WP 4 EPI-SoHo Approach and Implementation Technique
Assessment

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Energy Performance Integration in Social Housing

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Assessment

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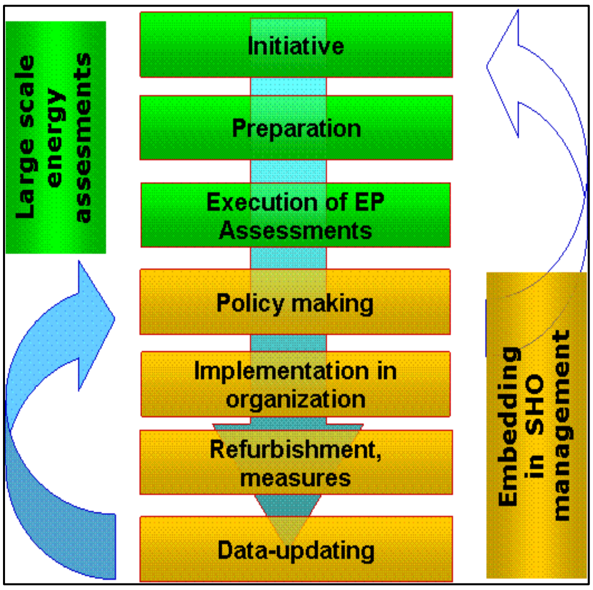
1 Objectives

The objective of this report is to provide guidance on the generic approach for large scale, cost-effective and high quality execution of Energy Performance Assessments that match the national or local context. This means the focus of this report lies on the modules "Initiative", "Preparation" and "Execution of EP Assessments" in the EPI-SoHo-Approach as shown beside.

Figure 1: EPI-Soho-Approach



Initiative

The step "Initiative" should define the framework for an Energy Performance Assessment in SHOs. In line with this the report starts with a description of the range of national requirements caused by the EPBD among the project partner countries. This range describes the "must" of a SHO concerning energy certificates as a first main driver for an EPA. The second chapter describes general "needs" of SHOs concerning energy and the relating energy data as further main drivers for EPA. Following the "added value" for SHOs is discussed by bringing together the "needs" and the "must".

Preparation

The added value of the EPI-SoHo approach can be quantified by several "indicators". Since every SHO is unique, each will have its own approach and needs for additional data. They will use the information according to their own priorities. Each SHO has to decide which of the indicators are relevant for its needs and may even develop other indicators for its own special circumstances of EPAs.

Execution

The step of execution means to collect data through an inventory of basic data from drawings and other sources within the SHO and inspection of the buildings 'in the field' by using the inspection and quality protocol, processing of the data in the chosen EP-tool, calculate the current situation and possible packages of measures, deliver EP certificates, EP advice reports and set up a data-management system / database e.g. by a building typology.

Recommendations

This 'theoretical' report provides guidance on the general approach. The National pilot projects during the EPI-Soho project have successfully demonstrated the usefulness and the applicability of the EPI-Soho approach, although the diversity of the National pilots is very high. The several National reports clearly demonstrate how the EPI-Soho approach can be adapted to specific needs and applied under varying circumstances and on different stages. As a feedback of the project partners we propose to read this 'theoretical' guidance in the context with the practice orientated reports of the National pilot projects (reports to Workpackage 5) to make the approach more clear.

Initiative

1.1 Must: EPBD requirements

The first main driver is the implementation of EPBD on national level. The EPBD obliges housing companies to collect a certain number of energy performance data depending on the national legislation (a “must” for SHO).

According to the state of the discussion in the partner countries there will be the alternatives to deliver an energy certificate based on the asset rating (calculated demand) or operational rating (measured consumption) for larger buildings, this is the case e.g. in Germany for buildings with more than 4 dwellings.

Range of national EPBD requirements

The status of national context is based on existing data and information available from the partners. The information given are restraint to the participating countries of EPI-SoHo project.

Most of the countries adopt a different method for new buildings and existing buildings. Asset rating (based on calculation demand) is the method most usually used in Europe, but some countries use operating rating (based on energy consumption measured) for existing building with central heating system (e.g. France or Germany).

