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BENCHMARKS FOR ENERGY EFFICIENCY FEASIBILITY STUDIES RELATED TO ENERGY EFFICIENCY AND THE USE OF RENEWABLE ENERGY FOR EFFECTIVE TENDERING RELATED TO PUBLIC HEATING

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1 LEGAL FRAMEWORK

The aim of this document is to give help to Public Authorities (PA) during the energy efficiency feasibility study process concerning energy efficiency and the use of renewable energy.

The Directive 2010/31/EU (recast of the Directive 2002/91/EC), the so called Energy Performance of Building Directive (EPBD) is the starting point, and also the point of reference, for any energy efficiency feasibility study, because this directive lays down requirements as regards "*the common general framework for a methodology for calculating the integrated energy performance of buildings and building units*" and, above all, "*the application of minimum requirements to the energy performance of technical building systems whenever they are installed, replaced or upgraded*".

As an indication, in the phase of the procurement for a tendering related to public heating, the latest point of reference should be the *GPP - Green Public Procurement*. The GPP is defined in the Communication (COM (2008) 400):

"*Public procurement for a better environment*" as "*a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured".*

The Communication lays down that the 50% of tendering have to be environmental friendly until 2010, observing minimum environmental criteria. The first set of ten environmental criteria was developed in 2008 for the European Union. Other ten criteria (windows, street light, cogeneration plants, thermal insulation, boiler, mobile phone) are under consultation.

Moreover, the former reference are two directives adopted by the Council and the European Parliament, aimed at clarifying, simplifying and modernising existing European legislation on public procurement:

- Directive 2004/18/EC covers public works contracts, public supply contracts and public service contracts;

- Directive 2004/17/EC covers the procurement procedures of entities operating in the water, energy, transport and postal services sectors.

The preamble to Directive 2004/18/EC identifies the objective of clarifying how contracting authorities *"...may contribute to the protection of the environment and the promotion of sustainable development, whilst ensuring the possibility of obtaining the best value for money for their contracts."* Particularly, more detailed provisions permit:

- the inclusion of environmental requirements in technical specifications (Article 23(3)b);
- the use of eco-labels (Article 23(6));
- setting social and environmental conditions for the performance of contracts (Article 26);
- requiring economic operators to demonstrate they have met their environmental obligations (Article 27);
- requiring economic operators to demonstrate they can perform a contract in accordance with environmental management measures (Articles 48(2)f and 50); and
- applying award criteria based on environmental characteristics (Article 53).

With regard to the environmental friendly design of products, the European Parliament and the Council of the European Union have adopted the Directive 2005/32/EC which establishes a framework for the setting of Community ecodesign requirements for energy-using products with the aim of ensuring the free movement of those products within the internal market.

The European Parliament and the Council of the European Union have also adopted the Directive 2006/32/EC which enhances the cost-effective improvement of energy end-use efficiency in the Member States by: providing the necessary indicative targets as well as mechanisms, incentives and institutional, financial and legal frameworks to remove existing market barriers and imperfections that impede the efficient end use of energy; creating the conditions for the development and promotion of a market for energy services and for the delivery of other energy efficiency improvement measures to final consumers.

At least the European Commission proposes a new Directive on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC. The proposed Directive establishes a common framework for promoting energy efficiency in the Union to ensure the target of 20% primary energy savings by 2020 is met and to pave the way for further energy efficiency afterwards. It lays down rules designed to remove barriers and overcome some of the market failures that impede efficiency in the supply and use of energy.

For the GovernEE project purpose, the proposed Directive measures lay down requirements on the public sector, both as regards renovating the buildings it owns and applying high energy efficiency standards to the purchase of buildings, products and services.

2 THE FEASIBILITY STUDY

The feasibility study (FS) takes account of the mentioned Directives and of National laws that implement the Directives.

The PA should fix energy efficiency goals, considering also the use of renewable energy, when decides to install, to replace or to upgrade a heating plant. These main aims are important because the feasibility study complies them with the heating proposals, in order to evaluate the best choice.

The FS evaluates technical aspects of the heating plant (characteristics, working diagram, fuels, etc.), all the costs of the project and also considers social and environmental impacts (negative or positive) of the project and its investment.

For a successful tendering the steps shown below are required:

1. definition of the criteria by the PA;
2. preparation of the feasibility study, divided in three main sections:
    a) technical feasibility study
    b) economic and financial analysis
    c) social and environmental sustainability analysis
3. evaluation of the feasibility study.

