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EPATEE

Evaluating financial incentives on energy efficiency in services (non-buildings) using deemed savings

This specific guide can be applied to evaluate the savings due to grants or subsidies in the service sector excluding buildings using the method deemed savings. It includes guidance and explanations specific to this combination of types of policy measure, sector and method. As well as links to general guidance and explanations, that can also apply to this combination.

CONTENT

1 | USE OF THE GUIDE–AUDIENCE, OBJECTIVES AND FOCUS

The primary **audience** for this guide is energy efficiency programme designers, implementers or supervisors, and evaluators looking for guidance on the evaluation process of energy savings in the scope of this guide.

Although the application of this specific guide will generally concern the (sub)national level, account will be taken of issues at EU level when relevant (e.g. the specific format of saving figures for the EED).

This guide is not about the preceding step in the evaluation process, the choice of the method. About this previous step in the evaluation process, see the guidance provided here. This guide is not about the preceding step in the evaluation process, the choice of the method. About this previous step in the evaluation process, see the guidance provided here. However, after presenting the capabilities and limitations of the guide at hand, the user will be offered alternatives for the method within this guide (see section 6).

The **objective** of this guide is to provide:

- Information on the scope of the guide that enables the user to decide whether this guide is suited to his/her needs, and whether complementary or additional method(s) could be needed or useful (section 2);
- Guidance about specifying the evaluation objectives and requirements (section 3);
- Guidance about key methodological choices to calculate energy savings (section 4);
- Guidance about the inputs (data requirements) and outputs of the method (energy savings metrics) (section 5)**;**
- Possible alternative methods (with pros and cons) (section 6)
- Background about evaluation results other than energy savings (section 7);
- Relevant examples, case studies and/or good practices (section 8);
- Relevant references for further reading (section 9).

The specific guide is intended for assessing realised (ex-post) energy savings. However, account is taken of earlier (ex-ante) evaluations of expected savings, if available (see section 4).

The **focus** of the guide is on impact evaluation, i.e. determining the energy savings, but not on how this has been reached through a step by step process with intermediate results (process evaluation).

Readers looking for the basic and general principles of energy efficiency evaluation may find the following link useful.

2 | SCOPE OF THE GUIDE – POLICY, SECTOR and METHOD

2.1 About financial incentives

More information and examples on the different subtypes residing under the main type **financial measures** can be found here and here. The focus of this specific guide is restricted to subsidies.

Subsidies are an important instrument for spurring investment in energy efficient technologies and services as they can address various barriers to energy efficiency technology deployment. These subsidies can make energy efficiency investments more attractive for private and public entities, particularly by lowering inhibitive upfront costs.

Subsidies may be used to complement other energy efficiency policies such as minimum performance standards and buildings codes, overcoming market barriers for cost-effective technologies.

More detailed information on the evaluation of financial incentives can be found here.

When subsidies are combined with other policy measure types it is assumed that the overall savings are mainly resulting from the policy measure at hand. However, the evaluation concerns the combined savings effect of both policy measures.

The guide is not capable of attributing part of the (overall) calculated savings to each of the policy measures (see also Double counting in section 4 on Gross to Net savings).

2.2 Evaluation when combined with energy taxes

The calculated savings effect for subsidies will overlap with that of the energy tax. The guide is not capable of attributing part of the (overall) calculated savings to either the policy measures at hand or the energy tax. For dealing with this overlap see section 4 on Gross to Net savings.

2.3 About services excluding buildings

Information on (sub)sectors defined in the Toolbox can be found here and here, chapter 2, p.17

Services excluding buildings refer to all energy using systems (the devices) in the service sector that are not applied for heating, cooling and ventilation in buildings.

2.4 About deemed savings

Information about the various evaluation methods can be found here, table 1 and 2. Deemed savings describe an estimate of unitary energy savings (one unit is usually a piece of equipment, but can sometimes be participant if end-use action taken are rather uniform). Deemed energy savings are energy savings that are calculated based on data and assumptions from sources of data and expertise available beforehand (e.g. previous studies, manufacturers' data, national statistics, expert estimates). Deemed energy savings are usually defined for a uniform type of action, which enables to calculate total savings (see next section).