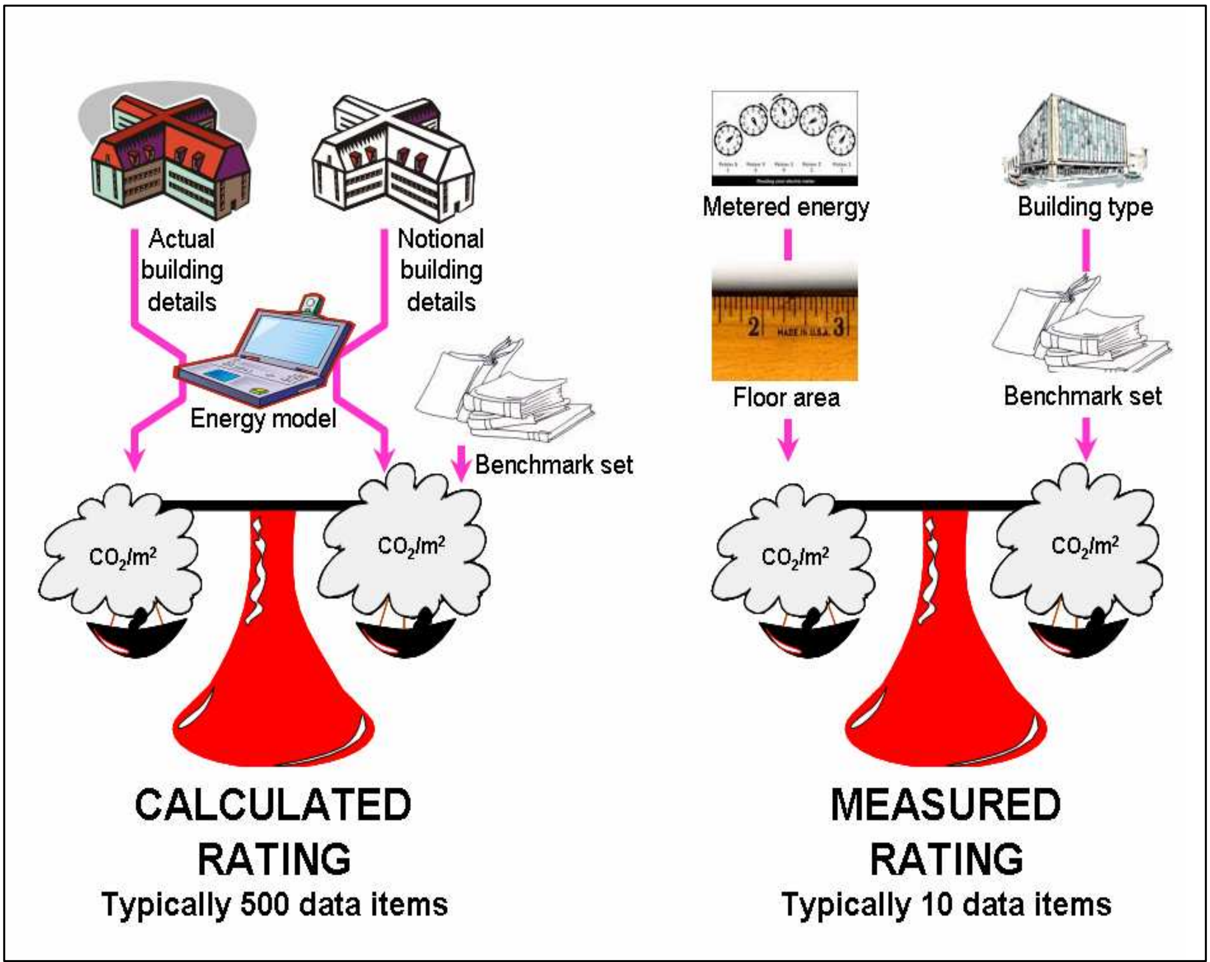


Figure 2: Methods of rating (source: CSTB)

Methodology of calculation

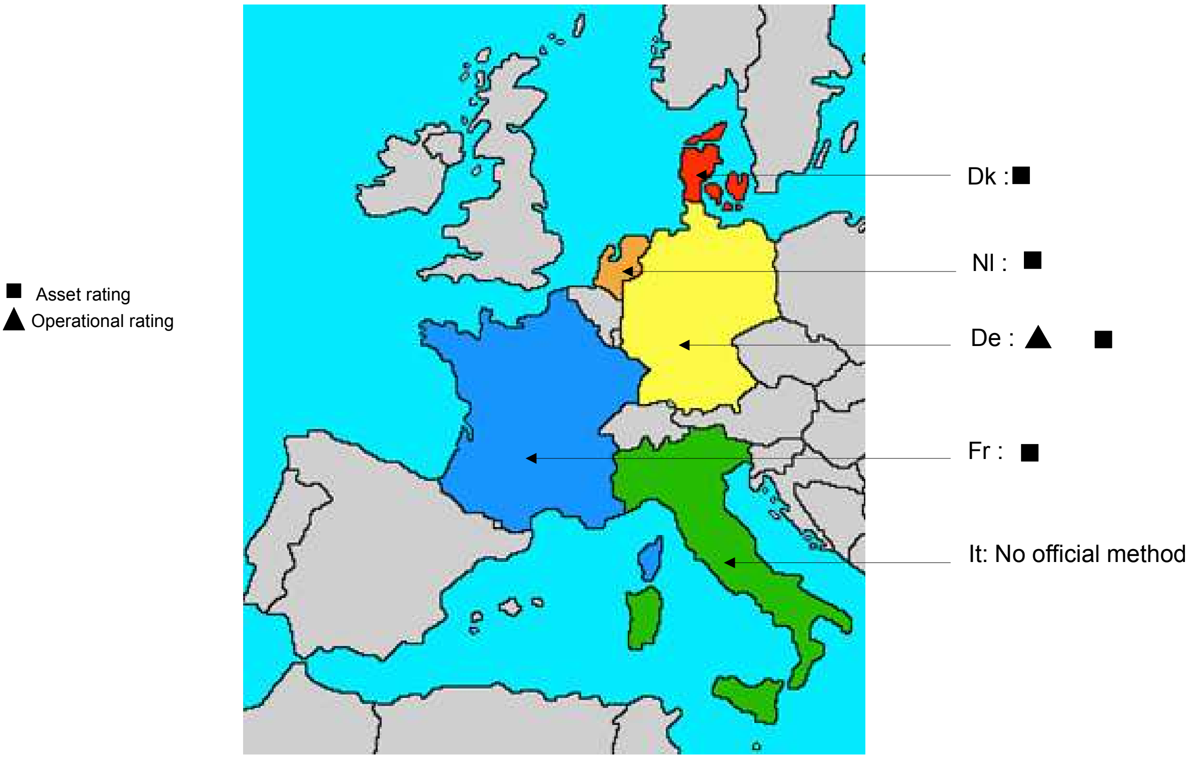


Figure 3: Methodology of certification (source: CSTB)

When shall Certification start?

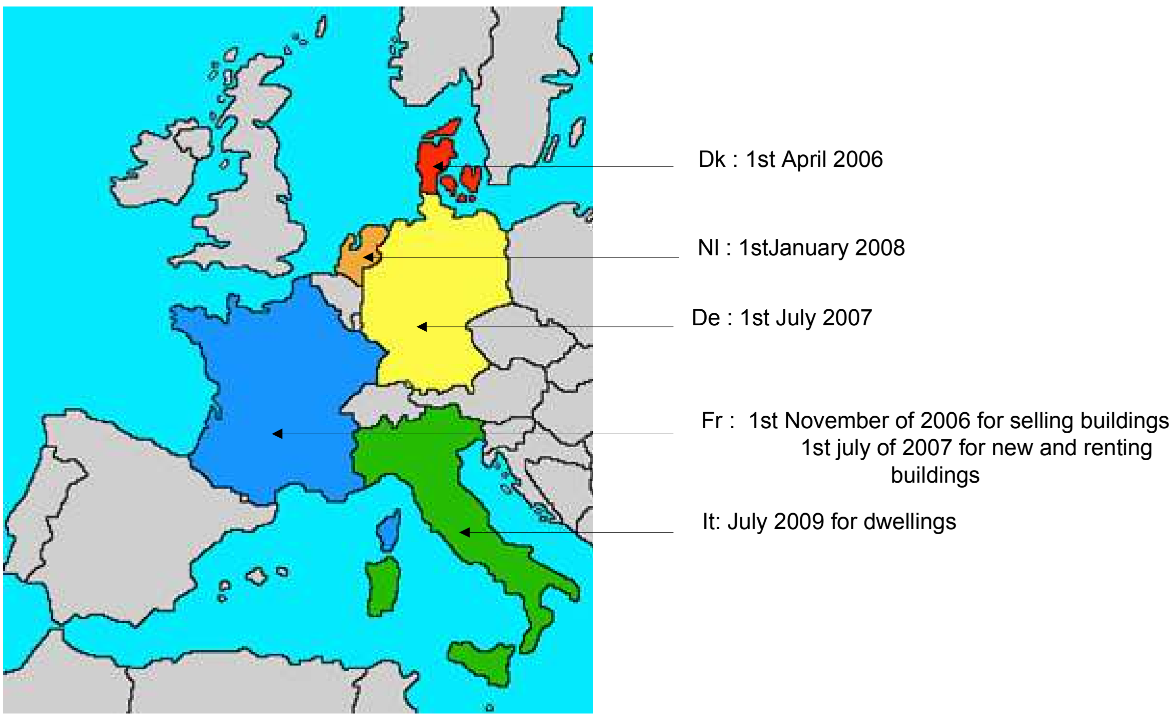


Figure 4: Start of certification (source: CSTB)

