Green ProcA

Green Public Procurement in Action

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Procurement and Climate Protection

Buildings and Building Components

Co-funded by the Intelligent Energy Europe Programme of the European Union

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Publisher: Consip SpA
Via Isonzo, 19/e
00198 Roma, Italy
E-Mail: lidia.capparelli@consip.it
Internet: www.acquistinretepa.it; www.consip.it

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Content

1. Introduction

This guide is intended to help trainers to perform trainings for total beginners and for more advanced users either. On the other hand, the objective is to contribute to fulfilment of various national goals through smart procurement decisions. The purpose of this guide is to provide initial help and support to public as well as private investors at defining criteria and preparing tender documentation. Therefore and for the possibility to adapt the trainings according to the time which is available a modular structure has been chosen.

Buildings and building components are a specific green procurement group. Seldom can we find an area where an individual decision may affect so many other technical and non-technical parameters. It is important to have in mind that we spend most of our time living and working in buildings. It is thus vital to ensure suitable indoor comfort as well as acceptable investment, operational (running) and maintenance costs. Too often procurement decisions – not well thought about - result in poor end-performance or in certain cases even in conditions leading to sick building syndrome.

As buildings normally have a **substantial technical and constructional lifetime**, it is vital to distinguish between components, which have a shorter technical lifetime and can be replaced or upgraded without major interventions into building structure (for example, boiler, solar collectors, etc.), and components, for which any intervention would require more substantial work and higher additional costs (for example, additional thermal insulation, new windows, not to mention load-bearing construction, etc.).

Green procurement in the building sector is often a more demanding task compared to other sectors or product groups – not necessarily and not always from the point of view of complexity of procedures, but from the point of view of possible cross-influences the decisions may have. For example, defining relevant criteria and selecting the type of material for the facade thermal insulation system with pre-defined technical characteristics or for interior paint is a relatively straightforward action, which normally does not imply study of eventual influences on other building elements or on end-users. In more complex cases (new construction, reconstruction, and major renovation) the green procurement team may need to be as interdisciplinary as the design team itself.

Proper timing and time-order of procurement decisions are essential for a good and long-term beneficent result, which is linked also to analysis of life-cycle costs, vital instrument allowing investors to check various procurement options against a long time scale and minimizing future costs due to unnecessary interventions. This principle is illustrated in the graph below, taken from http://www.uneptie.org/media/review/vol26no2-3/005-098.pdf.

Especially in buildings, with their already mentioned long life time, the procurement principle of the lowest investment cost without consideration of the use and demolition/disposal phase is extremely unreasonable. Various sources mention slightly different numbers, but all agree that the ratio of costs between pre-use phase and use and post-use phase is around 85:15, as illustrated below.

It is important to remember that the design costs usually do not exceed 0.5% of the life costs of a building. But, exactly the design stage is the one where all the major decisions are taken, on which the future building performance and related expenses depend. This is thus the stage where really detailed consideration of all aspects and impacts is needed, and where enough time (and knowledge) shall be available to avoid mistakes (see also Figure 1).

We can very roughly speak about **installed and built-in building components**. The latter ones should be designed and chosen in such a way that their characteristics allow normal and efficient functioning of a building as long as possible. For this reason national regulations usually provide already initial high-performance criteria for instance for the elements of the outer building envelope (maximal U-value being the most obvious example).

On the other hand, building components needed as a replacement or an upgrade of existent state shall be selected with future in sight, too. It is only sensible and highly advisable to purchase top of the range products affordable according to the available budget. By “top of the range” an optimal combination of at least technical specifications, energy- and environmental properties, and financial aspects is meant. EU and national strategic and operational documents about energy efficiency and environmental impact of buildings are based on these principles in order to guarantee long-term economic benefits and provide initial security for investors and end-users.

When it comes down to new buildings or renovation of existing ones, modern requirements in regulations often aim at the so-called **low-energy** or **low-carbon** levels. The most recent term introduced in official documents is “**nearly zero-energy building**” (nZEB). There is no uniform approach prescribed to nZEB in EU member states. In any case, already at early planning stages attention must be put upon operational and maintenance costs. The building sector is one of the major examples where analysis of life-cycle costs for possible solutions shows most valuable long-term effects.

Also, the approach towards procurement visible differs from many other product groups because of the complexity and interactions of all building components and systems. Of course, this depends again on the procedure level: we could be talking about construction of a whole building or about purchasing a specific individual building component. This will be explained later in the text.

