

SMART CITIES INFORMATION SYSTEM

Economic Monitoring Guide- EeB (Energy Efficient Buildings)

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This document has been elaborated by SCIS on the basis of the CONCERTO Premium Economic Monitoring Guide

The aim of the developed and hereafter introduced guideline is supporting a conceptual preparation and subsequent implementation of a long-term monitoring for the gathering and assessment of economic data for projects in the framework of, in particular, projects and activities that lead to lower emissions, produce renewable energy, lead to energy savings are considered in this Guideline.. For achieving this objective, an appropriate structure in Excel format for gathering relevant types of costs is introduced. This is a prerequisite for the economic assessment of the respective measures. Furthermore, by providing a common definition of economic parameters meaningful comparisons of assessment results of different projects are enabled.

This Guideline is written in the context projects that have been realized or will be implemented under the umbrella of the Public-Private Partnership (PPP) on Energy-efficient Buildings (EeB) and is in particular intended for building owners, planners, occupiers, operators, monitoring experts as well as persons responsible for financial project accounting and provides assistance in the systematic acquisition of data for assessing the economic benefit of measures. However, it can also be used by the respective stakeholders for supporting the development of a permanent structure for collecting and assessing costs in the context of an operating cost monitoring.

1. MONITORING OF PROJECTS IN RELATION TO BUILDINGS RENOVATION

1.1 Introduction : What is it ?

The success and the acceptance of measures intended to enhance the energy efficiency and to increase the usage of renewable energy sources on neighbourhood level strongly depend on the willingness of the stakeholders to invest in such measures. By conducting economic research and by assessing the possible measures, stakeholders get information and statements for supporting and justifying their decisions.

The aim of this Guideline is to support the gathering and processing of data for a subsequent assessment of economic benefits of measures intended to enhance the energy efficiency and to increase the usage of renewable/sustainable energy sources and solutions. This economic monitoring guide has the objective to guide the user through the process of monitoring and data collection.

The economic assessment and monitoring which is based on the data to be gathered provides answers to, inter alia, the following questions:

- What are the investment costs of energy optimized buildings compared to those of conventional buildings?
- What are the economic parameters of the underlying project for realizing the energy optimized building
- Is it economically more reasonable to invest in thermal insulation of the building envelope or its improvement or in technical installations or its modernization, respectively?
- Do buildings with innovative technical installations possibly have higher maintenance costs than buildings with conventional technical installations?
- To what extent are grants and subsidies needed to make investments in the energetic modernization of a building economically beneficial from the view of selected stakeholders?
- Are the planning costs of energy optimized buildings higher than those of conventional buildings?

This Guideline is mainly intended for building owners, planners, occupiers, operators, monitoring experts as well as persons responsible for financial project accounting and provides assistance in the systematic acquisition of data for assessing the economic benefit of measures. However, it can also be used by the respective stakeholders for supporting the development of a permanent structure for collecting and assessing costs in the context of an operating cost monitoring.

It is recommended to continue to operate the economic monitoring after the end of the actual project duration and to convert it into a long-term monitoring. Especially the effect of measures intended to enhance the energy efficiency and the effect of renewable energy sources on maintenance costs can only be identified by a long-term monitoring.

1.2 Fundamentals

1.2.1 Outline of monitoring

In general, three stages of economic monitoring can be distinguished:

- stage I: stage of planning and realization of the construction project or the refurbishment measures
- stage II: intensive monitoring
- stage III: long-term monitoring

In the proper sense **stage I** is not part of the monitoring. However, it can be assumed that, inter alia, target and comparative figures for the subsequent monitoring of stage II and III are determined. It is recommended that during the planning process an estimation of construction costs and costs in use is carried out. The level of expected future energy costs as part of the costs in use is based on the projection of the expected energy consumption. Expected costs for servicing and maintenance must be either estimated or determined based on existing offers for service contracts. For the planning of maintenance costs in the context of the maintenance cycle, inter alia, information about technical service lives of structural elements and building components are required. Especially in the case of new and innovative systems this information should be addressed to the manufacturers.

Determined costs are intended, inter alia, for executing comparisons of variants, for the considerations of economic efficiency as well as the elaboration of target values for a subsequent energy consumption monitoring and operating cost controlling.

Stage II – the proper monitoring begins with the determination of the actually incurred costs.

Especially in parallel to the energetic monitoring, in the context of the economic monitoring the energy costs (and on this basis the possible energy cost savings) have to be determined. Furthermore, the costs for inspection and servicing have to be gathered. It can be assumed that stage II must cover a period of at least three years.

