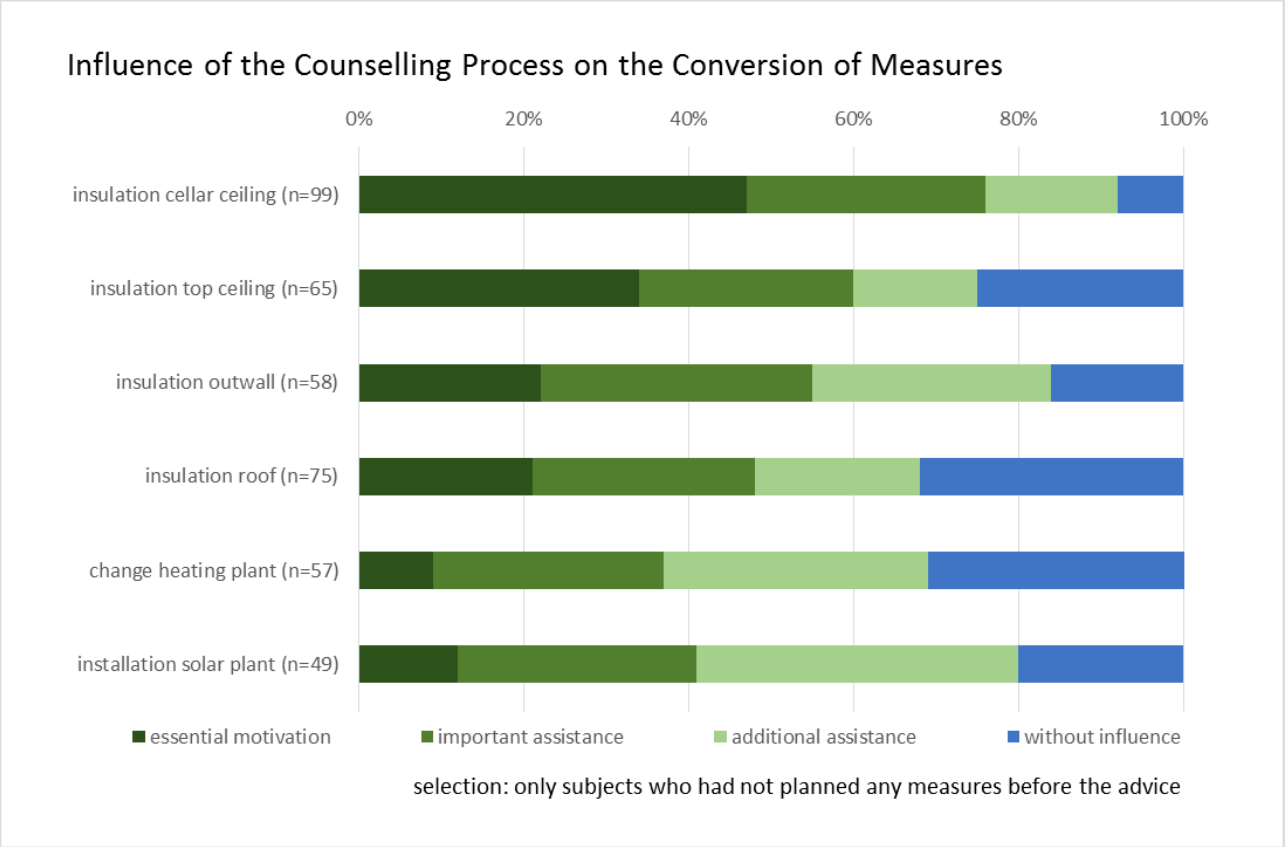

Figure 6. Influence of the counselling process on realised measures

2014) and may have a strong influence of the implementation especially of measures that are not compulsory like the thermal insulation of the outer wall.

TRIGGER EFFECT OF THE ASSESSMENT

To determine the contribution of the energy consulting process on the measures implemented ('net effect'), the customers were asked[9] how much the consultation influenced their decision to implement the proposed or previously planned refurbishment measures (Figure 6).