The following table presents the national context concerning the Energy Certificates

	Type of building	Date of application	Methodology	Indicators
Germany	***Selling***	1st July 2007	**Operational rating or asset rating** (> 4 dwellings) **Asset rating** (< 4dwellings)	- **Primary energy consumptions** (kWh/m²/year) - **Green houses gases emission** (CO_{2equ}/(m²a)
	Renting out			
	New		**Asset rating**	
Denmark	***New***	1st April 2006	**Asset rating**	- **Primary energy consumptions** (kWh/m²/year)
	Renting out			
	Selling			
Italy	***Existing***	July 2007 for large building (>1000 m²) July 2008 for small building (<1000 m2) July 2009 for dwellings	No official method. Implementation framework will be approved in 2008.	- **Primary energy consumptions** (kWh/m²/year)
	New	EPA is required since 2007. EC has not yet been introduced.		
Netherlands	***Renting out***	1/1/2008 and one extra year for SHO's	**Asset rating**	- **Primary energy consumptions** (kWh EP/m²/year) - **CO_2 indicator**
	Selling			
	New			
France	***Renting out***	1st July 2007	**Asset and operational rating** (building prior to 1948)	- **Primary energy consumptions** (kWh EP/m²/year) - **Green houses gases emission** CO_{2equ}/m²/year
	Selling	1st November 2006	**Asset rating and operational rating**	
	New	1st July 2007	**Asset rating**	

Table 1: National context of certification

The implementation of EPBD in the five participating countries does not progress at the same speed. Moreover there are very different methodologies to calculate the Energy Performance.

Strengths and weaknesses of ECs based on operational rating or asset rating

The strengths of ECs based on the operational rating are:

- The operating expense is slight. In Germany for example the certificate might be delivered by energy suppliers in combination with the service of calculation the heating costs for tenants.

- For tenants the heating costs are relevant. These are directly connected to the operational rating shown in the EC. By this the EC gives feedback to the behaviour of the tenants and might motivate them to save energy.

ECs based on operational rating have some essential disadvantages:

- In principle the approach is only possible for buildings with central heating system. For multi-family-houses with individual heating systems the values are normally not available.

- Energy saving measures can influence the assessment of the building in the EC earliest after a few years of measuring the (reduced) consumption. In consequence the motivation to invest in energy saving measures might be low.

- The energy demand is also corresponding to the individual behaviour. Therefore the assessment of the energy efficiency of the building is only approximatively. In fact the larger the buildings are the more irrelevant is the effect. But problematically is for example vacancy during a longer period.

- Based on operational rating and without the in situ description of the energetic characteristics of a building a qualified assessment of energy saving measures with recommendations is not possible. By this the external embedding as a part of cooperation management is not supported.

- The data of ECs based on operational rating provide hardly any additional information about the energetic quality of the building. The energy balance of the building cannot be calculated, recommendations for energy saving measures cannot be optimized. In short: there is hardly any connection between ECs and the decisions making process in housing companies. An internal embedding of additional energetic information is not possible.

Table 2: Advantages and disadvantages of ECs based on asset rating or operational rating

Energy certificate based on...	asset rating	operational rating
independance from user behaviour	+	– / O *)
costs	–	+
measures / recommendations	+	–
correlation with heating costs	O / + *)	+

*) depends on (small) detached house or (large) multy-family-house

1.2 Needs: Energy Performance Assessments

As shown above EC's are not enough to develop a long-term strategy for future investments. These strategies have to be based on main drivers with related individual indicators. To define these main drivers is a part of the initiative step. But the connection of the main drivers with individual indicators is part of the preparation step (see chapter 3). There are some common main drivers for SHOs defined in the following.

- **low living costs for the tenants**

In general SHOs have to provide dwellings to low (and medium) income-households. For this target group the total rent (basic rent and operating costs) is important. A low basic rent does not automatically lead to low living costs for the tenants. In Germany the so called "second rent" averages 36,5 % of the total rent. Most of the "second rent" is caused by heating costs. Increasing energy prices increase the heating costs and endanger the aim to keep the living costs of the tenants affordable. Therefore it is important for the SHO to get information about the heating costs and about the possibilities to reduce the heating costs by an energy saving investment.

- **adequate technical and functional requirements**

A functional requirement does describe standards of a building itself. For example the definition "Low-Energy-House" is a functional requirement describing a certain energetic standard of a building including its technical equipments. Against that technical requirements refer to several technical equipments of a building or a dwelling, e. g. the quality of the thermal insulation of the outer wall. Functional and technical requirements of buildings or dwellings are defined first and foremost by law or by market. But the indicators for the users of buildings are not the functional and technical requirements themselves but the effects connected with that:

  - Good thermal insulation and an efficient energy supply system reduce the running costs for heating, cooling and hot water.
  - Moreover this has an environmental effect by decreasing the energy consumption and the local $CO_{2\text{-equ}}$-emissions connected with it, especially by using solar systems and renewable energies.
  - Adequate thermal insulation increases the inner surface temperature of the building envelope in the heating period. By this a good thermal behaviour is guaranteed even in very cold winter periods, connected with low energy consumption and costs.
  - Thermal insulation measures can avoid structural damage of building elements. By the increase of temperatures of inner surfaces and elements condensation of water vapour and the connected structural humidity problems can be avoided or reduced to a minimum. By this an energetic modernisation extends also the lifetime of a building.
  - Further on there are many reasons for airtight buildings: Reduced energy requirements, protection from damage caused to the building by convection effects, enabling a ventilation system to meet the required needs, protection against ingress of harmful substances, good soundproofing, improved smoke- and fire-protection, enabling good ambient air quality, a more comfortable standard of living.

- **economic survival / success of the organisation**

Energy saving measures in new buildings and refurbishment projects have direct financial consequences for SHOs. Independent from the different forms of social housing across Europe the SHO has to finance the projects and has to avoid unprofitable investments wherever possible or has to cover negative results by other profitable investments. Energy saving measures that do not support the economic success of the SHO will not be executed as a standard. They will be an exception or these measures will be only realized as long as there are subsidies. But they won't change the typical standard of measures. Even more: uneconomic measures are bad examples and per definition not sustainable. Sustainability does include the economical success of the company. That means energy saving measures have to be included in the long term strategy of the company using the adequate instruments and tools of the EPI-SoHo approach. By this a good energy standard might be an element to distinguish from other competitors and to have an advantage on the rental market.

In the context of profitability and climate protection energy saving investment should be connected to refurbishment measures that have to be carried out at all. So it is of high importance to avoid “lost opportunities” particularly with regard to the fact that the surplus costs of additional centimetres of insulation are normally low. On the other hand the lifetime of the structural elements of a building is very high. If refurbishment measures are carried out and are not combined with sufficient energy saving measures later there will not be the chance to improve the situation for many decades ("lost opportunity"). There are several ways to estimate the economic efficiency of energy saving housing investments. The main problems are the definition of possible benefits (e.g. saving of heating costs, higher rents), the question who profits mainly from the investment (only the tenants by lower heating costs or also the SHO by rent increases) and the selection of a suitable calculation method to assess the economic efficiency.

