

[FINLAND] Energy audits in municipalities

Kuntien energiakatselmus

About the measure

Policy instrument	Sector	Starting date and status
Information (voluntary energy audits) and financial (audit subsidy)	Tertiary sector (public sector)	1992 – ongoing

The energy audit activity in municipalities is part of the voluntary Energy Audit Programme which has been a long-running important national initiative to improve energy efficiency already before EU directives (since 1992). The voluntary programme is also one of the alternative measures notified for Article 7 of the EED and supports effective implementation of the voluntary Energy Efficiency Agreements (www.energyefficiencyagreements.fi). The subsidy granted by the audit scheme is 50% of eligible labour cost of audits for municipalities participating in the Energy Efficiency Agreement Scheme (voluntary agreement between the government and municipalities) and 40% for other municipalities. In addition to energy audit subsidies, municipalities can benefit from subsidies in the Energy Aid Scheme to implement energy efficiency improvement actions proposed in the audits.

The responsible ministry is the Ministry of Economic Affairs and Employment (MEAE). The Energy Authority is in charge of most administrative matters except audit subsidies, which are administered by Business Finland (formerly the Finnish Funding Agency for Innovation, TEKES). Motiva (government-owned company pursuing sustainable development) has a central role in the implementation of the programme.

The voluntary energy audits always include an assessment of the current situation of energy

and water use, proposed actions relating to energy savings, estimated investment costs and the resulting estimated energy and cost savings (EUR/a). Energy audits are conducted by consultants who have been trained by Motiva and have obtained energy auditor qualification.

Four energy audit models are applicable for municipal buildings: lighter building energy review for smaller buildings, full building energy audit, building follow-up energy audit and energy audit of a recently commissioned building. In addition, a renewable energy audit model has been available since 2005 to be used for mapping the possibilities for increasing the use of renewables within the municipality (not discussed in this case study).

Data on status of the proposed actions and the realised savings is collected through the annual reporting of the Energy Efficiency Agreement scheme. As much as 96% of the municipal buildings (volume) audited in 2008-2016 were audited in municipalities which took part in the energy efficiency agreements over the same period. Therefore, the coverage of the data on actions implemented and realised savings is very high.

All types of energy saving actions are eligible with a view to the saving lifetimes.