Concerning insulation of the cellar ceiling and the top ceiling, the influence of the consulting session was very strong, which is also in line with the higher conversion rate for these measures in 2012–2014 compared to 2011. It can be asserted that these measures were often initiated only by the consultant.

ENERGY AND CO_2 SAVINGS

The energy saving effect could be calculated by the information regarding the measures implemented. The gross saving effect results from the overall effect of the realised measures as compared to the energy consumption of the building before the consultation. The calculations are based on the GEMOD calculation method, which uses typologies of residential buildings (Ifeu 2011, IWU 2012). This approach has been used also in several evaluations of energy consulting programmes like the BAfA programme (Ifeu 2008) and the programme of vzbv[10] (Ifeu 2005).

The net effect of the consultation was calculated as the gross effect multiplied by an influence factor in order to transform the interviewees' answer about the consultation influence into a gross-to-net ratio (essential motivation = 1.00; important assistance = 0.75; additional assistance = 0.50; without influence = 0.00; see also Figure 6).

Table 1 shows the results of the saving effects concerning energy and CO_2 emissions per consulting case for all house types, as well as the values for the specific segment of one- and two-family homes (EZFH).

Average energy saving effects of about 3,412 to 4,950 kWh[11] per year in final energy per consultation were achieved (average for all house types), from which about 1,119 to 1,600 kWh per year could be related to the influence of the on-site consultation (net).

The gross saving effect of the refurbishment measures implemented corresponds to a reduction of the final energy consumption by about 13 % compared to the consumption level before the consultation. The gross CO_2 reduction for a consultation is on average about 2.6 tons per year.

9. Question A: 'Which of the measures below did you realise after the consultation or are you planning to realise within two years?' Answer per measure: realised = 1, planned = 2, no = 3. If Answer = [1 or 2] then Question B: 'How strong did the consultation influence this measure?' Answer per measure: essential motivation/ important assistance/additional assistance/without influence.

10. vzbv (Verbraucherzentrale Bundesverband) is the Federation of German Consumer Organisations, a non-governmental organisation acting as an umbrella for 41 German consumer associations (www.vzbv.de).

11. The lower value includes only realised measures (i.e. already implemented at the time of the interview). The upper value includes realised and planned measures.

Table 1. Average savings per year per consultation.

			1-/2-family houses	all house types	
net	**final energy**	realised	956	1,119	**kWh/a**
		planned	531	485	**kWh/a**
		total	1,487	1,604	**kWh/a**
	CO_2	realised	445	416	**kg/a**
		planned	229	207	**kg/a**
		total	674	623	**kg/a**
gross	**final energy**	realised	3,071	3,412	**kWh/a**
		planned	1,409	1,538	**kWh/a**
		total	4,480	4,950	**kWh/a**
	CO_2	realised	1,820	1,807	**kg/a**
		planned	851	839	**kg/a**
		total	2,671	2,646	**kg/a**

When asked about their investments in energy renovation, the participants specified the amount of money they invested in the measures they already realised (not planned). The result is a mean gross value of about 13,900 Euro per building for the energy renovation measures – possible incentives from public programmes like KfW are ignored. Triggered by the consultation was a net share of 4,700 Euro.

The effects of small actions (such as the replacement of the heating circuit pump, insulation of pipes or adjusting the control set of the heating system) are not included in these results, because they are difficult to calculate and we concentrated on the major contributions to the saving effects.

QUALITATIVE EFFECTS OF THE COUNSELLING

Beside measurable energy savings effects, there are additional positive effects of the consultation service that are essential to the success of the refurbishment measures and were therefore investigated in the evaluation. Important factors are for example learning effects concerning avoiding mistakes when planning refurbishment measures. There is a strong evidence that the consultations improved also the specifications of already planned measures, increasing the performance level achieved, for example by avoiding thermal bridges when insulating the external wall or improving the technical specification of the new heating system.

More than half (57 %) of the participants stated that ineffective investments were avoided by the on-site assessment. 72 % answered that they could improve the efficiency of the planned measures, and in 67 % of the cases an optimised coordination of measures was achieved. Only in 34 % of the cases a planned measure was abandoned.