2. Building sector in numbers

The buildings sector is – with around 40% of the final energy consumption – one of the largest energy consumers in the European Union. The **main fields of energy consumption** here are:

- heating,
- cooling,
- hot water supply,
- ventilation, and
- electricity.

In addition to reduction of the energy demand of existing buildings, new building design strategies must show the way towards significant decreases in building energy demand. The structure of energy consumption varies depending on the building type. For example, office buildings usually can have higher electricity consumption but lower heat demand than residential buildings.

A quotation from the EU GPP Toolkit
(http://ec.europa.eu/environment/gpp/pdf/toolkit/construction_GPP_background_report.pdf):
"For most public authorities, the construction of new and renovation of existing buildings represents a major share of annual expenditure – in some cases over 50%. Additionally, the running costs of publicly owned buildings, including heating/cooling, electricity, waste, hot and cold water, are significant drains on public finances. Furthermore a large proportion of all construction works are publicly financed, with contracting authorities therefore able to exert considerable influence on the market as a whole."

The International Energy Agency has also estimated the long-term energy savings potential for new build to be at 70-75 %, and this without additional costs or with very limited additional costs for owners. The total feasible potential for energy savings by renovation and refurbishment is estimated at 55-80% depending on the building type and region.

McKinsey report from 2007 defined the following **key areas**, where large potentials at negative costs exist:

- Improved insulation (40%)
- Appliances (30%)
- Lighting (10%)

By cutting the energy use in buildings by about 30 %, Europe's energy consumption would fall by 11%, slightly more than half of the 20-20-20 target (20% less carbon dioxide by 2020, energy efficiency increased by 20%, with 20% renewables in the energy mix).

The building stock in the EU amounts to 21 billion m^2. The annual production of new buildings is 1%, demolition rate about 0.5%, and retrofit about 1.8 %. At that rate it will take a very long time to improve energy efficiency. A comprehensive and aggressive approach will be needed to reach the 30% target.

2.1 EU strategies related to the building sector and green procurement

Through the past fifteen years many important steps have been taken in Europe to reduce environmental load and to secure energy supply:
Probably the most important buildings-related EU documents, transposed into legislation of EU Member States, are:

- Construction Products Directive ("CPD"; 89/106/EEC)
- Directive on the Energy Performance of Buildings ("EPBD"; 2002/91/EC)
- Directive on energy end-use efficiency and energy services ("ESD"; „Services Directive"; 2006/32/EC)
- Directive on the promotion of the use of energy from renewable sources („RES Directive"; 2009/28/EC)
- Directive establishing a framework for the setting of ecodesign requirements for energy-related products ("Eco-Design Directive"; 2009/125/EC)
- EPBD Recast (2010/31/EU)
- Directive 27/2012 on Energy Efficiency : The new Directive entered into force on 4 December 2012. Most of its provisions have been implemented by the Member States by 5 June 2014.

NOTE: An overview of these and other relevant documents is given in the EU GPP Background report for the construction, see: http://ec.europa.eu/environment/gpp/pdf/toolkit/construction_GPP_background_report.pdf

In 2010 the recast of the EPBD was adopted, setting requirements for strengthening of national legislative criteria for buildings. Member States already had to adjust their legislation accordingly. All this is in coherence with EU Commission policy, which calls upon member states to develop and perform urgent actions also to boost renovation of existing renovation building stock.

EPBD, EPBD Recast and Green Procurement – most important common points:

- Calculation of the overall energy performance
- Definition of minimum energy efficiency criteria for new construction and major renovation, and of mechanical systems (heating, hot water, a/c)
- Feasibility studies of alternative energy systems
- Building energy performance certification (mandatory displayed in public buildings); stress on recommendations for improvement
- Cost optimum measures for construction and renovation – LCC-based planning
- Regular inspection of boilers, complete heating systems and a/c systems

3. Green procurement and buildings

Energy efficiency of buildings or their components is most probably the first thing we usually consider when we are trying to define green criteria in a general sense or for the purpose of a concrete procurement. However, kilowatt hours, efficiency coefficients and similar indicators are describing only one segment of the vast area of possibilities. There are other very important topics, which should be given proper attention, too; for instance, water use and conservation, indoor microclimate and comfort, waste production and disposal, and use of products and resources.