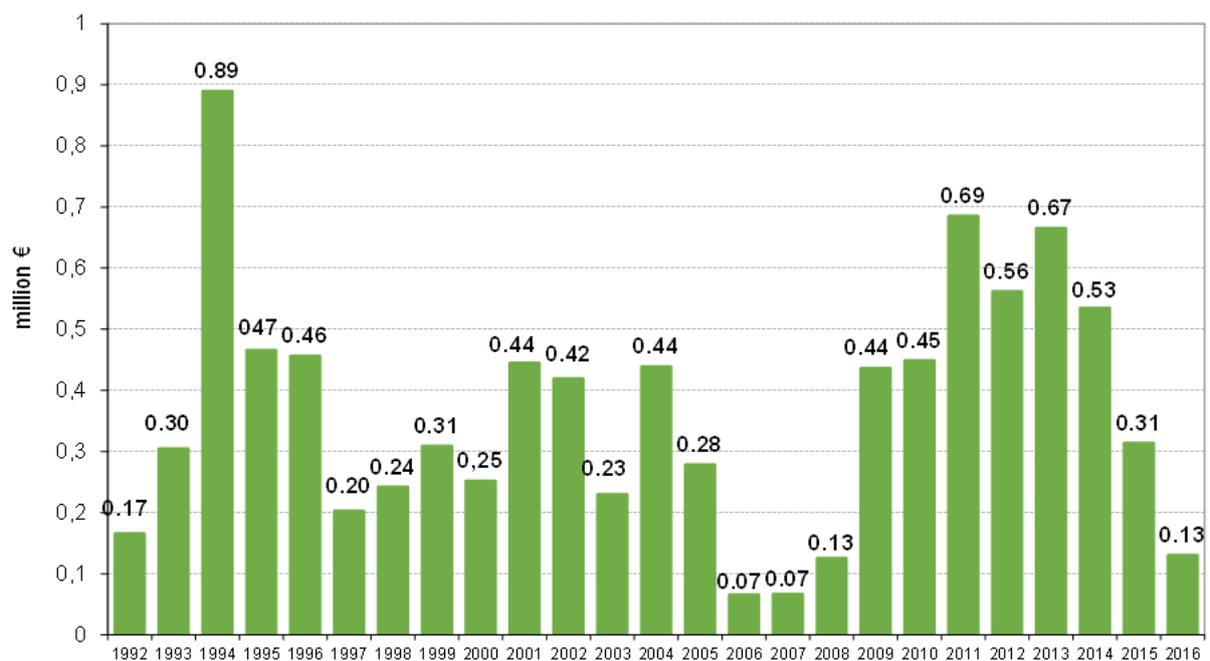


Expected energy savings in 2020	Benchmark
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Annual final energy savings expected in 2020 (source: NEEAP 2017): 88 GWh/a	This measure is estimated to account for 20% of all energy savings in the municipal sector in 2020. However, the contribution to the EED article 7 target in 2020 is very small.
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Means and outputs

Subsidies given for energy audits carried out by municipalities have totalled at **9.1 million euros in 1992–2016**. In 2008–2016 annual subsidies varied between 0.07 and 0.69 million euros totalling at 3.9 million euros over the period. In comparison, the total volume of audit subsidies in all sectors has been 38.3 million euros since 1992.



Source: Motiva Oy

Figure 1. Annual amount of energy audit subsidies in the municipal sector, million euros (1992-2016).

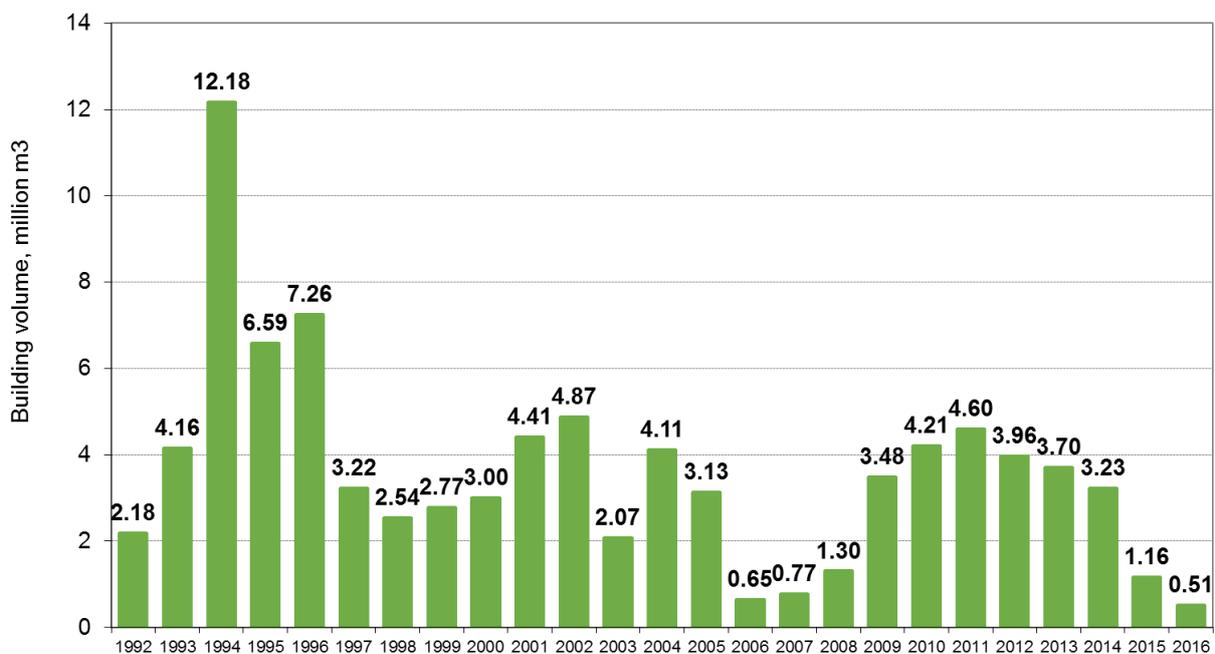
Public budgets are used also for the **administration** of the Energy Efficiency Agreement. The Ministry for Economic Affairs and Employment, and since 2014 the Energy Authority, have annually contracted Motiva for assignments in energy audit development (e.g. energy audit models), communication and marketing, quality control as well as monitoring and evaluation of the energy audits since 1992. The annual budget for the assignment in all sectors, covering a large part of the operational costs of the scheme’s administration, was roughly 300 000 euros in 2017. The level has been approximately similar in previous years.