- **communication und cooperation with stakeholders and tenants about energy issues**

Large (energetic) refurbishment projects in social housing require increasingly the cooperation among several stakeholders, mainly the municipality and the tenants. In such cooperation management just getting everybody on the table is not enough. There must be a well-defined common mission and a continuous management of the programme envisaged. Social housing can act as a model for energy-saving construction or refurbishment as it is clearly connected to public regulations. Public authorities can bind subsidies e. g. to conditions concerning thermal qualities or the use of certain building materials. Corresponding agreements with local authorities can lead to local targets (e.g. energy covenants).

In this context (of “needs”) the knowledge about the energy performance of a dwelling, a building or the total housing stock is important for SHOs to define mid- and long-term energy strategies. There is a great number of available energy performance data which helps the SHO to get information about the achievement of the different objectives. But the SHO has to know which data have to be collected for which reasons and how they can be used within the whole management process.

One of the drivers can also be that a SHO already has some kind of Corporate Social Responsibility (CSR). In Holland CSR means that the company has a clear, integral policy and everybody is committed in the execution of the work that takes into account people, planet and profit (Making profit without harming the first two, do it in a sustainable manner). This is like a way of working, a lifestyle and a mindset that serves as an umbrella for the total management, policy and work tasks of the whole organisation/ company. From this point of view, you can assign several indicators to this 'driver', like establishing low rents (people), be cost-effective (profit) and reduce CO_2-emmisions (planet).

1.3 Added Value: Embedding energy relevant data

SHOs are obliged to meet the national legal requirements for the energy performance of new buildings and the existing building stock ("musts"). Doing more than the legal requirements (e. g. EPAs) should create an added value for the SHO ("needs"). The EPI-SoHo approach focuses on this fact by bringing "needs" (EPAs) and "musts" (legal requirements, EPBD) together. This is independent from the fact that there is a broad range of national EPBD requirements among the European partners. The challenge for the SHO is to identify those additional relevant data that are not covered by the national EPBD implementation but create an added value by embedding them (see figure 1):

Internal embedding:
Integration of energy relevant data into management decision process

SHOs are facing the challenge to integrate energy data into their management. Using the new data for strategic management decisions instead of using them only on the operative level for new renting and selling creates an added value.

For SHOs Portfolio Management or Strategic Asset Management is becoming more and more important to control different investments and to secure the economic survive. Using the EPA-data together with an analysis of the possibilities of increasing the rent, the specific situation of different areas and the future development of population, incomes etc. creates an added value too. In the context of a running Portfolio Management system including energy diagnosis it is e. g. useful to define several energy performance standards, which can be applied if certain prerequisites are fulfilled. SHOs can thereby avoid expensive investments in the energy performance of a buildings, which must be demolished only few years later. (See WP 4, Report D 4.2).

External embedding:
Integration of energy relevant data into strategies for cooperation management

For housing companies cooperation management forms an integral part of the processes derived from the overall strategic management of the respective housing company. This systematic cooperation relates to tenants as well as to other stakeholders (e. g. town administration, police, utility supply enterprise, other housing companies, schools, non governmental organisations etc.).

In the housing field, one can discern between different types of cooperation management with regard to the intensity of the involvement of the stakeholders: from information to co-operation. The type of cooperation varies over time and project phase very rapidly but former projects in Europe have shown that one must not consider any of these types superior to the others without taking into account the concrete tasks and circumstances[1].

[1] For further information: see WP 6

1.4 Checklist: What to do?

In the initiative phase the management of the SHO has to discuss what the results and application of the energy performance assessments should be. Think of what kind of information, data, work flow process and organizational adjustments are necessary, when they are going to integrate energy assessments, energy performance data and certificates in the portfolio management and daily routine.

Use this check-list during the initiative phase. It may help to arrange your thoughts, objectives and defines the proper approach which suits your ambitions.

- What kind of analysis is required after the EP data collection (assessments)?
- What must be the (technical) program of requirements for the EP project?
- Make or Buy: EP assessments executed by own staff or third parties?
- Tender documents (in case of hiring third parties for the EP assessments)
- Commitment in own organization (management)
- Commitment of, or collaboration with external stakeholders (local authorities)
- Overview of the housing stock to be assessed
- Which data is already available?
- Assessment protocol
- Formation of a Project team
- Communication (internal organisation)
- Communication (external stakeholders, press etc.)
- Communication (tenants)
- Software implementation (data management)
- Etc.

2 Preparation

As shown above ECs based on operational rating are not helpful even if they fulfil the requirements of the EPBD. In principle there is no alternative to qualified ECs based on some additional information e. g. about the building construction as a basis for recommendations.[2]

2.1 Additional data for EPAs

Since every SHO is unique, each will have its own needs for additional data. They will use the information according to their own priorities. Each SHO has to decide which additional data are relevant for its own special use of EPAs. Nevertheless the process of defining indicators should include the following steps:

- **Identify the major energy vision of the company**

The aims and objectives of SHOs concerning the use of energy performance data in their policy, management and processes need to be thoroughly discussed. This defines the way EPAs are done, the kinds of data that have to be collected, the data information system in which the data have to be stored, etc. (See WP3, ToR).

This might already been done in energy plans or programmes. These plans could constitute a possible point of departure for an initial application of EPAs. Knowing vulnerabilities in the local energy structure or known financial, environmental or social pressures related to energy can inspire ideas on the critical areas to cover. These energy related vision has to be checked during the Epi-SoHo approach.

- **Select the indicators that are relevant**

The challenge for SHOs is to quantify the aims and objectives concerning the use of energy. In this context it has to be stressed, that the "delta-indicator" is the real important factor to set policy ambitions and to monitor the results, e.g. cost for energy consumption now and after some years.

As a help for SHOs a list of indicators that might be used by is included in the report. If necessary the SHOs have to define new indicators and their purpose and to determine how these indicators can be monitored by using EPAs.

- **Determine which data are needed to quantify the indicators**

Usually the indicators have to be calculated. Therefore additional data are necessary. In the following “list of indicators” these additional data are named. These data have to be integrated in the inspection protocol for ECs.

[2] In the preparation-step, the needs or questions from the tenants are also important to take into account, because tenants from different buildings or different parts of the city might have different needs.

2.2 List of indicators

The main objective of energy strategies for SHOs is to combine economic, environmental and social aspects in a balanced way and to use the information for an effective Portfolio and Cooperation Management with stakeholders and tenants. Moreover the needed environmental information has to be collected in a cost effective way. In practice this means: the data have to be collected in the context of ECs.