According to “Tackling climate change through public procurement” (ICLEI, 2007) the **key environmental impacts** of buildings are:

Impact		Approach
• The consumption of energy for heating, cooling, ventilation, hot water, and electricity, and resulting CO_2 emissions	→	Ensure high energy efficiency standards Encourage the use of localised renewable energy sources (RES)[3]
• The consumption of natural resources	→	Encourage the use of sustainably harvested resources
• Emission of toxic substances during the production or disposal of building materials leading to air and water pollution	→	Encourage the use of non-toxic building materials
• Negative health impacts on building users due to building materials containing toxic substances	→	Encourage the use of non-toxic building materials

Figure 8: Taken from http://deep.iclei-europe.org/fileadmin/user_upload/Procurement/DEEP/DEEP_publishable_report_FINAL.pdf_01.pdf

Based on these impacts one way of **grouping the criteria** would be according to their relation to:

- energy flows (gains and consumption),
- origin of the delivered energy (renewable and non-renewable sources),
- materials and products used in the construction, use, and removal phases,
- transport and construction procedures,
- management of water and other (local) resources, and waste,
- and to various other characteristics and impact significances.

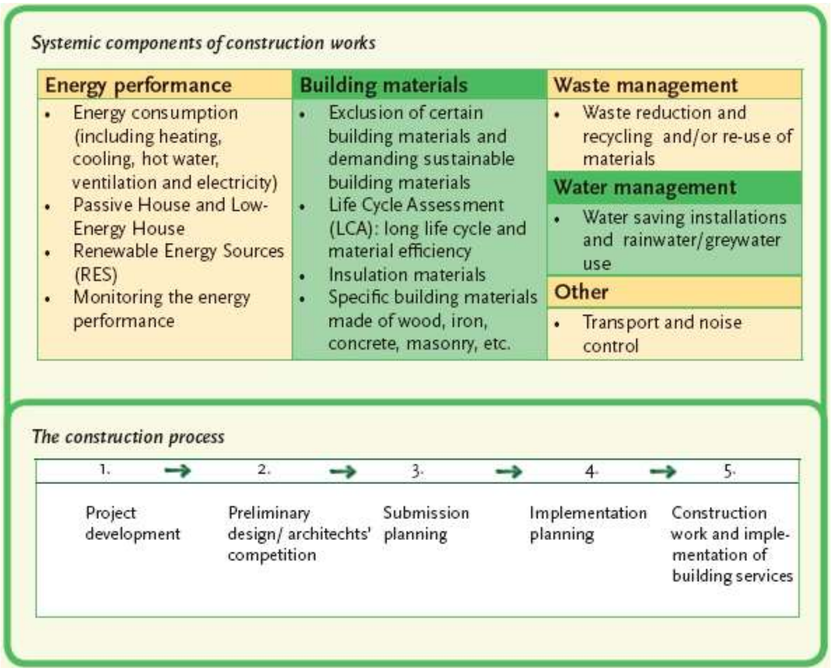

Figure 9: Construction works and possible areas for setting GP criteria
(taken from http://ec.europa.eu/environment/gpp/pdf/toolkit/construction_GPP_background_report.pdf)

The impact volume, which buildings have, is well illustrated in the figure below. But, precisely this volume shows also the range of opportunities for greening the procurement practice in the building sector:
An important segment of green procurement criteria is connected to the personnel required for individual tasks. Planners, engineers, contractors, supervisors and other profiles need to have relevant **knowledge, experience, skills, and references**. Requirements from this field are a logical part of complex green procurement criteria.

The more **technical criteria**, already presented above, may for instance comprise in detail:

- Energy performance, especially dealing with energy consumption, RES and innovative energy efficiency building services, including use of building energy management systems.
- Building materials, mainly considering the use of local and environmentally friendly construction materials (also by help of LCA-based environmental product declarations (EPD), see chapter further below), avoiding products containing harmful substances and preferring low thermal conductivity values.
- Water management, based on water saving installations and the rainwater and grey-water utilization.
- Waste management, comprising waste reduction, separation, recycling and disposal.

- Various mandatory quality verification tests during or after construction (i.e. IR thermography, Blower door)
- Organisational measures like energy book-keeping, prescription of use patterns, training of future building managers, etc.

REMEMBER: Criteria from buildings-related regulations (RUE, RES, G(P)P) usually vary from country to country. A direct transfer for use in tendering procedures is rarely possible. A „target“ or „bonus“ value in one country may be only a „must“ value in another (e.g. U-value of a window).
But, observing good practice in G(P)P from other environments can provide valuable ideas about the criteria concept and methods of assessment of offers.