The final annex gives indicators for each sections of the feasibility study; these indicators are placed in cells in tables and should easily used by PA for the real evaluation of sent projects during tendering.

3 DEFINITION OF THE CRITERIA FOR THE PUBLIC AUTHORITIES

At first the PA should fix its main aims and the project basic requirements.

3.1 The aims of the project

The PA sets the aims of energy efficiency and economic targets accordingly with EPB Directive. External expert is expected to follow them in the project proposal.

Example of main PA aims:

- Achieving energy efficiency over a defined percentage (%)
- Energy efficiency class achieved by the building, see EPB Directive (Class A+, Class A, Class B, etc.)
- Reaching carbon emission (%)
- Reducing primary energy demand from fossil fuels (%)
- Increasing renewable energy sources – RES (%)
- Energy independence
- Reducing heating cost (%)
- Adopting high-efficiency technological systems available in the market (awareness effect)
- Adopting high-innovative technological systems (demonstration effect)
- Improving the energy balance on urban level (in every tendering process the use of renewable energy, if in some proportion, should be required)

PA can choose between two kind of proceeding approach:

1. Defining the method in order to achieve the objective and choosing the economically most advantageous offer. External expert defines an optimum technical content.
2. Defining the budget and choosing the technically most effective offer for the achievement of the objective. External expert offers the most efficient technical solution.

3.2 Basic requirements

Basic requirements are provided and are divided in thematic categories, which the PA should fix in order to evaluate each proposal.

3.2.1 Compliance with PA aims

The project has to meet the aims that the PA targeted in the tender.

3.2.2 Minimum energy performance requirements

The point of reference for energy performance of buildings is the Directive 2002/91/EC and its recast in Directive 2010/31/EU that Member State have to implement.

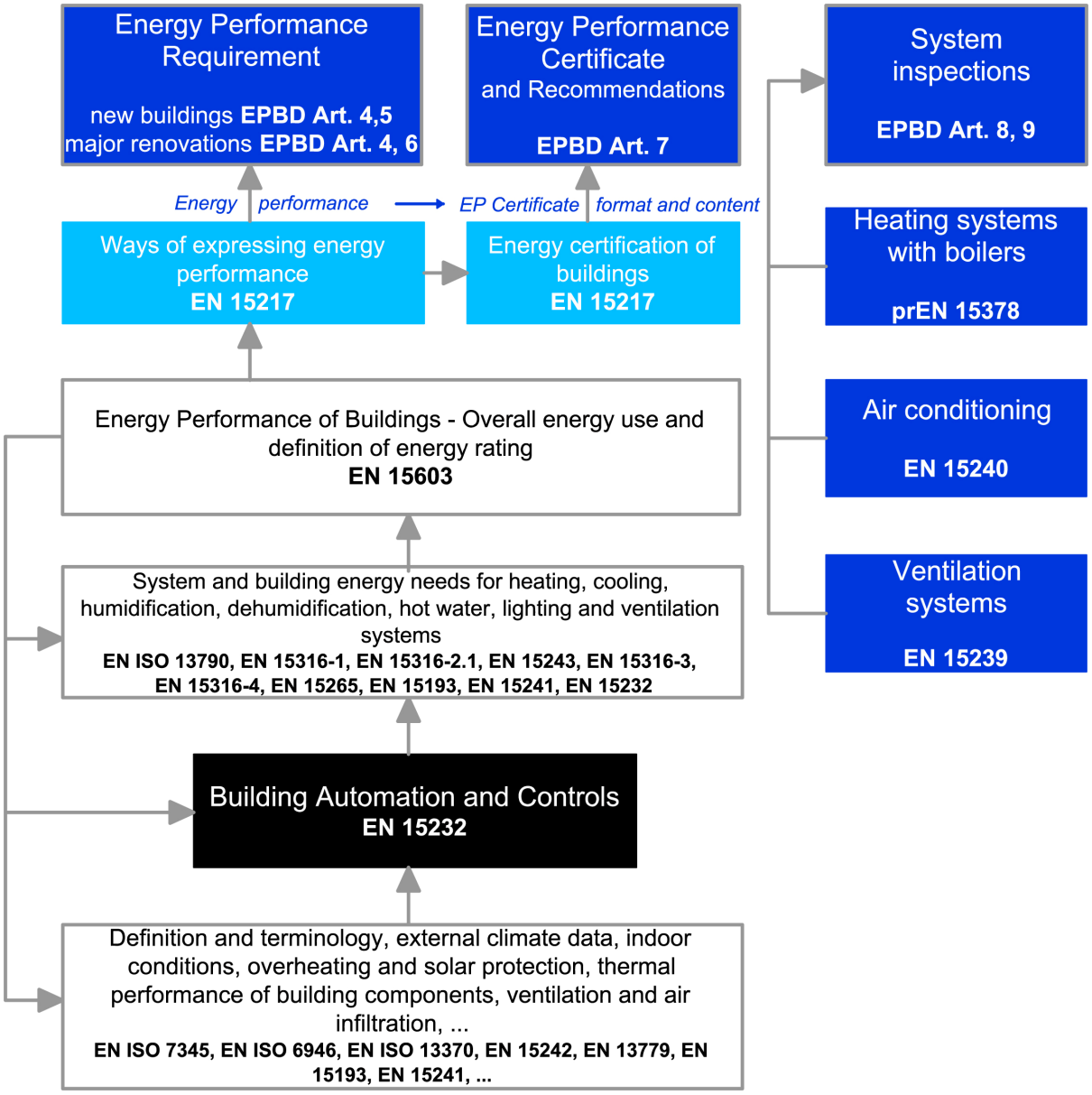
Indeed, the proposal must meet the minimum energy performance requirements of EPB Directive, its implementation and other national laws or more stringent requirements sets by PA.