Taking into account these boundary conditions a list of indicators has been developed including a short description of the purpose and the needed additional data to quantify the indicators. It has to be considered that some of the indicators can be allocated to different "needs" of SHOs and that other indicators are possible depending on the individual situation of every SHO.

2.2.1 Low living costs for the tenants

In general SHOs have to provide dwellings to low and medium income-households. For this target group the total rent (basic rent and operating costs including costs for heating, cooling and hot water) is important.

Indicator: Costs for energy consumption [€/m²]

- Brief definition
  Actual and future costs paid by tenants for energy (heating, domestic hot water, electric cooling)

- Purpose
  This indicator reflects the final price paid by the tenants or consumers for energy services. Energy prices are driving forces for incentives or disincentives for consumption or conservation, or efficiency improvements. Also, energy prices will affect the affordability of housing for the tenants.

- Data to be collected
  - energy consumption for heating and domestic hot water (maybe included in ECs) and electric cooling (actual and calculated for the situation after modernisation)
  - actual end energy prices for heating, domestic hot water, electric cooling
  - average of the future inflation of costs for end energy (estimation)

Indicator: Share of total rent spent on energy [%]

- Brief definition
  Share of total rent spent on energy on average and for the e. g. 20% of the population with the lowest income

- Purpose
  This indicator provides a measure of energy affordability for the average tenant and for the poorest segment of households. From a sustainable development perspective, it is important to examine income, wealth and in particular affordability of modern energy services across the population. The population of a region or city may have a high per capita income, but their income distribution may be so skewed that a large percentage of the population has no possibility to meet their needs for commercial household energy at current energy prices and private income levels. Therefore, there is/might be a need to increase energy availability and affordability for the lower-income groups of the population so as to promote social and economic development.

- Data to be collected
    - cold rent per dwelling
    - actual end energy costs for heating, domestic hot water, electric cooling
    - other running costs
    - average of future inflation of costs for end-energy and other running costs
    - energy use and costs of representative households for each income group or target group

Indicator: Total rent neutrality [€/(m²Mon)]

- Brief definition
  Possible rent increase after energetic modernisation on the level of a building or a dwelling under consideration that the total rent stays on the same level after energetic refurbishment (with a higher cold rent but lower end energy costs for heating, hot water and electric cooling).

- Purpose
  A possible concept for socially balanced rent increases in consequence of an energetic modernisation is the so called 'total rent neutrality'. The goal of the concept is it to keep on the one hand the total (warm) rent before and after the energetic modernisation constant and on the other hand to improve the tenants satisfaction by a better thermal behaviour in the dwellings.[3]

- Data to be collected
    - estimation about the (additional) costs for (additional) energy saving measures. In this context it is helpful to have a table with typical energy saving measures and the full costs and additional costs
    - actual energy consumption for heating and domestic hot water (maybe included in ECs) and electric cooling
    - actual end energy costs for heating, domestic hot water, electric cooling
    - average of the future inflation of costs for end-energy
    - actual cold rent

[3] In this context the Ecological Rental Table Darmstadt (Germany) is a tool for SHOs to increase the rent without disadvantaging the tenant (total rent doesn't increase, but the part of cold rent versus energy costs changes). In Holland there's discussion about integrating the energy efficiency index of the Energy Certificate in the WWS (National Rating System for Dwelling Quality: basis for rent-setting): the idea is that if you have an energy efficient dwelling, the WWS total points get higher. The higher the outcome of the WWS, the more rent an SHO can ask. This means a reinforcement of the present WWS system which already sets a (partial) link between energy performance and rent.

2.2.2 Adequate functional and technical requirements

Functional requirements are describing standards of the building itself, e.g. the definition "Low-Energy-House". Technical requirements however refer to several technical equipments of a building, e. g. the quality of the thermal insulation of the outer wall.

Indicator: Household energy intensities (End energy) [kWh/(m²a)]

- Brief definition
  Amount of total residential energy used per person or household or unit of floor area or per electric appliance.

- Purpose
  This indicator is used to monitor energy use in the household sector. Improvement of energy efficiency in private households is an important priority, since it translates into the more effective utilization of energy resources and a reduction of negative environmental impacts. Many policies addressing energy efficiency and savings have been formulated for this sector. In colder countries, for example, the space-heating component has been the focus of many energy-saving policies, while in almost all countries, the electric appliance and lighting component is still the focus of many policies. This indicator in combination with benchmarks from EC is a good basis for external embedding in the frame of cooperation management.

- Data to be collected
  - Most of the data are included in the 'must' for ECs based on asset rating and an in situ survey
  - Consumption or asset rating of electricity for e. g. pumps or ventilation/cooling systems

Indicator: Efficiency of energy conversion and distribution (Primary energy) [kWh/(m²a)]

- Brief definition
  Efficiency of energy conversion and distribution, including fossil fuel efficiency for electricity generation, efficiency of oil refining and losses occurring during electricity transmission and distribution, and gas transportation and distribution. The indicator is defined on the level of primary energy.

- Purpose
  This indicator measures the efficiency of energy conversion and distribution systems in various energy supply chains including losses occurring during electricity transmission and distribution, and gas transportation and distribution. Improvements in the efficiency of energy supply systems translate into more effective utilization of energy resources and into reductions of negative environmental impacts.

- Data to be collected
  - Most of the data are included in the 'must' for ECs based on asset rating and an in situ survey, e. g. the status of the elements of the building envelope and the energy supply systems
  - The relevant reference value is the primary energy consumption. (Germany: calculation based on GEMIS)

Indicator: Renewable energy share in energy and electricity [%]

- Brief definition
  The share of renewable energy in e. g. total primary energy consumption, total end energy consumption or electricity generation.

- Purpose
  This indicator measures the share of renewable energy and electricity generation and generating capacity. The promotion of energy and in particular of electricity from renewable sources is a high priority for sustainable development for several reasons including the security and diversification of energy supply and environmental protection. This indicator can be also used as a good basis for external embedding in the frame of cooperation management.[4]

- Data to be collected
  - All relevant data are usually included in national ECs. The work to do is to transfer the information on the level of several building (ECs) up to the level of the building stock or parts of it. In this context building typologies might be helpful including typical buildings of the building stock

2.2.3 Economic success of the organisation

Energy saving measures that do not support the economic success of the SHO will not be executed as a standard. This means that energy saving measures have to be included in the long term strategy of the company, e.g. by using the following indicators.

Indicator: Costs per saved kWh of end energy [Cent/kWh]

- Brief definition
  Costs per saved kWh of end energy on the level of a building or dwelling

- Purpose
  This indicator compares the (additional) costs of the end energy saving measures with the saving of end energy costs. To calculate the costs of the saved energy the annual additional costs of the energy saving measures are divided through the quantity of saved energy per year. A refurbishment investment is efficient if the price for the unit of saved energy is lower than the expected price for the energy to be paid at each future time period.