Always check first what is required by current national legislation – setting selection criteria, which are mandatory in any case, is not green procurement. National buildings-related energy efficiency regulations may have already set more severe demands for public buildings (e.g. a 10% lower final energy demand than private buildings, or similar). In such cases do not prepare even tighter criteria without carefully checking the technical and financial feasibility beforehand. **For building components the line of the action is similar:**

Always remember, *green* must go hand in hand with cost effectiveness. First, check the eventual mandatory requirements about product efficiency, thermal properties, environmental characteristics, and similar. Do not demand better characteristics of building components („just to be greener“) without knowing the technical and economical limits and market availability – **criteria must be justified**. Also, consider potential influences and impacts one component may have upon the others or upon the overall building – are there any boundary conditions, which would negatively affect the situation after the component is installed, in spite of its perfect individual characteristics?

For example, defining relevant criteria and selecting the type of material for the facade thermal insulation system with pre-defined technical characteristics or for interior paint is a relatively straightforward action, which normally does not imply study of eventual influences on other building elements or on end-users.

On the other hand, there are cases where our actions can result for instance in a need for ad-justed or amended behavioural patterns or schedules. The timing and order of actions are very important, too. A newly purchased construction product may be “green” and have excellent over-all characteristics, but the performance can be far from optimal if boundary conditions are not appropriate.

Let us take a look at two practical examples:

(a) Replacing existing deteriorated windows with state-of-the art products is beneficial from the energy and environmental aspects: reduced heat losses, less draught, better indoor thermal comfort. But, as the airtightness of the envelope is increased, the indoor microclimate may be significantly affected: lower overall air quality, higher air humidity, increased possibility of surface condensation on thermal bridges and consequent mould growth. It is very advisable to install simple humidity meters in rooms where water vapour production is above average (sleeping room, kitchen etc.) and to monitor the relative air humidity in order to react in time by ventilating the spaces when needed. Usually the daily level of ventilation has to be increased, either by opening windows more frequently (change in usage patterns) or by installing a mechanical ventilation system (hygro-sensible one only to regulate air intake or one with heat recovery to reduce heat losses further).

(b) Replacing old valves on radiators with thermostat ones is an excellent way of gaining more precise control over indoor temperature and energy use for heating in general. At the same time the temperature deviations in the rooms are much lower, which increases indoor thermal comfort. But, for all this to be practically realised, appropriate boundary conditions are needed, especially in larger buildings like office or multi-apartment ones. If the heating system (boiler, burner, pipe-lines etc.) is already deteriorated and inefficient the final result will be poorer. It will be even less favourable if the system is not hydraulically balanced – the distribution of heat and consequently of the operational costs will be unbalanced, too. This shows that the time order or sequence of particular purchasing decisions is very important in order to maximise the long-term cost optimality of procurement decisions.

We can illustrate this principle in the following way: when making procurement of for instance new lamps or IT equipment we can calculate the benefits in a quite similar way as with individual building components. As long as the technical characteristics of new lamps or IT equipment are the same (or, preferably better) as of the old products, the advantage of reduced energy consumption is clear. With building components the situation is not that simple. Their nominal energy and environmental performance may be outstanding, but to activate this potential in full other important prerequisites may be needed. As illustrated above, one action, which is without doubt positive if looked at in isolation, may negatively affect some other building features and thus spoil the overall result, if additional measures are not taken in parallel. We need not only a clear picture of the existent state, but also good vision of the future new conditions.

To sum up, we can define green criteria for example as:

Qualitative	• references regarding planning of low-energy houses • required transport and construction procedures • use of certain calculation methods • etc.
Quantitative	• thermal characteristics of building materials • building energy performance certificate class • lowest primary energy demand among offers • duration of product's technical lifetime • etc.
Combined	• optional combination of the above options

Another option could be according to different project/construction levels:

On the level (at the stage) of planning and/or construction	• references • procedures • methods • etc.
On the level of characteristics of materials, products and systems	• thermal conductivity • content of certain chemicals • operating efficiency • RES share and type • etc.
On the level of overall building energy and environmental properties	• heat and cooling demand • final energy indicator • CO_2 emissions • etc.