PA should require energetic calculations based on EPBD national building code[1]. To support the implementation of the EPBD, the European Commission issued early 2004 a mandate (M343-EN-2004) to the European standards body (CEN) for the development of standards covering 31 individual work items.

This mandate asked CEN to elaborate and adopt standards on a methodology, calculating the integrated energy performance of buildings and estimating the environmental impact, in accordance with the Directive. The summary is described in Table 1.

[1] An energetic calculation with special software required could guarantee the controllability.

Table 1: Methodology for calculating energy performance (EPBD Article 3 and Annex)



3.2.3 Law Constraint

The PA has to evaluate limits and constraints for the building, also considering spatial planning regulations.

3.2.4 Quality Control

The proposal must meet the minimum quality requirements of European Union laws, national, regional and local laws or more stringent requirements set by PA.

PA can request that the product meets the underlying criteria of a recognised Ecolabel (European Ecolabel – Reg. EC 1980/2000). PA can also request that the product meets the underlying criteria of a recognised eco-management and eco-audit scheme (EMAS - Reg. EC 761/2001).

3.2.5 Workplace safety

PA have to require guarantee during the heating system installation, accordingly with law requirements, as regard:

- workers safety, their health, guaranteeing the respect of labour rights;
- costumers and employees safety during working day. The PA should check if the installation needs to open the building for authorized personnel only;
- building safety, in order to avoid damage especially in historical buildings.

3.2.6 Costumer-friendly services

The management criteria must be clear from beginning, preferring simple management for the PA and for the final users (employees). For example to avoid damages to the heating plant or system, the heating control ought to be simple and user friendly for the employees.

The PA has to take into account the maintenance, because a heating plant more efficient needs less maintenance. Moreover the PA has to consider the technician availability and spare part availability.

3.2.7 Easy and convenient buying

The service needs low and steady price for medium-long term.

For the heating service prices must be competitive, predictable and steady.

For the biofuel heating district biofuel prices must be guaranteed, efficient and transparent and finally the availability all year round and the security of supply must be guaranteed.

4 ENERGY EFFICIENCY FEASIBILITY STUDY

The feasibility study (FS) aims to objectively and rationally uncover the strengths and weaknesses of the existing business or proposed opportunities and threats as presented by the environment, the resources required to carry through, and ultimately the prospects for success. The results determine whether the solution should be implemented.

The FS framework described in the document evaluates and analyses the potential impact of a public heating project to found out if the project will complies PA energy efficiency aims and if the project will work successfully.

The evaluation of the feasibility study determinates whether the project can be operated in a sustainable, economical and environmental way.

The feasibility study consist of:

1) technical feasibility study
2) economic and financial analysis
3) social and environmental sustainability analysis.