- Data to be collected
  - Costs of energy saving measures (total and additional costs)
  - End energy savings through energy saving measures
  - actual end energy prices (heating, domestic hot water, electric cooling)
  - future end energy prices (estimation/prognoses)
  - For calculation: rented living space, period under review and interest rate

[4] This indicator is different in several national contexts. For instance, in France nuclear energy is part of the renewable energy sources, because French atomic energy use does not effect CO_2-emissions. In the Netherlands or Germany nuclear energy is not seen as renewable energy.

Indicator: Profitability (additional cost approach) [€]

- Brief definition
  Net present value of the investment on the level of a building or dwelling (additional cost approach)

- Purpose
  Conventional indicator to describe the profitability of single energy saving measures (replacement of a damaged heating systems, insulation of the outer wall, replacement of windows). A positive net present value means that the investment should be made. The present value of cash outflow (the (additional) costs of the energy saving measures) is subtracted from the present value of cash inflow (the additional rent). Suitable if the SHO profits from rent increases after energetic modernisation in a full rented housing segment.

- Data to be collected
    - Costs of energy saving measures (total and additional costs). In this context it is helpful to have a table with typical energy saving measures and there full costs and additional costs
    - Actual rent on the level of a building or dwelling
    - New rent after energetic modernisation (e.g. based on rental law or other criteria)
    - For calculation: rented living space, period under review, interest rate, general future rent development

Indicator: Profitability (full cost approach) [€]

- Brief definition
  Net present value of the investment on the level of a building or dwelling (full cost approach)

- Purpose

Energy saving measures are often carried out together with other refurbishment measures (e.g. refurbishment of kitchen and bathroom, refurbishment of staircase). Most of the usually used calculation methods for housing investments neglect the impact of the refurbishment investments upon the future repair costs, the rest life time of buildings, the higher rent levels which may be induced by better comfort of the flats, and above all lower vacancies and other risks against which the refurbishment investments may hedge. Because of all these advantages the real estate value of an energetic modernised building can be much higher, especially in the long term, than of a building with a poor insulation standard. In order to estimate the sustainability of energy saving investments under efficiency perspectives it is helpful to integrate these risk indicators within the economic assessment. In detail they depend mainly on the circumstances of each SHO.

- Data to be collected
    - Total costs of energy saving measures and other refurbishment costs
    - Actual rents and vacancy rates on the level of a building or dwelling
    - Future rents and vacancy rates on the level of a building or dwelling
    - Estimation upon the future maintenance costs, administrative costs, the rest life time of the building
    - Long-term real estate value without refurbishment and after refurbishment on the level of a building or dwelling
    - For calculation: rented living space, period under review, interest rate, general future rent and price development, tax rate, depreciation rate

Indicator: Public funding [%]

- Brief definition
  Share of public funding on the energy saving investment

- Purpose
  Social housing finance is a mix of loans or bonds, subsidies and own funds. Also legal requirements concerning the energy performance of a building are regularly completed by public funding programmes. Financial support is given predominantly as low interest loan, tax deduction or grant. SHOs have to analyse if there are specific energetic requirements for a certain form of funding e.g. a certain amount of CO_2-eq. savings through the energetic refurbishment and have to collect these data in the frame of an EPA.

- Data to be collected
  - Specific energetic requirements for public funding
  - Total costs of energy saving measures
  - Net present value of public funding e.g. a low interest loan (calculated)

2.2.4 Communication and cooperation with stakeholders and tenants

Large (energetic) refurbishment projects in social housing require increasingly the cooperation among several stakeholders, mainly the municipality and the tenants. Such a cooperation management is a relevant part of external embedding.

Indicator: Greenhouse gas (GHG) emissions [CO_2-equ./(m^2a)]]

- Brief definition
  Emissions of greenhouse gases (GHGs) from energy production and use per capita, including carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O)

- Purpose
  This indicator measures the total or per capita emissions of the three main GHGs from energy production and use that have a direct impact on climate change. The greenhouse gases indicators are often the basis for national or regional climate protection concepts. By introducing this indictor to SHO management the efficiency of energy saving measures in the SHOs building stock can be evaluated in context with other national/local climate protection activities.

- Data to be collected
  - Most of the data are included in the 'must' for ECs based on asset rating and an in situ survey, e. g. the status of the elements of the building envelope and the energy supply systems
  - The relevant reference value is the CO2eq- emissions per unit of used end energy for each end energy carrier

3 Execution

The step of execution means to collect data through an inventory of basic data from drawings and other sources within the SHO and inspection of the buildings ‘in the field’, processing of the data in the chosen EP-tool, calculate the current situation and possible packages of measures, deliver EP-certificates, EP-advice reports and set up a data-management system / database.

The basis for this work is an inspection and quality protocol for ECs based on asset rating, extended with the additional data to be collected according to the needs of SHOs.

3.1 Objective of the inspection and quality protocol

This chapter discusses one of the most critical steps of the procedure required to produce an EPA: the inspection phase, necessary to obtain the data needed. The objective of the inspection protocol is to give a guideline for those who collect and process energy data as a basis for EPAs. A well planned inspection protocol is necessary in order to:

- make sure that the collection of the data is cost-effective;
- make sure that those (individual) additional data are collected that are needed to aspire the (individual) added value;
- make sure that the collected data are accurate, i.e. does not induce unacceptable deviations on the final energy results in comparison with the building real energy performances;
- make sure that the data collection is carried out with a standard approach and, as a consequence, does not depend very much on the particular person who performs the inspection.

The inspection protocol has to support the inspector to provide

- a standard outline of the inspection procedure;
- a summary of all the building data which has to be collected during the inspection;
- a simplification of the number and type of measures to be collected;
- a standard approach to the measurement of surfaces, volumes, etc.;
- a guideline on the most important parameters to be identified about the installations.

3.2 Groups of data-sets

The number and kind of data to be collected and the level of detail depends mainly on the objectives of the assessment, the assessment procedure and the type of building. Further on the data structure has to be adapted to the specific National regulations on ECs.

Nevertheless the data structure should be complete as possible. At the same time it should be kept as simple as possible to be practicable and cost-effective. (For further information: see D4.1c-report)

Different groups of data sets can be defined as follows (from current EIE-Project DATAMINE):

- Energy Certificate data
  Basic data of the energy certificate, e.g. certification date, classification of the building according to the national indicators which are used in the energy certificates

- General data of the building
  Basic data of the type and size of the building: e.g. location (city), climate zone, year/period of building erection, building utilisation, conditioned floor area and building volume.

- Building envelope data
  Data describing the thermal performance of the building envelope (enclosing the heated part of the building): U-values and area of the elements, window properties

- Energy supply system data
  Data describing the building energy supply systems, e.g. type of heat generation systems for space heating and hot water supply, type of heat distribution systems, information on air conditioning systems, actual conditions of the systems, information on pump efficiency, lighting

- Calculated Energy Demand (Asset Rating) …
  Quantitative results of asset rating e.g. heat demand, hot water demand, energy input and output of heat generators and air conditioning equipment, boundary conditions of asset rating.