2.5 Complementary methods to determine total savings

Complementary methods are methods that are required, in addition to the primary selected method, to calculate energy savings.

The method at hand is meant to calculate unitary savings for one device typically used in the service sector. These unitary savings should be multiplied by the number of actions or participants in order to have the calculated total savings. The number of actions or participants can be obtained in various ways. See this link, table 2 and 3. The number of actions is sometimes directly available from the monitoring of policy measures, such as from awarded grants in case of a subsidy scheme.

2.6 Additional methods to increase reliability of the results

An additional method can be applied on top of **deemed savings** to improve the reliability of the evaluation results and/or the cost-effectiveness of the evaluation approach.

As deemed savings are based on data available from other sources than the actions implemented and evaluated, their reliability is unknown and depends on the quality of the data used and whether the data and assumptions used to calculate the deemed savings represent well the actions and their conditions of implementation. Measurement of savings (direct measurement or billing analysis) for a sample group of the saving actions can be an additional method to check the accuracy of deemed savings. The combination can increase the reliability of the savings figures and is more cost-effective than measurement for all dwellings.

For possible combinations with an additional method see chapter 6 here.

3 | EVALUATION OBJECTIVES and REQUIREMENTS

3.1 Meeting evaluation goals and ambition

The table shows whether this guide can be used to report on general evaluation goals or criteria. See also this document.

General types of evaluation goals or criteria	Level of ambition	Remarks
Calculation of realized energy savings from saving actions	Fair	If savings actions are homogenous
Calculation of energy savings attributed to the policy measure(s)	Medium	Estimates of number of actions expected are critical
Cost-effectiveness of saving action (for end-users)	Medium	Subsidies aim for cost-effectiveness
Cost-effectiveness of policy (government spending)	Low	Government budget is known
CO_2-emission reduction from saving actions	Low	See energy savings
CO_2-emission reduction attributed to the policy measure(s)	Medium	See energy savings

For more information on verification of actual energy savings and attribution/baseline/corrections, see section 4, and for cost-effectiveness and emission reduction see section 7.

3.2 Reporting expectations

The method will make it possible to report (net) savings of subsidies for service devices. However, the described method of direct measurement is associated with an increased effort.

3.3 Time frame for evaluation

The length of the period under evaluation is dependent on the active period of the policy measure, the need to monitor developments before the implementation of savings actions (in case of methods based on before/after saving actions), and the time needed to present (sufficiently reliable) results or impacts that fit into the decision making process. In some cases, the periodicity of evaluation can be set by law.

The planning of evaluation activities concerns regular monitoring of energy consumption and factors that define consumption, intermediate check of (ex-ante) estimated (unitary) savings through measuring or surveys, intermediate evaluations to improve the policy implementation and the final evaluation and reporting. See also planning of evaluation in the link here.

3.4 Expertise needed for chosen method

The method deemed savings builds on assumption of unitary savings and the impact of financial incentives on the number of actions performed. Thus, a good data basis for these assumptions should exist and the expertise on how to interpret these data must be available.

4 | KEY METHODOLOGICAL CHOICES FOR CALCULATION OF ENERGY SAVINGS

This section deals with key methodological choices to be considered when calculating energy savings: consistency between ex-ante and ex-post evaluation, baseline, normalization and adjustment factors. These choices are important **to document** when reporting energy savings, to ensure the **transparency** of the results.

General principles of calculating realized savings using different methods can be found here and here.

4.1 Matching method with earlier ex-ante evaluation

From the viewpoint of methodological consistency and data availability using the same method in the ex-ante evaluation and in this specific guide on ex-post evaluation might be an obvious choice. This is indeed possible as one of the (few) applicable ex-ante evaluation methods is deemed savings.

A different method than the one(s) used for the ex-ante evaluation can be applied for the ex-post evaluation, depending on the evaluation objectives, timeframe and data available for the situation after implementing the actions. For possible combinations of methods applied ex-ante and ex-post, see chapter 7, calculation approaches in this document.