A one-off large budget item was the construction of a new **web-based monitoring database** in 2007-2008 for the monitoring of the Energy Efficiency Agreements and the Energy Audit Programme. The resources needed for setting it up were about 200 person-days used by Motiva (specification, testing, introduction) and 300 000 euros for subcontracting. The annual resources for operation and maintenance of the database have been about 50 000 euros for maintenance activities and additional development by a third party and about one person-year of Motiva’s own work in 2009–2016. It is not possible to single out the proportion of only municipal energy audits in the totality.

Total audited building volume in the municipal sector reached 90.1 million m³ at the end of 2016 corresponding to well **over two thirds of the total municipal building volume**. Given the relatively old date of the inventory of total building volume, the estimate on the coverage should be taken as highly indicative. Because the energy audit activities are closely related to the Energy Efficiency Agreements, it is relevant to consider the coverage of the Agreements of the population in the joined municipalities in comparison to total population in Finland. At the end of 2016, the coverage of the total population was 78%.

Table 1. Energy audit volumes in municipalities.

	Number of subsidy decisions	Number of buildings	Building volume, million m ³	Total audit cost, million euros	Total subsidy, million euros
2016	19	44	0.51	0.25	0.13
1992-2016	886	5 634	90.1	18.9	9.1



Source: Motiva Oy

Figure 2. Annual building volume (in m3) audited in the municipalities (1992-2016).

Furthermore, the type of municipal buildings undergoing an energy audit is monitored. In terms of number of buildings, 35% of the energy audits have been carried out in the educational buildings and 28% in the health and social sector followed by offices (6%) and sport facilities (5%). The remaining 26% is dispersed among a wide array of building types.

Data about energy savings

Unit	Main source of data
Final annual energy savings, GWh/a	Monitoring database operated by Motiva

The **savings potential** identified in municipal energy audits in comparison to the energy consumption of municipal buildings undergoing energy audit (in energy and monetary terms) is shown in the following table. The energy audit models used in Finland also cover inspections for the possibilities to save water.

Table 2. Final energy savings potentials and investments needed for actions recommended in audits conducted in municipalities over 2011-2016.

Energy consumption before the audit	Savings from proposed actions and average savings potentials in audits conducted 2011–2016		
Heat and fuels			
554 263 MWh/a	89 037 MWh/a	16.1 %	
32 515 457 €/a	5 492 218 €/a	16.9 %	
Electricity			
264 313 MWh/a	22 743 MWh/a	8.6 %	
24 132 892 €/a	2 312 312 €/a	9.6 %	
Water			
1 600 239 m ³ /a	115 016 m ³ /a	7.2 %	
4 986 667 €/a	308 648 €/a	6.2 %	
Total energy cost	Total savings		Total investments
61 635 016 €/a	8 113 177 €/a	13.2 %	19 518 565 €

Realised savings are reported in Finland’s fourth National Energy Efficiency Action Plan (NEEAP-4, 2017). Estimated realised annual savings from actions implemented since 1995 are 69 GWh/a in 2010, 89 GWh/a in 2016 and 88 GWh/a in 2020. The savings reported in 2010, 2016 and 2020 are calculated by taking into account savings lifetimes of each type of action so that only savings “valid” each reporting year are reported.

Data on the status of the proposed actions and the realised savings is collected through the annual reporting of the Energy Efficiency Agreement scheme. As much as 96% of the municipal buildings (volume) audited in 2008-2016 were audited in municipalities which took part in the energy efficiency agreements over the same period. Therefore, the coverage of the data on actions implemented and realized savings is very high.

Figure 3 shows a summary of the actions proposed in energy audits in 2008-2016. The roughly 6 400 proposed actions entailed a savings potential of 175 GWh/a. The number of realised energy saving actions (most arising from energy audits) was about 1 700 providing energy savings of 54 GWh/a. The figure shows that the proportion of implemented actions in ventilation systems is larger than the share of this among the proposed actions. The reason is that there are lot of possibilities to improve energy

efficiency in ventilation without major investments entailing significant savings. In contrast, electricity savings often require significant investments.