Yet another classification of most common stages of procurement in the European building sector brings the study »Dissemination of Energy Efficiency measures in Public buildings« (DEEP 2007):

Stage of the construction process	Aspects which may impact on the environmental performance of the building
Building design	• Net energy demand (for space heating, cooling, ventilation) • Selected materials (wood, glass, metal etc) • Intelligent transport systems • Waste generation • Noise control • Lighting services needed • Potential for using localised RES
Building construction	• Percentage of sustainable building materials • Recycability of materials • Reduction of dangerous substances • Energy demand for the construction plot
Building services installation	• Final energy demand • Localised RES • Wastewater generation

Figure 11: Source: http://deep.iclei-europe.org/

3.1 European Commission GPP Training Toolkit

The GPP Training Toolkit developed by the EC is intended to be a support tool for the European authorities for implementation of environmental criteria in their tenders. It is providing guidance for the following aspects to consider when including environmental criteria:

- **Subject matter**: Detailed description of what is going to be purchased.
- **Technical specifications**: Minimum mandatory requirements that goods, services or transports must fulfil - requirements for contract awarding. This information can be based on: criteria defined in various eco labelling schemes, technical standards, production methods, use requirements, etc.
- **Selection criteria**: exclusion criteria, technical capacity and financial capacity.
- **Award criteria**: the lowest price, the most economically advantageous offer, environmental criteria.
- **Contract performance clauses**: special and specific clauses in the contract.

There are also other aspects, which can be considered:

- **Environmental site and building design**: Decisions about the location and appraisal of the site will fundamentally influence the sustainability of a building.
- **Alternative Cost Models**: cost models such as Third party financing or Energy Performance Contracting offer ways to overcome the gap between construction costs and life-cycle costs.
- **Behavioural Aspects**: training of building users in energy- and water-saving behaviour, establishing of an energy accounting system or environmental management system.

For each product/service group it presents two sets of criteria:

- **Core GPP criteria** address the most significant environmental impacts, and are designed to be used with minimum additional verification effort or cost increases.
- **Comprehensive GPP** criteria are intended for use by authorities who seek to purchase the best environmental products available on the market, and may require additional administrative effort or imply a certain cost increase as compared to other products fulfilling the same function.

EU Commission's GPP Training Toolkit can be ***downloaded*** from the GPP website:
http://ec.europa.eu/environment/gpp/toolkit_en.htm

4. Considered products, features, and related criteria

A building is an organic system, whose performance depends on energy flows. With correct, well considered and expert creative design of its individual elements and by taking into account their interaction, energy consumption can be significantly reduced during the whole life-time of a building. A parallel step in the planning process is design of a whole building, its components and support systems, which besides securing efficient use of energy creates also suitable and satisfactory living and working conditions. Green procurement in the building sector combines energy- and environmental aspects with well-being of occupants.

The above already mentioned **EU GPP Toolkit** currently (2012) offers criteria and tools for:

- Construction
- Windows, glazed doors and skylights
- Thermal insulation
- Hard floor-coverings
- Wall panels
- Combined heat and power

See: http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm

NOTE: Also indoor lighting, IT equipment and other internal heat sources have impact on building energy performance (internal gains, cooling load, final energy demand etc.), although they are not counted in as „classical" building components.

As stated above, buildings comprise so many constituent elements – materials, products, and systems – that it would be impossible to cover them all in this Annex. Instead, some major items are presented here, which are usually connected to more substantial investment (but also operational and maintenance) costs.

Nevertheless, in all cases one should follow the "value for money" principle by setting appropriate criteria and selecting among different offers. This is true for example when purchasing a complete heating system or only thermostat valves, or when deciding for plans for a whole new building or just for replacing windows in an existing one.

4.1 Thermal insulation

Insulation is one of the key factors for low heating and cooling demand of a building (and consequently also for low related operational costs), and for high thermal comfort of its users. It is not easy to discuss about an optimal thermal protection of buildings in general - it depends on the nature and purpose of the building, local climate, concrete building location and its orientation in space. However, there are **three basic rules**, which should be followed in any case of thermal protection: **high level** of insulation (low U-value), **uniformity** of the thermal insulation layer (prevention from material and structural thermal bridges), and an **airtight** construction (prevention from convection thermal bridges). Following these principles serious problems really should not appear. Important differences and specific situations can, however, occur in planning of insulation of existing buildings, where some additional limitations can arise, for example from structural features or demands of cultural heritage protection.