If the **deemed savings method** does not provide an acceptable combination with the earlier applied ex-ante method it might be useful to select another method (see examples of alternatives in section 6).

In practice, ex-ante and ex-post evaluations are applied consecutively. The ex-post evaluation builds on an ex-post evaluation that makes use of data coming from previous ex-post evaluation or studies (e.g. about previous periods of the same policy measure, or about the same types of energy saving actions as the ones promoted by the new policy measure). These previous ex-post studies could have used another type of method as well.

4.2 Calculation baselines

Energy savings are defined in general as the difference between the actual situation and a reference situation without the saving actions (and without the policy measures that influence these saving actions). In case of saving actions the reference situation can be defined using various calculation baselines: Before/after, With/without, Trend, Target/control group and Minimum efficiency standards. For further background further here.

The applicable baseline options regarding financial incentives targeting devices in services are minimum efficiency standards or with/without.

Depending on the requirements in section 3, preference should be given to before/after baseline.

Depending on the requirements in section 3 preference should be given to one or the other baseline.

See further information on baselines in this document.

4.3 Normalization factors

The calculation with the baseline options provides a change in energy consumption that should be corrected for influences on energy consumption other than the saving actions. These so-called normalization factors can be weather (with effect on consumption), the rebound effect and changes in energy using activities, such as production (industry), occupation rate (buildings) or car usage (transport).

Normalization factors that also comprise Performance gap and the Pre-bound effect; see this link and in this document or in this link.

For the Specific Guidance at hand, the normalization factors can concern changes in production value. See table 1 in this link.

4.4 Adjustment factors

Adjustment factors define which part of the calculated energy savings can be attributed to a policy measure or meets the definition of savings specified in the evaluation objectives or reporting requirements (see next section on "Calculating Gross and net savings).

Adjustment factors can concern the Free rider effect, the Spill-over/multiplier effect, Additionality and Non-compliance.

In case of another policy focusing on the same saving actions as evaluated with the Specific Guidance at hand, the adjustment factor Double counting might be relevant. If the other policy is not covered in the Specific Guidance at hand, double counting can only be accounted for at a higher level than an individual Specific Guidance.

See Distinction of energy efficiency improvement measures by type of appropriate evaluation method, in this link and here; and also in this EMEEES document.

See also "Saving calculation methods and their application in the EPATEE Toolbox", in this link.

The adjustment factors Additionality and Non-compliance influence the unitary savings of a saving action (see Gross and net savings), but the free rider and spill-over effect influences the number of actions.

The adjustment factors to consider in priority are free-rider, spill-over and non-compliance, see Annex in internal note on Application of Knowledge Base saving quantities, baselines and calculation factors), chapter 8.

For free riders a distinction must be made between saving actions due to the policy measure and actions which would have been taken anyway. The method deemed savings does not provide directly this information, thus other ways must be found, such as a survey among participants to the policy measure about their motivation, or application of Randomized Controlled Trial (RCT) or Quasi-experimental design (see further in further in this topical case study.

4.5 Calculating Gross and Net energy savings

Gross savings concern the calculated savings from saving actions using a chosen baseline and normalization factors. Net savings concern the savings attributed to policy measures or to a stakeholder (e.g. an energy company with an obligation to realise savings at their customers).

When calculating the savings a distinction must be made for most guidances to the **unitary savings** and **number of actions**; see here.

The gross unitary savings can be calculated using the earlier chosen baselines (see section on baselines) and correcting for relevant normalization factors (see section on normalization factors). The gross number of actions is determined with the complementary method (see chapter 2). Total gross savings are equal to gross unitary savings times gross number of actions.

Net unitary savings can be determined from gross unitary savings applying the relevant adjustment (see section on adjustment factors > factors for unitary savings). The net number of actions are determined from the gross number, applying the relevant adjustment factors (see section on adjustment factors > factors for number of actions). Net total savings are equal to net unitary savings times net number of actions.

See also this document.

Gross savings can be corrected for non-compliance due to inappropriate implementation of saving actions. To this end data should be available of sample-wise checks on the implementation.