With **stage III** the transition to a long-term monitoring takes place. Continuously, costs for energy, inspection and servicing have to be determined. Possibly, it is necessary to refer the cost values to a common reference year. As an alternative the present value of the cash outflows can be calculated.

Moreover, the determination of maintenance costs including costs for replacement investments in case of the replacement of building components and systems takes place in stage III. Stage III must cover a period of at least five years. A transition to a permanent energy consumption monitoring and operating cost controlling is strongly recommended.

Figure 1 gives an overview on the stages I to III and the embedded starting points for planning and monitoring.

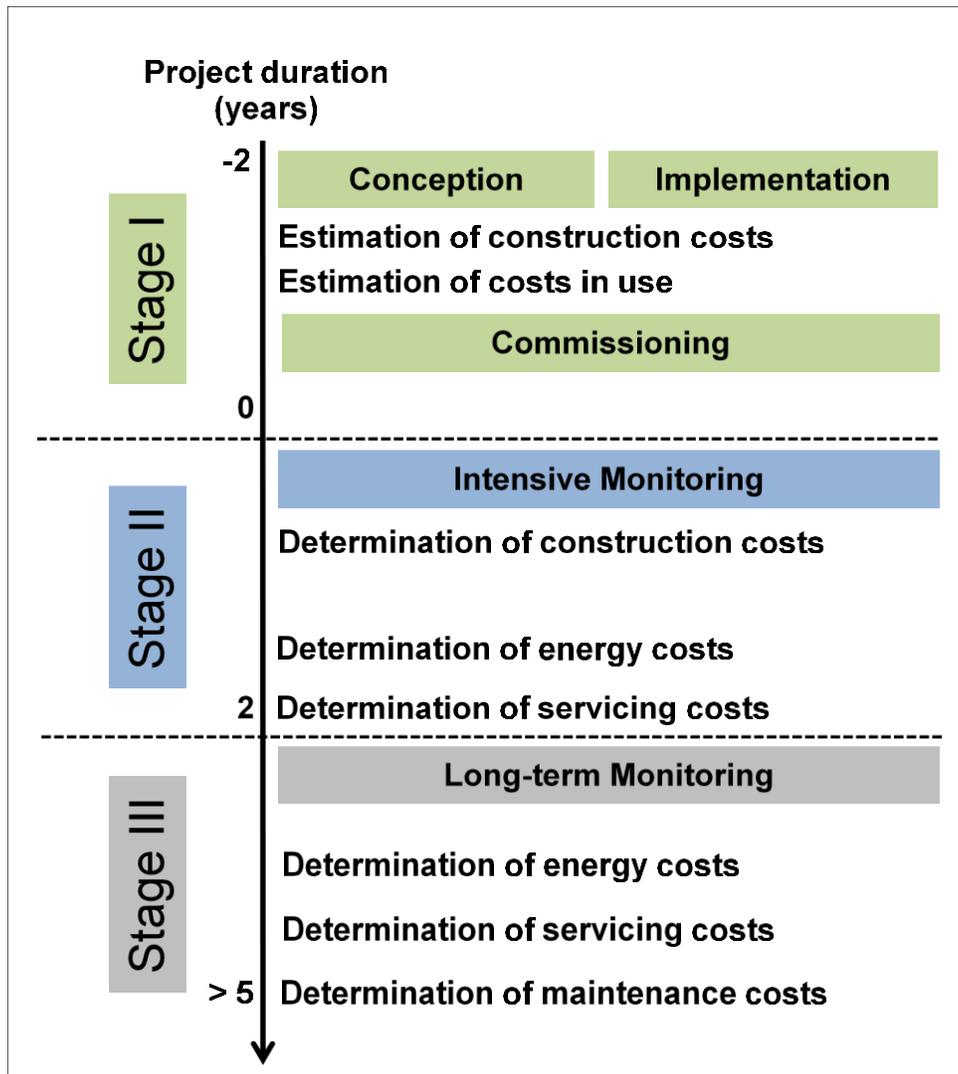


Figure 1: Stages of monitoring (Source: Illustration from CONCERTO Premium)

1.2.2 Outline of key cost items

Key cost values

An essential requirement for the determination and interpretation of cost key values is assuring transparency and comparability. Therefore, at least the following information for cost data must be available:

- handling of VAT (not included, included with x %)
- reference year for the invoiced costs (price level) – e.g. II/2010
- type, extent, level of difficulty or quality standard of measures which cause the costs

Furthermore, it is preferable to specify in case of single measures

- the technical service life of components or systems.