The choice of insulation materials is large and therefore there are many possibilities for the respective fields of use (for example: insulation for the cellar has to have different characteristics than an insulation material for external walls or the attic). By selecting the right material for specific purpose, proper long-term functioning of the individual structure and the whole building can be insured and risk of early repairs and associated costs can be limited.

Especially the following aspects should be considered when choosing insulation:

- thermal conductivity coefficient (λ= Lambda, measured in watts per meter per degrees Kelvin, W/mK) and heat transmission coefficient (U-value, measured in watts per square meter per degrees Kelvin, W/m2K);
- water vapour diffusion characteristics;
- density, compressive strength, loading capacity;
- environmental impact: energy demand in production, possibility of recycling/disposal and repeated application (re-use), and other parameters, visible for example from LCA-based environmental product declarations (see chapter about labels).

Same general principles as for the whole building envelope should be considered also in each case of an individual building element. Thickness, disposition and structure of the building thermal envelope should be defined for each particular example.

- **External walls**

External walls have maximum surface among all building envelope elements, although they are not necessarily the source of highest thermal losses of buildings in relation to other structures. Design and construction of external walls can differ for different types of materials, and for different types of buildings. With regard to their particularities, material for thermal insulation, and the thickness of the protective layer should be considered. For example, for thermal protection of a wall in contact with terrain different materials as for an outer wall (facade) above terrain are used. Or, for instance a lightweight prefabricated building (panel, endoskeleton wall, with fillings ...) has a number of specific features, which do not appear in massive (heavy weight) construction. In particular, air-tight construction and elaborated details (e.g. preparation of construction itself for installation of doors and windows, connection between thermal insulation of outer wall and window frame etc.) seem to be of greater importance here.

More obvious problems from the building physics point of view - especially in terms of required precision of realization - can in principle be expected in cases where insulation is installed on the interior side of external walls: in this case it is very likely that a vapour barrier and an absolute air-tightness of all joints will be necessary, while this not being easy to achieve in practice.

- **Attic**

Insulation of a ceiling towards an unheated attic can be one of the most cost-efficient and in terms of realization one of the easiest measures to save energy. To some extent, this also reduces risk of summer overheating of rooms underneath. In both cases, thermal comfort in areas below can be significantly improved. The investment payback period is very short, usually around 2 years. The same principles apply, of course, to new buildings.

If the attic space is also expected to be used permanently as a living or working area at some time in the future, it is necessary to determine whether it is more reasonable and cost-efficient to insulate the roof above the attic immediately rather to insulate the ceiling. In terms of renovation of existing building this can be a very complex measure, which requires participation of experts and a thorough review of circumstances, which will influence the renovation.

4.2 Windows

In recent couple of decades windows have undergone a technological revolution. High-performance energy-efficient windows and glazing systems are now available, which can dramatically cut energy consumption and emissions. They have **lower heat losses, less air leakage, and warmer inner glazing surfaces**, which improves comfort and removes condensation risks on interior glazing surface within normal occupancy patterns.

Windows are composed of a number of components, such as frame, glass, gas filling, and low-e coating. These components can be used in a large number of combinations and materials; however, they are not unlimited. The architectural design of a building usually conditions the shape and size of a window. The structural design of a window depends on this, also, including possible manners of its fitting and mounting, possible ways of opening, and the size of each individual casement and glazed panel, possible types of window hardware and possible materials of casement and frame. Also, the desired colour can be decisive in terms of material selection. Additional criteria can for example include also protection from meteorological impacts (water- and air-tightness) and security features.

As for the opaque parts of building envelope, U-values (heat transfer coefficient; W/m^{2}K) for glazing (U_g) and whole window (U_w) have to be considered. Lower U-values mean reduced heat losses; at the same time temperature of the inner surface of the inner pane increases, thus improving thermal comfort. Nevertheless, adequately high transmission values for overall solar radiation and visible light (g, T) must simultaneously be achieved to allow utilisation of passive solar gains, to provide daylight and indoor visual comfort, and to reduce electricity consumption for lighting.

The most important constructional parts of windows are:

- **Glass / glazing system**
  - **insulating glass**

    Double or triple glazing is possible, whereby such glazing without gas filling and low-e coating (with U-value above 2,0 or 2,5 W/m^{2}K) nowadays in most national regulations is not considered as an allowed option anymore.