4.1 Technical feasibility study

The technical feasibility checks every conditions for the realization, the installation and maintenance of the system, so the technical feasibility study considers the technical features of the heating system:

- Plant characteristics, single units characteristics and energy performance of the units. Envelope characteristics (windows, roof, etc.) and insulation performance.
- Plant layout and plant working diagram for a complex plant (for example, a district heating).
- Availability of the energy source and environmental sustainability of the energy source use. For example: a geothermal power plants needs a water-bearing strata with suitable characteristics; photovoltaic power plant checking solar orientation, obstacles that creates shadings, regulatory constraint, roof pitch.
- Minimal space requirements (plant, fuel storage facilities in case of biomass, boiler or burner, etc). In case of biomass heating plants: size of the biofuel supply area, biofuel suppliers, biofuel continuous supply, size of biofuel storage area. In case of district

heating, an evaluation of the public buildings served, the distance in order to avoid heat losses.

- Any malfunction.
- Maintenance and management.

4.2 Economic and financial analysis

Based upon the technical feasibility study, a preliminary cost estimation should be developed which includes all project expenditures and revenues. If the planned revenues value exceed the costs, the project can be implemented. An external expert has to accurately balance the costs versus benefits before taking an action.

The economic FS checks cost and benefits as regard:

- Investment costs, access to credit, amortization, free grants;
- Ordinary and extraordinary maintenance costs;
- Consumption-related cost (fuels costs, electricity costs, etc.);
- Operational costs (personnel cost, insurance, cost of premises);
- Avoided costs (for example when a proposal cuts down heating fuel consumption)
- Revenues (for example when a proposal guarantees revenues with the sale of electricity)

The financial sustainability of the proposal is based on the cash flow analysis. Cash flow is the movement of cash into or out of a business, project or financial product (equals cash receipts minus cash payments). It is usually measured during a specified, finite period of time, typically one year. This calculation tool works with the discounted cash flow (DCF) method which links streams of future money flows to lump sum amounts.

In order to synthesize the analysis three indicators can be calculated: Net Present Value (NPV), Payback period and Internal Rate of Return (IRR).

a) Net Present Value (NPV): is defined as the sum of the present values (PVs) of the individual cash flows of the same entity. To calculate the NPV it is necessary to define the cost of borrowing capital (or lost income from capital which could have been invested elsewhere) and the period for the analysis of the project. If the NPV is positive, the project would add value to the PA and therefore the project may be accepted. If you are

comparing several proposals choose the proposal with higher NPV in case of equal conditions.

b) Payback period: defined as the period in which the initial investment is recovered by the annual saving. Generally this approach is too simplistic where the capital expenditure may be spread over a number of years, and where the income may vary from year to year. It is therefore not recommended. If you are comparing several proposals choose the proposal which has the lower Payback period.

c) Internal Rate of Return (IRR): this can be defined as the test discount rate that results in a net present value of zero. IRR is less robust than NPV as it can lead to the selection of a smaller-scale project which, although generating a higher return, involves less capital so that the total value of the income stream is lower than the maximum potential. In cases where one project has a higher initial investment than a second mutually exclusive project, the first project may have a lower IRR (expected return), but a higher NPV (increase in shareholders' wealth) and should thus be accepted over the second project (assuming no capital constraints). Comparing several proposals choose the one which higher IRR. In any case the IRR should be higher than project's cost of capital.

The indicators calculation is available within most spreadsheet software packages.

The above parameters are normally sufficient to compare options and present the results to the PA for a decision to proceed further. An appraisal by a financier is also likely to involve the calculation of tax implications and debt cover ratios.

4.3 Social and environmental sustainability analysis

The social and environmental sustainability analysis considers the environmental and social costs and benefits of the proposal (the so called negative and positive externalities).

The social and environmental sustainability analysis checks:

- Avoided carbon emission;
- Carbon emission (for example, in case of district heating, the emissions due to the biomass transport);
- Other produced/avoided impacts (for example, increase or cut of noise and vibration);
- Waste management (for example, ash residues from biomass combustion plants);

- Job creation.

5 EVALUATION OF THE FEASIBILITY STUDY

The FS report provides some main indicators in order to evaluate if the project complies with the chosen PA aims. It details the evaluation criteria, the study findings and the recommendations.

The report, therefore, has to provides a complete summary of feasibility study results and sets up the investments for a project specifying the reasons for undertaking the project and analyzing its costs and benefits.