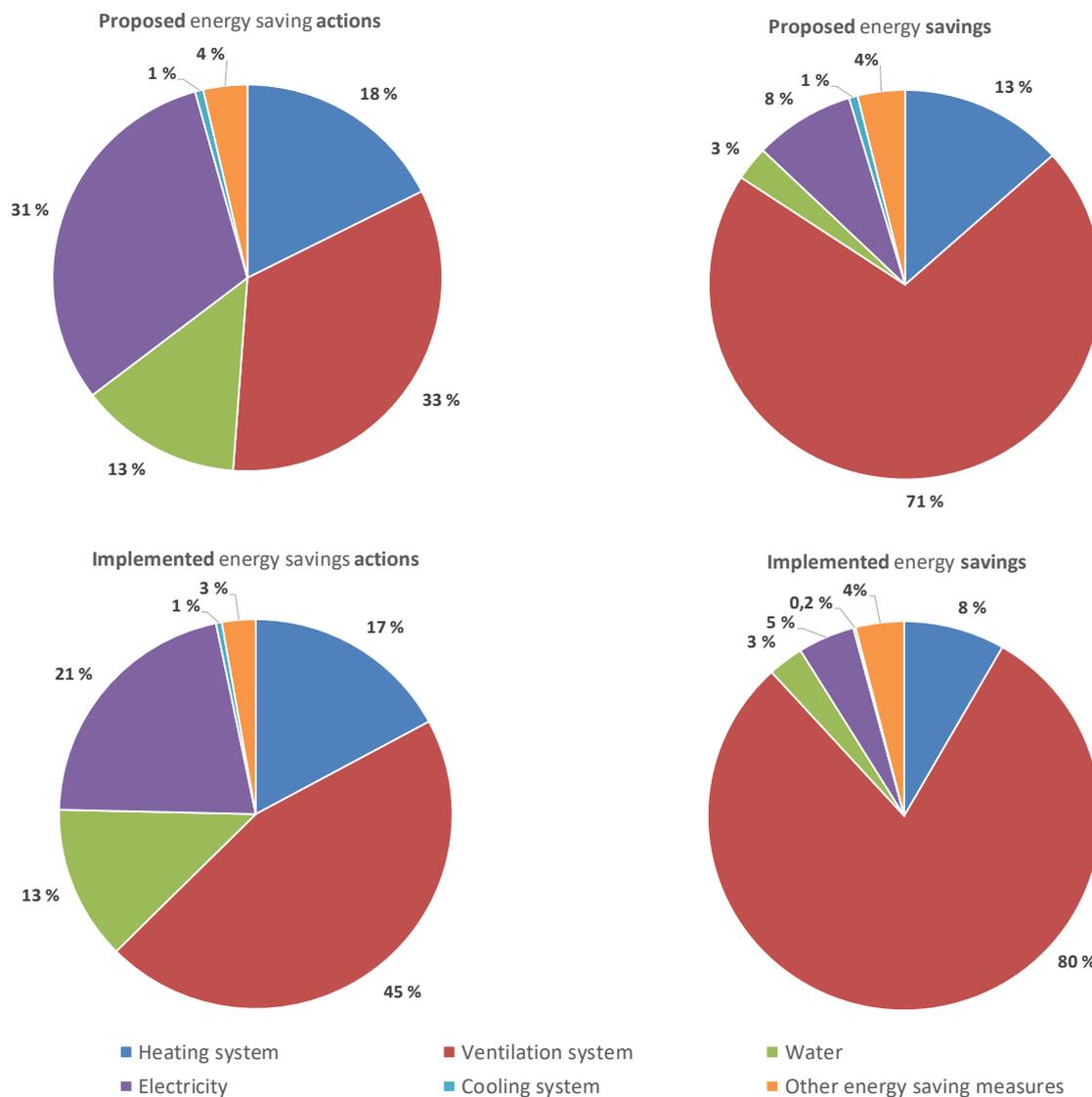


Figure 3. Share of proposed and implemented energy savings action categories and corresponding energy savings in energy audits by different action types in municipalities in 2008-2016.

Sources of uncertainties about energy savings

- The accuracy of the savings calculation for reported individual actions corresponds to the accuracy that may be achieved in normal field work and the calculations are typically carried out by an external consultant on behalf of the participating party (e.g. energy auditor).
- Some of the initial data are design data of technical systems or estimates, since measurements are often not possible or at least too costly. Savings calculations of individual actions dependent on outside temperatures are made using normalised energy consumption data.