The savings should be corrected for Double counting effects, i.e. the overlap between the savings due to financial incentives and savings due to other policy measures. The overlap in the calculated savings of both policy measures cannot be processed at the level of a Specific Guidance but must be corrected at the level of savings due to overall policy portfolios. For addressing double counting see this link or here.

See section 8, Concrete examples, Karner et al.

5 | INPUT AND OUTPUT

5.1 Main data requirements and data sources and collection techniques

Data requirements specified in the table below correspond to the calculation of energy savings, when using the baseline option minimum efficiency standards.

Calculation subject	Data requirements	Possible data sources and collection techniques
Energy consumption / unitary savings	Estimates on deemed average savings per action	Typical savings from prior implementations
Normalization factors affecting energy consumption	For production value effect: - running hours per year - behaviour of the device at different load levels; average load level	Subsector information data from manufacturer Measurement/estimates
Adjustment factors	Free-rider, non-compliance	Surveys; data from prior implementations; case studies
Number of actions	Subsidised devices per type (and capacity)	Awarded subsidies per type of action

Data issues when evaluating net energy savings

The main good practice to ensure the feasibility and reliability of the evaluation of net energy savings is to think about the method to be used when designing (or revising) financial incentives.

Experience indeed shows that unless the data collection has been planned in advance, it will be very costly, time-consuming or even impossible to collect the data required to apply most of the methods that can be used to evaluate net energy savings. Which makes that in practice, using surveys will remain the only option possible (or considered feasible).

The main challenges when using surveys (e.g. on free riders) are:

- to achieve a high answer rate, in order to limit sampling bias
- to use question phrasing that can limit the risk of bias in the answers

For more details about the evaluation of net energy savings, see this topical case study

For possible other methods with different data demands see section 6 on alternatives for the chosen method.

5.2 Energy savings in final terms or in primary terms

Energy savings can be expressed in final terms or in primary terms; see definitions about primary and final energy here.

The method of deemed savings can calculate savings in final terms. It can also calculate savings in primary terms provided that savings at end-users are calculated for each energy carrier apart, and primary factors are available to convert the savings in final terms to savings in primary terms.

5.3 Energy savings over time

Implemented saving actions in a year lead to savings over a number of consecutive years. E.g. a more efficient boiler can save gas over its lifetime of about 15 years, insulation over up to 30 years and more efficient computers up to 5 years. Energy savings can be calculated in different metrics in terms of time reference, for example: year-to-year, annual, cumulated annual, cumulative. See the definitions here.

The calculated annual savings concern the savings of all new saving actions in that year. In this approach only data for the savings in the chosen year are needed.

Adding up the annual savings over a period, provided that earlier saving actions are still delivering savings, leads to cumulative savings. For the cumulative savings data are needed for the whole period.

Another cumulative approach, to be applied for the EED, is to multiply the (new) savings in a year with the number of years up to a target year and sum this result with that for all other years up to the target year. This cumulative approach stimulates early saving actions, as these count more to the target than later actions.

Finally, savings from a saving action can be discounted and summed up over the lifetime of the action when discount factors have been defined for yearly savings over time .See also the link here.

The method deemed savings can provide annual savings of new saving actions in that year. It can also provide cumulative savings provided that data are available over a period.

Cumulative savings according to the Energy Efficiency Directive can be provided when the lifetimes of savings actions are known.

6 | ALTERNATIVE FOR CHOSEN METHOD

6.1 Alternatives for the chosen method

Other savings calculation methods can be applied as well, although they will all have pros and cons regarding various aspects dealt with in preceding sections of this guide.

The table below presents the pros and cons of the method for evaluating financial incentives in services (non-buildings) and for commonly used alternative methods for the same combination of policy measure and sector.