86 % of the clients mentioned that the energy advice helped them to clarify whether a planned measure is useful and reasonable (Figure 7). This emphasizes the importance of energy consulting as a help for the owner of the building, giving certainty for the decisions needed to be made.

An important part of the energy consulting is a refurbishment roadmap that schedules the measures in a short term perspective, as well as a plan for medium and long term energy renovation. Homeowners, who intend only one specific measure, for example changing the heating system, get additional information about what measures could be performed later in order to meet a higher energy performance and they get information about the recommended order of the measures.

Thus, 58 % of the participants confirmed that the on-site consultation was helpful, by giving them a long term vision on what to do (Figure 8). In the NAPE programme, the government announced that this method of an individual renovation roadmap for every building would be part of the German national renovation strategy.

The evaluation also showed a strong diffusion effect of the results of the consultation due to communications with their neighbours and friends. About half of the clients confirmed that they talked about content and information obtained during the consultation with friends and neighbours, and therefore shared their experience. This may as well increase the number of consultations.

ASSESSMENT OF THE ENERGY CONSULTING AND THE ACHIEVED SAVINGS

The interviewees were furthermore asked to assess their overall satisfaction, as well as specific features of the on-site consulting, by giving grades from 1 (best) to 6 (worst). Best rated was the neutrality of the advice (grade 1.5). Also important (grade 2.1) is the personal benefit of the consultation.

In the overall assessment, 95 % showed satisfaction with the on-site energy consultation (58 % very satisfied) and 93 % would recommend the product.

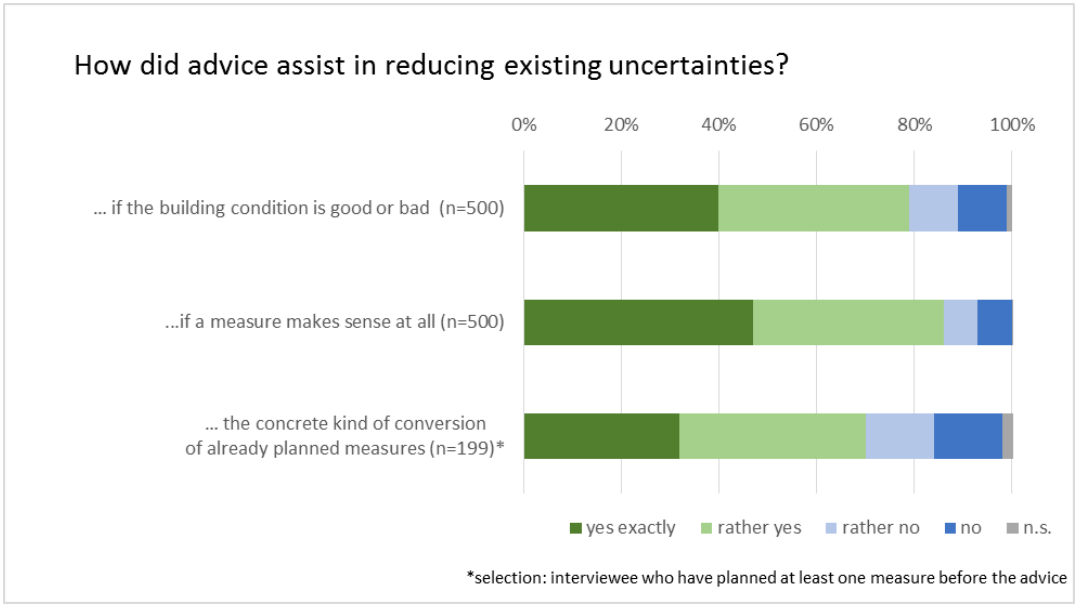

Figure 7. Reduction of uncertainties.