Key Cost Items

The projects in the context of smart Cities can be characterised as ventures that are undertaken to realize, besides environmental, technical and policy objectives also to generate a profit from the investment that is linked to the specific project. The venture is characterized by a number of key cost items that are important to analyse the profitability of different alternatives, or projects in a different geographical context.

There are numerous references of cost accounting for energy related projects, this Guideline only touches on the key cost elements.

The first important element of cost is the required capital investment of a venture. This **capital cost** refers to the total cost of the direct installed project and can be subdivided in different elements as purchased equipment, electrical installation, installed services, building renovation. The indirect capital cost refer to expenses for construction or installation,. Contractor fee, contingency. In most cases the total capital costs of the investment for a project will be known,

In most cases, also **operational costs** are involved, these costs refer to the operational; expenditure in the form of utilities (cooling water, electricity, steam,...), raw materials, labour costs, maintenance and are usually expressed in Cots /per year.

The capital costs and the operational costs together will determine the operating income of the venture. For projects in the smart City context often tax education or subsidies are applicable, these must also be taken into account for determining the resulting cash flow of the venture.

We have prepared a data collection table that collects all the key cost data of the project venture and can be used to generate also the profitability analysis of a project, that ultimately can be expressed in payback time or return of Investment.

1.2.3 Data collection

Excel Data Collection Sheets

The data collection sheets (attachment) are available as Excel sheet on the SCIS website support the determination of the relevant types of costs and complementary information for assuring transparency and comparability.

These excel data sheets will be used until the finalization of the SCIS data collection web based tool to collect the data from ongoing projects.

Self-reporting for data collection under implementation

One of the goals of the SCIS project is that this data collection work will involve as much as possible the existing projects. To facilitate and stream-line the dataset collection and outcome, we propose where possible the implementation of the *self-reporting* and *auto-analysis* functionalities.

The self-reporting will allow direct access for the project coordinator and the different experts taking part in the applicable DEMO projects to data into the SCIS database. This will also improve the data quality and plausibility of data since the responsible people of the Demo Site will be involved in the data provision directly.

In order to make the process of entering a minimum-dataset as user-friendly and timesaving as possible, default auto-completion values will be used. Depending on predefined choices (i.e. office building, hotel, etc.) the crucial inputs are filled with a set of default values. The defaults can be changed if the actual value is known and the changes can be visualized to easily track them. This guarantees a complete dataset that allows for further analysis with a minimum effort for the user

2. LARGE-SCALE ENERGY SUPPLY UNITS ECONOMIC MONITORING

2.1 Introduction

With the integration of energy transformation units into the municipal energy supply system a trade-off between investments in demand side and supply side measures arises. Building owners are not only confronted with the decision to which extent they invest in energy saving measures of their buildings, but additionally which type of energy they want to use. In return, utilities have to decide which energy carriers and energy systems they provide.

This part of the economic monitoring guide assists in answering possible questions of stakeholders involved in energy supply systems. These are mainly energy supply companies, utilities, network operators for large-scale energy transformation units, legislators, grant providers, but also building owners or households that have joined an owner/operator association in order to run a plant and/or a distribution network.

Some possible questions include:

- If not only investments but total costs of the energy supply system are decisive, which technologies are most adequate for energy supply?
- Are central energy supply systems more cost-effective than distributed ones?
- What is the adequate balance between investments in demand-side and supply-side measures? Where is the economic trade-off between these measures?
- Is it economically reasonable to develop a district heating/cooling network in a given district?
- Is a grid-bound energy supply system still profitable for the network operator when the insulation standard increases?
- Is it economically reasonable to invest in an energy storage unit?
- At which level of grants does the investment in renewable energy facilities become economic?

The motivation for the monitoring guide for large-scale energy transformation units on municipality level is the provision of support for a reasonable economic data collection concept. The collected data serve as a basis for a meaningful assessment and finally help in the stakeholders' decision-making process. This part of the economic monitoring guide is structured as follows: In Chapter 2.2, firstly the scope of this part of the Guideline is defined. Secondly, business-relevant cost terms are explained and adapted to the requirements of the economic monitoring process for energy supply units. In chapter 3, also the possible ownership structure of large scale energy transformation units is discussed. Chapter 2.3 is devoted particularly to the collection of the data. Monitoring data are gathered by means of the data collection sheets as will be explained there.