Type of method	Pros	Cons
Deemed savings	Relatively low cost	Only a limited number of types that can be described in a standardised way
Direct measurements	Precision and provides data about actual energy consumption	Costly and time consuming depending on the number of actions

7 | ADDITIONAL EVALUATION RESULTS

7.1 Calculating avoided CO_2 emissions

Avoided CO_2 emissions can be evaluated from the energy savings by applying emission factors. Four key aspects are to be taken into account when choosing the emission factor(s):

1) Emission factors vary according to the **energy type**, so the data about energy savings need to be available per energy type.
2) Emission factors for a given type of energy **can vary over time** (especially for **electricity**).
3) Emission factors can take into account:
    a. **Direct emission factors**: that take into account the emissions generated when producing the energy used;
    b. **Lifecycle emission factors**: which take into account all the emissions generated from the extraction of the energy resources up to the dismantling of the energy plant.

Due to the differences that the choice of emission factor(s) can induce, it is important to document what emission factor(s) has (have) been used.

The reduction in CO_2-emissions can only be calculated when savings are calculated per relevant energy carrier and a specific emission factor is available for each energy carrier.

The avoided emission of **other greenhouse gasses** due to energy savings are not taken into account here, as these emissions (and more specifically their reductions) are generally negligible compared to CO_2 (apart from policy measures targeting the agriculture sector).

IPCC (Intergovernmental Panel on Climate Change) provides a **detailed database of peer-reviewed emission factors.**

7.2 Calculating cost-effectiveness

Cost-effectiveness is the ratio between costs to achieve energy savings and the amount of savings and possibly other benefits.

A distinction can be made according to the point of view adopted to assess cost-effectiveness:

- Cost-effectiveness for the end-user or participant
- Cost-effectiveness for society at large
- Cost-effectiveness for the party that takes responsibility for saving targets (government or actor with an Energy Efficiency Obligation)

See here.

The calculation of cost-effectiveness for end-users demands, next to the savings, data on investments made, subsidies on investments, interest rates, lifetimes of the saving actions, energy prices (including taxes) per type of end-user and discount factors per type of end-user.

For cost-effectiveness from a societal viewpoint no account is taken of subsidies and taxes, energy prices concern world market price, and a lower value of the discount factors is valid.

7.3 Other aspects of importance

Possible co-benefits from saving energy concern:

- Extra employment
- Reduction of energy poverty
- Other emission reductions (NOx, SO2, fine particles, etc.)
- Better indoor climate
- Reduced dependency on (insecure) energy import

The following co-benefits are regarded as most relevant and/or feasible to calculate in conjunction to this specific guide (see table)

Type of aspects	Why it is evaluated	References where more details can be found
Productivity	Substitution of equipment might have a positive effect on productivity besides the energy savings	https://www.mbenefits.eu/
Work environment	Improvement of work environment due to new (more efficient) equipment (better lighting, air quality)	https://www.mbenefits.eu/

8 | CONCRETE EXAMPLES

Karner et al.: *Evaluierung und Monitoring des Städtischen Energieeffizienz-Programms (SEP) der Stadt Wien für die Jahre 2006-2015.* Available online *https://www.wien.gv.at/stadtentwicklung/energie/pdf/sep-endbericht.pdf*

9 | FURTHER READING

General guidance on evaluations:

- Baumgartner, R. (2017). Chapter 12: Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Prepared for NREL (National Renewable Energy Laboratory), September 2017. http://www.nrel.gov/docs/fy17osti/68568.pdf
- Hoffman, I., Schiller, S., Todd, A., Billingsley, M., Goldman, C., Schwartz, L., 2015. Energy Savings Lifetimes and Persistence: Practices, Issues and Data. Technical Brief, Lawrence Berkeley National Laboratory, May 2015. https://emp.lbl.gov/publications/energy-savings-lifetimes-and
- Eichhammer et al., 2008. Distinction of energy efficiency improvement measures by type of appropriate evaluation method. Final Report on Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services. EMEEES Project report. https://www.epatee-lib.eu/media/docs/EMEEES_WP3_Report_Final.pdf

Specific guidance on deemed savings method:

- Evaluation qualitative du dispositif CEE 2ème période 2011-2013 (Qualitative evaluation of the French white certificates scheme – second period 2011-2013), ADEME, 2013

Relevant case studies

- Not available

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