Evaluation of the energy savings

Calculation method(s) and key methodological choices

- Impact evaluations of the same policy measures are often made using different calculation rules depending on the reporting at hand. The savings calculations described in this case study represent the evaluation of all realised savings valid in a given reporting year as the result of energy efficiency projects implemented as a consequence of the energy audits.
- Realization of proposed actions is monitored through annual reporting by energy efficiency agreement participant. This provides quite comprehensive data because 96% of energy audits in municipalities are undertaken by participants to the agreements.
- Calculation method used is detailed engineering estimates (**scaled savings, Method 5**).
- Type of baselines:
 - In most cases “before” energy consumption; “actual before” energy consumption in the cases when consumption has been metered
 - In EED article 7 cumulative energy savings calculations, the baseline is based on the minimum energy performance standards for actions for which eco-design requirements are taken into account in electricity savings calculations, i.e., only savings exceeding standards are accounted for
- Energy auditor proposes the implementation order of different actions in the same building. In this process, possible technical interaction of individual end-use actions is taken into account and double-counting is removed from the total savings.
- In the calculation of realised savings each year, the actions which are taken into account are: 1) all actions implemented in each year, 2) actions for which an implementation decision has been made during the year and 3) one third of actions which have been reported to be under consideration.
 - In the cumulative savings (GWh/a of “valid” savings in any given year) actions of these three types are calculated only once without double counting. This is possible because data for implemented actions is collected every year and it is known when, e.g., an action under consideration becomes an action implemented.
- Lifetimes of technical and operational actions are different. An average lifetime of 12 years is used for technical actions. This is conservative in comparison to the proposed guidelines for the Energy Services Directive (ESD) related to the savings lifetimes of the actions given by the European Commission, which set 15 year lifetimes for most technical actions. Lifetime of 5 years is used for operational actions taking into account good level of consumption monitoring and prompt reaction to deviations, which is one of the obligations in the Energy Efficiency Agreements.
- Interaction between end-use actions and double counting of policies (with the Energy Efficiency Agreements) have been taken into account and removed from the results based on data collected to the monitoring database of the two schemes.
 - When participants to the Energy Efficiency Agreements fill in their annual on-line reporting, they automatically see a list of actions proposed in their energy audits. They choose which actions have been implemented and report the implementation year. These formulate the savings of the Energy Audit Programme. They can also report additional actions not proposed in energy audits (e.g. actions implemented in buildings without an energy audit or street lighting actions). These formulate the savings of the Energy Efficiency Agreements.

Ex-post verifications and evaluations

- The savings achieved by the energy saving actions are not usually verified by subsequent measurements, since it is most often difficult to make measurements in practice and it generates significant additional costs.
- Other important policies which have been running in parallel with the Energy Audit Programme are the Energy Efficiency Agreements and an energy investment subsidy scheme (Energy Aid) which both are under the jurisdiction of the Ministry of Economic Affairs and Employment. All three schemes operate at the national level. The impact evaluations given here exclude impact of actions reported for the Energy Efficiency Agreement. The impact of the investment subsidy scheme overlaps with impact of the energy agreement scheme and the voluntary energy audits and, therefore, there is no separate impact estimate for investment subsidies. Also actions not proposed in energy audits are eligible for investment subsidies.

Other indicators monitored and/or evaluated

Indicator	Explanations
CO ₂ emissions avoided ***	Data used in calculation: energy savings by energy carrier (electricity, heat, fuels) and emission factors
Direct pay-back times *	Data collected from the energy audit reports
Annual cost savings *	Data collected from the energy audit reports. Calculated by using average energy prices and energy savings by end-use action.
Investment cost *	Data collected from the energy audit reports for all proposed actions.
Public budgets used for energy audits *	Data collected from the subsidy applications and decisions.
Audited building volumes by building type *	Data collected from the subsidy applications and decisions and the energy audit reports.
Total energy consumption in the audited buildings *	Data collected from the energy audit reports.
Savings in capacity charges (electricity and district heat) **	Data collected from the energy audit reports.
Water consumption *	Data collected from the energy audit reports.
Savings of water and energy associated with water heating *	Data collected from the energy audit reports.

* The data is reported in the annual summary report prepared by Motiva (in Finnish only, see “To go further”).

** The data is monitored but not reported.

*** Calculated for international reporting (UNFCCC country reports and Policies and Measures (PaMs) reporting of the European Commission).

Experience feedback from stakeholders

Feedback: Mr Heikki Väisänen (Deputy Director General, Energy Efficiency) and Juha Toivanen (Senior Engineer). Energy Authority, Finland [evaluation customers].

1. What is the role of evaluation in the management of the scheme?

The role of continuous evaluation was critical during the first years and it has been very important afterwards.

2. What were the main lessons learnt from the evaluations (about the impacts of the scheme and what could be improved)?

a. Is there a link between the evaluation of energy savings from energy audits and provisions used to ensure the quality of energy audits/qualification of energy auditors?