2.2 Fundamentals

2.2.1 Outline and scope of monitoring

In addition to the phased approach as explained in section 1.2.1 (which is equally applicable for energy supply units), there are some key issues that are applicable for the economic monitoring of large-scale energy transformation units, in order to assess their economic advantage. Besides the energy supply units itself (e.g. heating plants, combined heat and power plants), large-scale energy transformation projects may also encompass large-scale spatial transformation units (e.g. district heating/cooling networks, electricity/gas grids) and large-scale temporal transformation units (e.g. thermal storages). This section of the economic monitoring guide exclusively considers non-building integrated facilities. Small-scale energy supply systems inside a building are counted as building equipment and are therefore included in Chapter 1 of this guide.

2.2.2 Terms and definitions

As large-scale energy transformation units are mainly operated by companies rather than households, it is recommended to view the economic monitoring from the businesses perspective. From this point of view, the terminology of the accounting system helps in specifying financial transactions more precisely and enhances transparency and clarity of all payments within the funding programme. Even if the detailed differentiation of financial transactions in the programme monitoring process is too ambitious and not practicable in reality, it is meaningful to specify all relevant flow variables at least in a theoretical way to create an understanding for the economic terms. The applied version which becomes relevant for the SCIS monitoring will be explained in section 2.2.3.

The entire differentiation of the economic terms is provided in Table 1.

Table 1: Basic concept of the accounting system [based on Wöhe, 2010]

No.	Stock figure	Definition	Term		Relevant e.g. for
			Positive change	Negative change	
1	Stock of instruments of payment	Cash, Liquid assets	Incoming payments (I)	Outgoing payments (I)	Capital budgeting and economic efficiency
2	Monetary assets	Stock of instruments of payment + Receivables ./. Liabilities	Incoming payments (II)	Outgoing payments (II)	
3	Total assets	Monetary assets + Tangible assets	Revenues (I)	Costs (II)	Taxation (at least in given countries e.g. Germany)
4	Operating assets	Total assets ./. Non-operating assets	Revenues (II)	Costs (II)	Optimization of operating results and internal control

The relevant flow variables of monetary transactions are defined in the following:

- Incoming payments (I) are the effective cash inflows of a company. They induce an increase of the liquid asset stock. (Example: Receipt of a payment on the bank account)
- Incoming payments (II) are the effective cash inflows corrected by the receivables and liabilities. (Example: Advance payment for heat delivery)
- Revenue (I) is an effective net increase in value of the company due to commodities produced or services provided within the accounting period. (Example: Sale of fixed assets)
- Revenues (II) are the equivalent value of produced goods and services of a company. (Example: Sales revenues for heat delivery)
- Outgoing payments (I) are the effective cash outflows of a company in a certain period. Outgoing payments only have an impact on the stock of liquid assets. (Example: Cash payment for energy carriers)
- Outgoing payments (II) are the effective cash outflows of a company corrected by receivables and liabilities. (Example: Purchase of energy carriers)
- Costs (I) are the total wear and tear of commodities and services in the accounting period. (Example: Consumption of energy carriers for heat production, donations, losses due to stock market transactions)
- Costs (II) are the wear and tear of production factors due to operating effort. (Example: Consumption of energy carriers for heat production)

The cash flows as mentioned in table 4 determine the capital costs and operational costs that are relevant for the project/venture. The key cost items that are relevant in this respect are listed in chapter 2.2.3.

2.2.3 Outline of key cost items

The energy supply projects in the context of Smart Cities can be characterised as ventures that are undertaken to realize, besides environmental, technical and policy objectives also to generate a profit from the investment that is linked to the specific project. The venture is characterized by a number of key cost items that are important to analyse the profitability of different alternatives, or projects in a different geographical context.

There are numerous references of cost accounting for energy related projects, this Guideline only touches on the key cost elements.

The first important element of cost is the required capital investment of a venture. This **capital cost** refers to the total cost of the direct installed project and can be subdivided in different elements as purchased equipment, electrical installation, installed services, building renovation. The indirect capital cost refer to expenses for construction or installation, Contractor fee, contingency. In most cases the total capital costs of the investment for a project will be known,

In most cases, also **operational costs** are involved, these costs refer to the operational; expenditure in the form of utilities (cooling water, electricity, steam,...), raw materials, labour costs, maintenance and are usually expressed in Cots /per year.