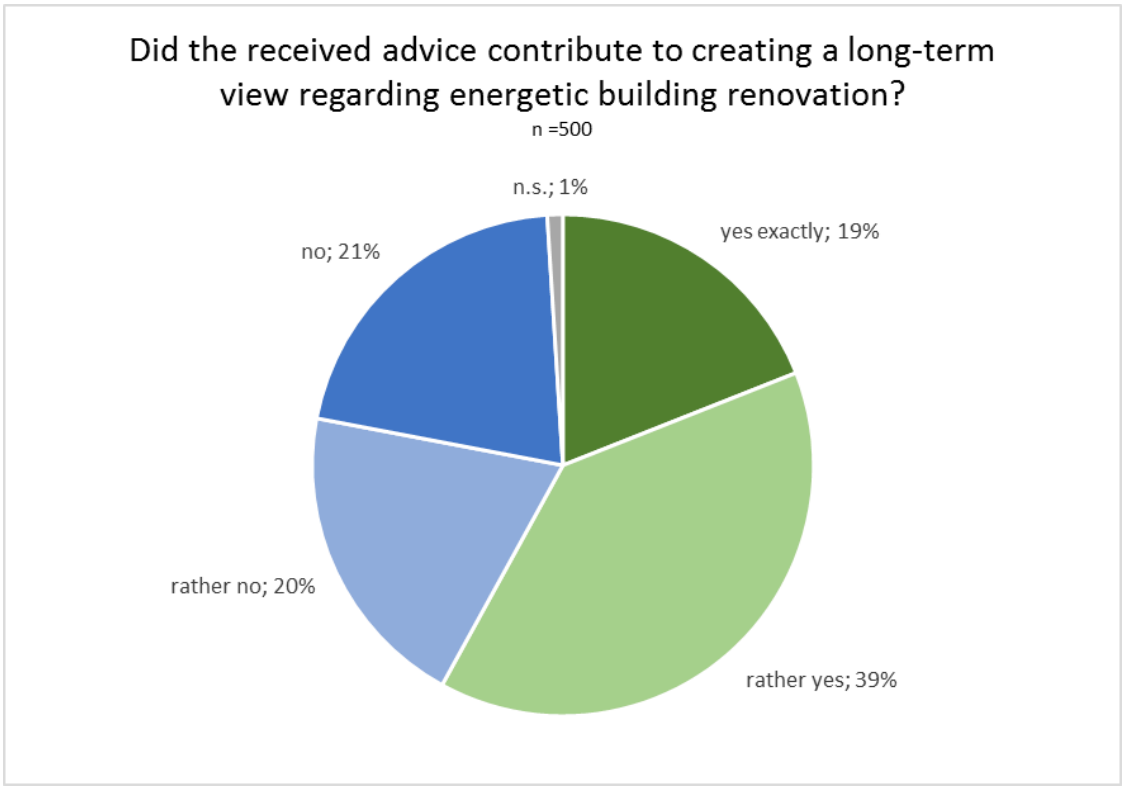

Figure 8. Long-term roadmap and refurbishment perspective.

Conclusion

The energy consulting project for private homes of the consumer association NRW has shown that the consultations could trigger energy saving effects of about 1,600 kWh per year per consultation, based on answers of the interviewees about the influence of the assessment on their renovation project. This results in a mitigation of about 620 kg CO_2 per year per consultation. The additional investment of the homeowner triggered by the consultation can be estimated as 4,700 Euro.

It has to take into account, that this figures concerning energy saving and CO_2 mitigation include also the effect of planned measures if the interviewees intend to implement them within the next two years. This may be a significant source of uncertainty and it would be interesting to check it with an additional interview within a few years. Likewise, the gross-to-net ratios used are partly subjective and therefore have a strong influence on the estimation of the net impacts.

Furthermore, significant additional positive effects can be demonstrated. It can be shown that errors due to inappropriate measures can be avoided and the performance of the refurbishments can be improved.

Most of the clients who took part in project were home owners aged 60 and older (which is in line with the average age of homeowners in Germany), who already lived in their property for some time. Typically, their children were leaving home and/or they were facing the beginning of retirement. In this period of life, higher financial resources are used to improve the home.

The participants of the project also get a longer-term refurbishment plan that shows the perspective to an optimal energy performance of the building.

The participants appreciate especially the neutrality and the usefulness of the advice delivered. Because of low costs and the easy way to get an expert with high qualification there was a great demand for this offer and about 17,000 homeowners took part in the project.

The neutral and independent on-site energy consultations therefore contribute in a significant way to promoting the energy refurbishment of buildings as an important part of the Energiewende.

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