Yes. E.g., the provision to nominate two auditors (one for heating, ventilation and air conditioning (HVAC) and one for electrical systems) came from the fact that using only one auditor delivered nearly zero savings from the “other system”. Also, constant low level of savings compared to the average is an indication that there may be a quality problem.

b. What are the uses of the data collected from the energy audits? More data is collected than needed in energy savings calculations only.

Information collected is used also in quality control, in preparing lists of energy saving actions, marketing of energy audits and in reporting of savings to the EU. Data is also used in the sphere of the energy efficiency agreements.

The overall performance of the scheme is continuously evaluated. If there are problems, we need to know where those are. It is another question if we can interfere, but we must know and understand the situation.

Comprehensive and reliable data was very important during the first years of the scheme

for marketing purposes. If the audience is, e.g., managers of city hotels, then the results and experience presented must be from hotels located in city centers.

3. What were the lessons learnt in terms of evaluation practices? Particularly, what is the approach to manage synergies and double counting when policies are designed to be complementary (such as voluntary energy audits, energy efficiency agreements and energy aid)?

Synergies we really try to develop, there we have 1+1 is more than 2. Agreements sort of saved the energy audits. That can be seen from the development after the first years of new agreement periods (1997-2007 and 2008-2016).

Double counting is not a problem when the monitoring boundaries are properly designed. We did a few times a detailed calculation of the net savings from Energy Efficiency Agreements, voluntary energy audits and subsidies. Only two persons could do that reliably and accurately.

4. In parallel of the ex-post evaluations, are there other evaluations or studies that provided insights about the impacts of the scheme and/or possible interactions with other policies or drivers (or barriers) for energy efficiency?

When we started promoting ESCOs we needed to ensure that we do not create competing policy measures. We have also seen an interaction between the subsidies for investments and audit volumes. If subsidies are taken away, that will lower the interest in audits.

5. Although mandatory energy audits do not concern municipalities, more generally: is there any link between the monitoring and

evaluation of voluntary and mandatory energy audits in Finland? Can something be learned from the monitoring and evaluation of voluntary energy audits which could be applicable for the mandatory energy audits?

In Finland mandatory audit for large companies consists of two parts and includes a company level energy audit supplemented with on-site energy audits. From on-site energy audits we collect pretty much the same data than from the voluntary on-site energy audits and thus we had no need to set up a new separate Monitoring and Verification (M&V) system for mandatory audits. This also means that there is a strong link between M&V of voluntary and mandatory energy audits in Finland. We used our knowledge gathered thru our long history of M&V (1994->) of voluntary energy audits when we planned M&V for the mandatory audits.

Concerning the mandatory company level energy audits we have not seen the need to set

up a separate M&V systems while more or less all useful information would be overlapping with the data we already receive through other channels like voluntary agreements annual reporting. Company level mandatory energy audit reports are collected by the Energy Authority only as part of the compliance check procedure.

6. What would you like to highlight about your experience related to the evaluations of the scheme?

Concerning energy audits and voluntary agreements it is so normal thing to have that we don't question it. It is a sort of guarantee that what we do has a clear and unquestioned justification.

To go further

About the measure

- Description in the MURE Database (TER-FIN3):
http://www.measures-odyssee-mure.eu/public/mure_pdf/tertiary/FIN3.PDF
- Motiva Oy (2015). Brochure on voluntary energy audits, 32 pages (Energiakatselmus kannattaa, in Finnish).
https://www.motiva.fi/ajankohtaista/julkaisut/energiakatselmukset/energiakatselmus_kannattaa.10778.shtml
- Motiva Oy (2011). Energy audits and analyses, brochure, 5 pages.
https://www.motiva.fi/ajankohtaista/julkaisut/energiakatselmukset/in_english/energy_audits_and_analyses.10780.shtml
- Latest available annual reports on energy audits (in Finnish).
https://www.motiva.fi/ratkaisut/energiakatselmustoiminta/tem_n_tukemat_energiakatselmukset/tilastotietoa_katselmuksista

References of the evaluation(s)

- Finnish National Energy Efficiency Action Plan (NEEAP-4):
https://ec.europa.eu/energy/sites/ener/files/documents/fi_neeap_2017_en.pdf
(unofficial unchecked translation by the Commission in English)

Other useful references

- Suomi, U., Puhakka, P. and Väisänen, H. (2007). Comprehensive monitoring system – essential tool to show the results of the energy audit and voluntary agreement programmes. Proceedings of the 2007 ECEEE Summer Study 2007.
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- Suomi, U., Puhakka, P., and Väisänen, H. (2009). New board energy efficiency agreement. Proceedings of the ECEEE 2009 Summer Study 2009.
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