The capital costs and the operational costs together will determine the operating income of the venture. For projects in the smart City context often tax education or subsidies are applicable, these must also be taken into account for determining the resulting cash flow of the venture.

We have prepared a data collection table that collects all the key cost data of the project venture and can be used to generate also the profitability analysis of a project, that ultimately can be expressed in payback time or return of Investment.

2.2.4 Ownership structure of large-scale energy transformation units

Differences in costs/revenues and the economic assessment occur due to different possible ownership structures. As illustration, Figure 2 illustrates possibilities of the ownership structure along the energy (heat) supply system. In case A, the biomass heating plant and the district heating network are owned by different organizations. The district heating network operator is faced with a price for heat fed into the district heating network at delivery point 1 (DP1). The district heating network operator also sells the heat to the customer for a certain price. The household, which is supplied with heat from the biomass heating plant using the district heating network, is confronted with price margins of both companies (simplified: price=cost + margin). In case B, only one margin of the company owning both units has to be paid. At DP1 the district heating network operator is only faced with costs for the heat generation. At DP2, however, the customer has to buy the heat, which is delivered to his/her building. If several households own a district heating network and a biomass heating plant (case C), they have to pay neither the price margin of the biomass plant owner nor of the district heating owner. In this case, only costs for heat generation and distribution are relevant.

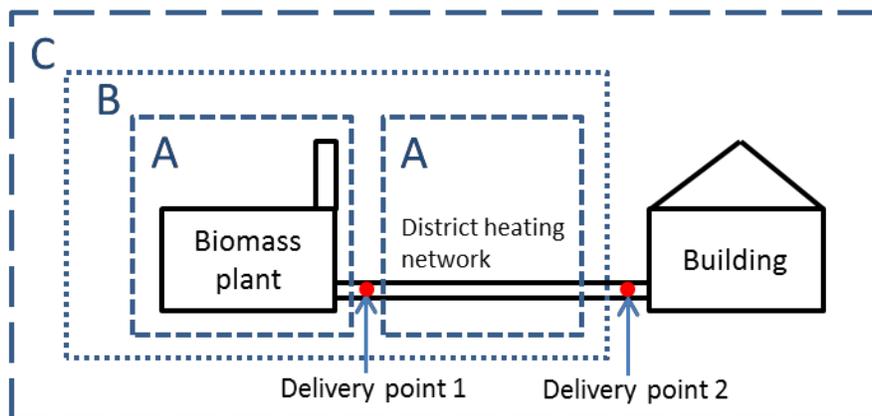


Figure 2: Schematic illustration of different ownership structures along the energy (heat) supply system

The allocation of costs therefore depend on the ownership structure of the energy supply companies.

Examples for major costs and revenues in case of different ownership structures from different points of view are provided in Table 2.

Table 2: Examples for major costs and revenues in case of different ownership structures

Case	Ownership of biomass heating plant	Ownership of district heating network	Ownership of buildings	Comments	Major costs	Major revenues
A	Company 1	Company 2	Residents	District heating network owner has a contract with the final customer	Company 1	
					Capital-related costs, biomass costs	Sales revenues (basic and kilowatt hour rates)
					Company 2	
					Capital-related costs, costs for heat (basic and kilowatt hour rates)	Sales revenues (basic and kilowatt hour rates)
B	Company 3	Company 3	Residents	-	Company 3	
					Capital-related costs, biomass costs	Sales revenues (basic and kilowatt hour rates)
C	Residents	Residents	Residents	-	Residents	
					Capital-related costs, biomass costs	-

Analogously to the data collection sheets for buildings, which have been presented in Chapter 1 of this monitoring guide, data collection sheets for large-scale energy transformation units have been elaborated, too (attachment). The data collection sheets try to deal with these heterogeneous situations by splitting the costs if possible. A similar statement holds in case of electricity production, but in this case the electricity is not sold directly to the residents (although, strictly speaking, this is possible, in order to avoid network fees).

2.2.5 Handling of payment/revenue/cost key values

As discussed in Chapter 1, a comparable and transparent assessment of large-scale energy transformation units can only be ensured in case of a clear specification of the cost structure. At least the following information should be provided:

- handling of VAT (not included, included with x %)
- handling of energy tax (not included, included with x %)
- handling of grants (not excluded but specified separately)
- reference year for the invoiced payments/revenues/costs (price level) – e.g. investment in II/2010 for a biomass combustion chamber.
- payment which corresponds to a price (margin included) or to costs (margin not included) (cf. section 2.2.4).