- … or alternative: basic Parameters (Operational Rating)
  Information on the basic conditions of operational rating, method of operational rating, information on climate or weather correction.

- Summary of Energy Consumption and Energy Generation
  Summary of end energy consumption and energy generation, in the first place for operational rating but also for asset rating.

- Primary Energy, CO_2 Emissions and benchmarks
  Primary energy demand and CO2 emissions for both operational and asset rating. The benchmarks should be also connected to an economical assessment.

- Additional information
  Additional data to be collected for the indicators creating an added value.

Regarding to the individual requirements of housing companies, parts of these groups of data-sets are necessary to integrate the results of the EPAs into the social housing management process, thus stimulating energy saving.

3.3 Data describing the current situation

The inspection protocol shall be easy to understand even for non-experts, especially regarding to the assessments and recommendations. The protocol might include a photo of the building itself and of several details and a description of the energetic characteristics and specials of the thermal envelope and the heating or ventilation systems. These information can be summarised in a building data sheet from building typologies describing the current situation.

3.4 Recommendations for energetic refurbishment

Based on the description of the current situation the report has to include recommendations for the energetic refurbishment of the following components:

- Building envelope

Recommendations for the improvement of the building envelope to reduce the heat losses by transmission and air ventilation.

- Energy supply systems

Recommendations for the improvement of the energy supply systems to improve the energy efficiency for space heating, hot water supply, air conditioning and lighting.

The recommendations should discuss the several measures itself and different kinds of combinations, e. g. insulation of the outer wall and new windows. The proposed measures have to fit to the "vision" of the SHO concerning to energy. This has to include an assessment of the extra costs for energy relevant measures and extra gains caused by this measures (economical assessment).

The report should include a comparison of the current situation with the situation after energetic refurbishment and an estimation of the expected energy saving potentials, reduced energy costs, reduction of CO_2-eq. Emissions and an economical assessment. The results can be summarised in the second sheet of building typologies describing the situation after refurbishment.

The report should also include a chart describing which maintenance works necessary at all should be connected with (additional) energy saving measures. By this connection high additional costs for extra energy saving measures can be avoided. The following chart is an example connecting maintenance measures necessary at all with energy saving measures. This chart should be explained to and discussed with the investor or house owner.

External embedding - individual consulting

A consultant should explain the essentials of the report to the different kind of target groups e. g. tenants, staff of local authorities, … The focus should lie on the description of energy saving measures, there technical feasibility, public subsidies, … taking into account the special circumstances of the different target groups.

Vorhandene Konstruktion/Heiztechnik

IWU

Haustyp MFH

Baualtersklasse 1969 bis 1978
Bezugsfläche 1145 m²

Heizenergiebedarf: 175 kWh/(m²a)
Warmwasser: 36 kWh/(m²a)

Heizspiegel München: Gas
Heizenergieverbrauch (ohne Warmwasser)
durchschnittlich: 168 kWh/(m²a)
erhöht: 169 kWh/(m²a) bis 254 kWh/(m²a)
extrem hoch: > 254 kWh/(m²a)


Foto: Stadt Erlangen, Umweltamt

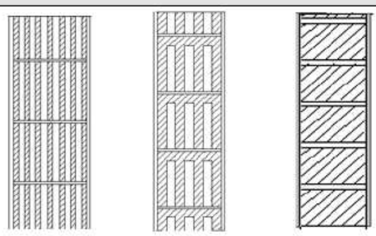
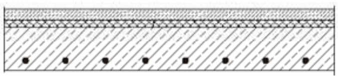
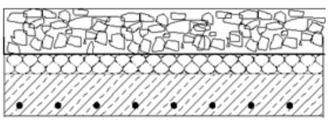
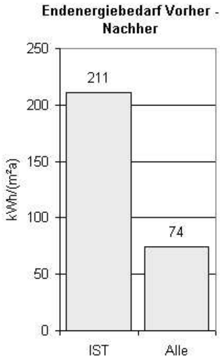
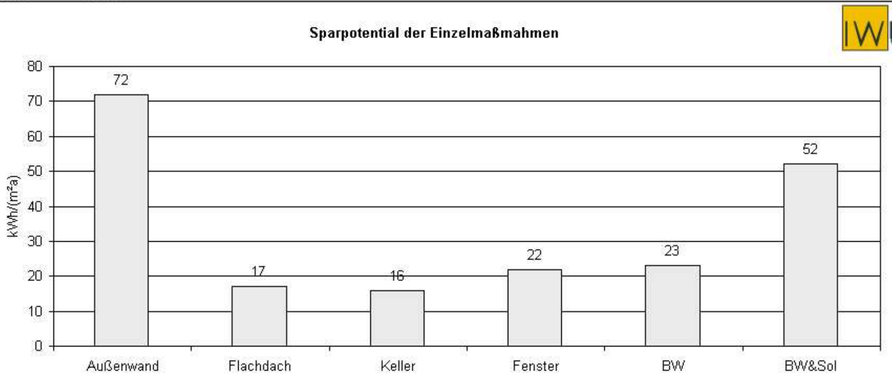
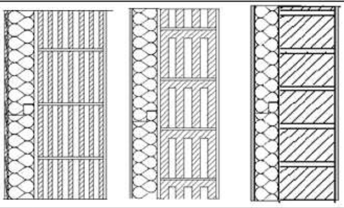
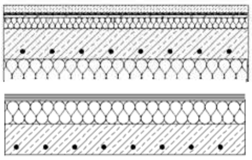
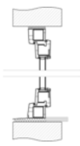
Bauteilskizze		Beschreibung	U-Wert [W/(m²K)]
Außen-wand		30 cm bis 36 cm Hochlochziegel, beidseitig verputzt	0,8 bis 1,1
		24 cm oder 30 cm oder 38 cm Hohlblockmauerwerk aus Bimsbeton oder Schlackenbeton, beidseitg verputzt	0,9 bis 1,3
		30 cm Porotonziegel oder Gasbetonmauerwerk, beidseitig verputzt	0,7
Keller-decke		14 cm Stahlbeton mit schwimm. Estrich auf 3 bis 4 cm Polystyrol oder Mineralwolle	0,8 bis 1,0
Flach-dach		Flachdach, 15 cm Stahlbetondecke + 6 cm Schaumglas + Dachhaut	0,6
Fenster		2-Scheiben-Isolierverglasung, Kunststoffrahmen	2,7
Heizungstechnik			
Heizsystem		Niedertemperatur - Gaskesselaußerhalb der therm. Hülle Baualtersklasse 1978 bis 1986 typischer Betrieb	
Warmwasserbereitung		Warmwasserbereitung über den Heizkessel mit beigestelltem Speicher außerhalb der thermischen Hülle	