Documentation must contain at least the following information:

- The complied PA aims and how the proposals complies them;
- Strong and weak points of the proposals;
- An economic analysis of each of the alternatives considered in the feasibility study that meets the established objectives and functional requirements, and the reasons for rejecting the alternatives that were not selected;
- An economic analysis of the life time running costs and benefits of the project and the costs and benefits of the current method of operation during the life cycle of the project;
- The source of funding for the project;
- A detailed project schedule showing key milestones during the project's life.

6 REFERENCES

Publications

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Web Sources

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- http://www.reg-energy.org/web/tool2b5e.html?id=24&sid=13
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7 ANNEX

For your convenience find below some examples reporting some basic data and output for feasibility studies

Case A. *Improving the energy efficiency in heating buildings*

1. Technical Feasibility study

To be collected:

a) data in order to evaluate the project from a technical point of view.

Building element	Units of measurement **a**	Value (according to the law) **b**	Measured value **c**	Value gap **d=c-b**	Value (after project implemen-tation) **e**	Improvement (%) **f=(e-c)/c**
Overall heat transfer coefficient of the external wall (U value)	W/m^2K					
Overall heat transfer coefficient of the roof (U value)	W/m^2K					
Overall heat transfer coefficient of the ground floor (U value)	W/m^2K					
Efficiency of the heating plant	%					
Average annual consumption for heating	kWh/yr					
Renewable energy						
…						

b) performance indicators in order to check if the PA aims are reached.

	Units of measurement **a**	Value (according to the law) **b**	Measured value **c**	Value gap **d=c-b**	Value (after project implemen-tation) **e**	Improvement (%) **f=(e-c)/c**
Primary Energy Consumption	[kWh/m3a]					
Energy efficiency class of the building						
Fuel saving	Litres, m^3, kg, …					
…						

c) result indicators in order to monitor the project.

	Units of measurement **a**	Measured value (before project implementation) **b**	Measured value (after project implementation) **c**	Improvement (%) **d=(c-b)/b**
Average annual energy consumption	kWh/yr			
Percent renewable energy	%			
....				

2. Economic and financial analysis

To be collected:

a) data in order to carry out the economic and financial analysis of the project.

A. INVESTMENT		1st year	2nd year
Demand			
1	Investment costs (studies and design)		
2	Investment costs (project implementation)		
3	Investment costs (others)		
4	Grand total (from 1 to 3)		
Coverage			
5	Own resources		
6	Free grants		
7	Loan		
8	Other		
9	Grand total (from 5 to 8)		
B. MANAGEMENT			
Demand			
10	Maintenance		
11	Reimbursement funding (2)		
12	Interest expense (2)		
13	Grand total (from 10 to 12)		
Coverage			
14	Falling tariff		
15	Avoided costs (savings for fuel costs for heating)		
16	Own resources		
17	Operating grants		
18	Grand total (from 14 to 17)		

b) performance indicators in order to assess the project financial feasibility

		1st year	2nd year
19	Total demand (4+13)		
20	Total coverage (9+18)		
21	Balance (20-19)		

c) performance indicators in order to assess the project economic feasibility

		1st year	2nd year
	Cash flow		
	Used cash flow		
	NPV		
	Payback period		
	IRR		

d) result indicators in order to monitor the project

	Units of measurement **a**	Measured Value (before the project implementation) **b**	Measured Value (after the project implementation) **c**	Improvement (%) **d=(c-b)/b**
Average annual heating costs				
…				

3. Social and environmental sustainability

a) data in order to assess the social and environmental sustainability

	Units of measurement	Measured Value (before the project implementation)
Atmospheric emissions (for each pollutant)		
Job creation		
…		

b) performance indicators in order to check if the PA aims are reached

	Units of measure-ment **a**	Aim value **b**	Measured Value (before project implementation) **c**	Measured Value (after project implementation) **d**	Improvement (%) **e=(d-c)/c**
Carbon emissions					
Other pollutant emissions (NOx, SO2, dust)					
Fossil fuel consumption					
Use of renewable energy					
…					

c) indicators in order to monitor the:

	Units of measurement **a**	Measured value (before the project implementation) **b**	Measured value (after the project implementation) **c**	Improvement (%) **d=(c-b)/b**
Average annual heating costs				
Energy from renewable energy sources				
…				