2.3 Data collection

Excel Data Collection Sheets

The predecessor project (CONCERTO Premium) provided Excel templates for the collection of data. These excel data sheets will be used until the finalization of the SCIS data collection web based tool to collect the data from ongoing projects.

Data requirements to determine costs/outgoing payments and revenues/incoming payments for each type of energy transformation unit are defined in separate data collection sheets. Only energy supply systems using renewable energy sources or cogeneration are supported.

With respect to economic monitoring they encompass

- **one-time payments:** Investments (cf. Figure 3, the term cost is used in the data collection sheets as it is widely-used [although wrong]) and investment-related grants, and
- **annual payments:** Requirement-related, operation-related and other costs/revenues (cf. Figure 4).

Self-reporting for data collection under implementation

Up to now the dataset within the collection sheets had to be completed by the contracting consortium in charge of Concerto Premium. One of the goals of the SCIS is that this data collection work would involve as much as possible the projects. To facilitate and stream-line the dataset collection and outcome, we propose where possible the implementation of self-reporting and auto-analysis functionalities.

The self-reporting will allow direct access for the project coordinator and the different experts taking part in the DEMO projects to deliver detailed project or monitoring data into the database. This will also improve the data quality and plausibility of data since the responsible people of the Demo Site will be involved in the data provision directly.

In order to make the process of entering a minimum-dataset as user-friendly and timesaving as possible, default auto-completion values will be used. Depending on predefined choices (i.e. office building, hotel, etc.) the crucial inputs are filled with a set of default values. The defaults can be changed if the actual value is known and the changes can be visualized to easily track them. This guarantees a complete dataset that allows for further analysis with a minimum effort for the user.

2.3.1 Determination of one-time payments

The one time payments are mainly related to the capital cost investment.

2.3.2 Determination of annual payments

The second part of the economic data collection comprises the gathering of data on annual payments (or the corresponding costs/revenues)

The annual costs encompass the production or operating costs , these include the energy carrier costs and further costs such as maintenance for the energy supply units. The annual revenues include net energy sales revenues/grant revenues for :

- 1) electricity fed into the grid and/or
- 2) delivered heating energy and/or
- 3) other additional revenues e.g. revenues from the sale of residual materials.

The capital-related costs, e.g. depreciation and interest, are determined based on the one-time payments and the expected lifetime of the energy transformation units.

3. ATTACHMENT DATA COLLECTION SPREADSHEET

a) Building indicators

v1.0, dated July23 2015						
Economic and Technical Indicators for Smart City Projects						
SC theme	Indicator title	General information	value	Indicator unit	Definition and extensive description	Other
BUILDING INDICATORS						
General information	Name of project					
General information	Realisation time of project			months		
General information	Location of project					
General information	Funding sources					
General information	Tax deduction			%		
General information	Type of project					
General information	Other information that may be relevant					
General information	Contact information (e-mail)					
Economic	Capital costs of investment in or around building			€		
Economic	Estimated payback period			yr		
Economic	Lifetime estimated			yr		
Economic	Operational costs			€/yr		
Economic	Maintenance costs			€/yr		
Technical/economical	Amount of energy produced or saved			kWh/yr		
	Electricity ?			kWh/yr		
	Heat ?			kWh/yr		

b) Energy transformation units indicators

v1.0, dated July23 2015

		Economic and Technical Indicators for Smart City Projects		
ENERGY SUPPLY UNIT INDICATORS				
General information	Name of project			
General information	Realisation time of project		months	
General information	Location of project			
General information	Funding sources			
General information	Tax deduction		%	
General information	Type of project			
General information	Technology involved			
General information	Other information that may be relevant			
General information	Contact information (e-mail)			
Economic	Capital costs of investment		€	
Economic	Estimated payback period		yr	
Economic	Lifetime estimated		yr	
Economic	Operational costs		€/yr	
Economic	Maintenance costs		€/yr	
Technical/economical	Amount of energy produced		kWh/yr	
	Electricity ?		kWh/yr	
	Heat ?		kWh/yr	
Economic	Capital costs of investment		€	
Economic	Estimated payback period		yr	
Economic	Lifetime estimated		yr	
Economic	Operational costs		€/yr	
Economic	Maintenance costs		€/yr	
Technical/economical	Amount of energy produced		kWh/yr	
Environmental	Emission reduction		t/kWh, %	
Technical	Final energy demand reduction		%	

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