Figure 5: Building data sheet from building typologies describing the current situation

Verbesserter Wärmeschutz/Heiztechnik MFH





Dämmkonstruktion		Beschreibung	U-Wert neu [W/(m²K)]	Vollkosten [€]	Vollkosten [€ /m² Bt]	energie-bedingte Mehr-kosten [€ /m² Bt]	Kosten der ein-gesparten kWh [Cent/kWh]
Außen-wand		16 cm Wärmedämmverbund-system (0,035 W/(mK)) auf Altputz, gewebearmierter Neuputz	**0,19**	101.118	114	57	4,6
Keller-decke		8 cm Dämmung (0,035 W/(mK)), unterseitig, geklebt oder gedübelt oder bei Erneuerung des Bodenbelages oberseitig	**0,30**	12.182	32	32	5,0
Flach-dach		24 cm Dämmung (0,035 W/(mK))	**0,12**	51.775	136	34	5,0
Fenster		2-Scheiben-Wärmeschutzglasung, Kunststoffrahmen	**1,30**	80.150	350	35	2,4
Modernisierung der Heizungstechnik und der Warmwasserbereitung				Voll-kosten [€]		Mehr-kosten [€]	
Heizsystem		Einbau eines neuen Gas-Brennwertkessels inkl. Schornsteinsanierung und neuem biv. Speicher		15.924		4.777	4,3
Warmwasserbereitung		Solarthermische Anlage zur Unterstützung der Warmwasserbereitung		1200 € je WE		28.800	
Alle Maßnahmen				289.949		117.277	**5,6**

ausgehend von 7,5 Cent/kWh beträgt der mittlere Energiepreis bei 25 Jahren Betrachtungszeitraum und:

	2,0 % Energiepreissteigerung:	**9,3**
Die Maßnahmen sind rentabel, wenn die Kosten der eingesparten kWh	**3,0 % Energiepreissteigerung:**	**10,4**
kleiner sind als der mittlere Energiepreis über den Betrachtungszeitraum!	**4,0 % Energiepreissteigerung:**	**11,7**

Figure 6: Building data sheet from building typologies describing the situation after energetic refurbishment

3.5 Quality control

The quality of the data collection process is of great importance. Many studies are available in the technical literature on the impact of the various EPA steps on the quality of the final results. In general, the most impacting is the quality of the data collection and in particular the inspection.

In order to control the quality of the inspection, the inspection protocol has to be provided to all the staff members or external consultants who are in charge of the inspection campaign. It should be conceived with an effective input interface in order to guide the inspector in the various steps of the data collection, trying to avoid data missing problems and minimizing the risk of inaccurate data entry. For instance, when possible, it is preferable to avoid the direct estimation of too much detailed numerical parameters, such as the thermal properties of the materials, but rather ask to choose among a set of standard materials configurations.

Based on the available results of the Altener project EPA-ED, the Dutch experience on the assessment of the typical errors of measurement of the building envelope geometric characteristics (areas and volumes) shows that an expected 5 to 10% mismatch between measured and real surface areas is quite normal. Depending on the thermal behaviour of the building, this measurement error, however, can result in different extents of deviations on the final energy results depending on which surface is affected by the error: a 10% error on the area of the walls can lead to a 1.5-2.2% error in the total energy demand estimation; a 10% of error on the measurement of the area of the windows can produce a 2.1-3.2% deviation; a 10% error on the floor can lead to a 0.2-0.5% final deviation.

Higher impact on the final result has the estimation of the conductance of the walls, depending on the estimation of the construction layer set and the insulation properties of each layer. Quoting the same above project, misidentifications in not-insulated structures can lead to up to 30-40% errors in the calculation of the total energy demand. Errors in insulated structures, conversely, lead to a lower miscalculation of the energy demand.

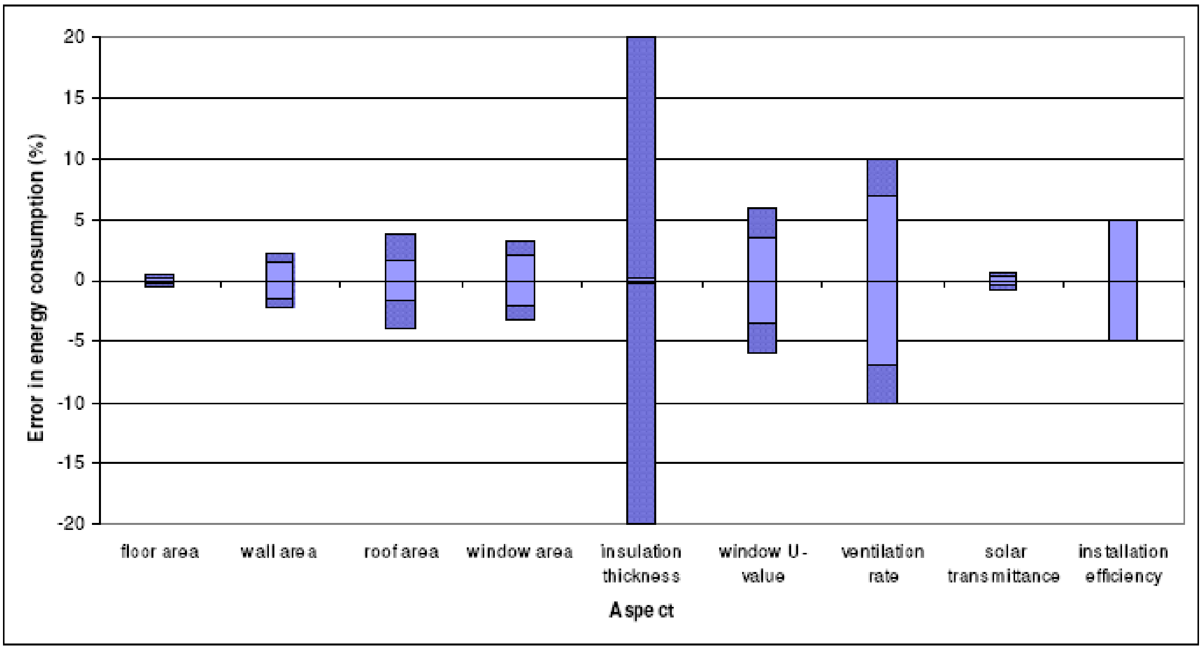


Figure 7: Impact on the EPA results of the estimation of different building parameters (source: EPA-ED project reports)

Often in old buildings with no insulation the U-value can be quickly determined only by means of an historical database of building typology and materials. As a consequence, the

inspection protocol should tackle this issue with high attention, trying to minimize the degrees of freedom of the inspector on the decisions about the construction and the thermal insulation characteristics of the various parts of the building envelope. This means that the inspection protocol does not avoid the need for a careful study of the stratification of the walls of the dwelling/building inspected, but the input data for the EPA derived during the inspection only slightly affect the overall results of the assessment.