  - **energy efficient glazing**

    Double or triple pane glazing is available. Double pane thermal protection glass has at least 50 – 60% better insulating properties compared to ordinary double insulating glazing. Between the two panes an inert gas is filled in and the inner pane is coated with a low emissivity coating. Typical U-values are 1,0 to 1,3 W/m^{2}K. This technology is now considered as a standard basic option in many EU countries.

Triple pane high performance glazing shows even better insulating properties, with U-values from 0,4 to 0,7 W/m^{2}K, thus suitable also for passive house standards. These properties are achieved by combining three panes, two low-e coated panes and an inert gas filling (Argon, Krypton).

- **spectrally selective coatings**

  Spectrally selective coatings are optically designed to reflect particular wavelengths while remaining transparent to others. Such coatings are commonly used to reflect the infrared (heat) portion of the solar spectrum while admitting a higher portion of visible light. They help create a window with a low U-value (low-e coating) and solar heat gain coefficient, but with a high visible transmittance. Window systems with spectrally selective coatings can also filter damaging UV wavelengths and increase the lifetime of room furnishings.

- **Frame**
  - Frame materials play an important role in the overall thermal performance of windows. PVC and wooden frames have better thermal characteristics than frames made of metal materials, because of their lower thermal conductivity. But it is also important to consider some additional issues when choosing frame materials: exposure to weather conditions (rain, wind, UV), maintenance possibilities, mechanical requirements, and similar. There are also frames with combinations of materials for an improved U_f-value available, for example aluminium frame with an insulating filling, wood with PU filling, wood-PU-metal structure (see Fig. 22), and similar.

Modern windows cover the entire area of building physics. In reference to windows we are talking about light, sound and thermal comfort of a room, indoor air quality, protection from atmospheric impacts and psychophysical effects. With such high baseline requirements typically also higher investment costs are expected. However, they need to be evaluated considering all their positive effects, not just economic ones (longer life expectancy and lower maintenance costs, reduced demand for energy for heating and partly for cooling, adequate level of natural illumination, and consequently lower demand for artificial lighting): good sound insulation, glare control, proper daylight levels, and along with these also an improved level of living and working conditions in terms of thermal, visual, and aural comfort. This is what is unfortunately often being forgotten when an economic analysis of long-term effects of different options is being performed.

4.3 Air-tightness

An air-tight building shell and a high level of insulation are prerequisites for an energy efficient building construction. While insulation reduces heat losses, an air tight construction (**prevention of convective thermal bridges**) makes sure that there are no disturbing air draughts to compromise comfortable room microclimate, as well as that certain building components or their parts do not cool down unevenly, which can cause surface condensation and mould growth.

Several tests help to establish the level of airtightness, and the so-called blower door test is the most common one. The main principle is to measure the hourly air change rate (ACH) due to untight envelope elements (cracks in the building shell), which is done by special equipment at prescribed pressure levels. In majority of "standard" housing an ACH between 1 and 3 would be expected, while low-energy and passive criteria set these levels far below 1.

On the other hand, a crucial thing to remember is that the more air-tight a building is, the more care has to be taken to ensure sufficient controlled ventilation of indoor spaces to avoid excessive increasing of air humidity and to guarantee an appropriate level of **indoor air quality** (prevention of stale indoor air).

One of the most common problems is related to renovation of existing buildings either by additionally sealing existent windows or by installing new ones with a high level of air-tightness: hundreds of buildings throughout Europe were affected by mould growth afterwards because building users did not adapt ventilation patterns to new conditions.

4.4 Ventilation systems

For a healthy and comfortable room climate **regular controlled ventilation** is necessary. The demand for fresh air depends on the number of people and the activities and patterns of use of a particular room. ACH (see paragraph above) in living and working spaces should as a rule not fall below 0,5 (or, 15 m^3 of fresh intake air per person per hour). National and local regulations and codes usually govern the minimum ventilation requirements in a detailed manner.

Prolonged ventilation with a window in an inclined position ("ventus") or with only partially open window in colder periods is not correct. In such cases air movement is slow and does not reach air pockets in remote locations, while on the other hand sub-cooling of the structural elements near windows (asleep, lintels) occurs. This can result in a surface condensation of water vapour from the air. Constantly repeating this kind of ventilation pattern can result in development of mould. It is particularly important that sufficient airflow is allowed along all internal surfaces of building structures.

A large part of abovementioned problems can be eliminated using mechanical ventilation (local or central), if possible with waste heat recovery. Sufficient exchange of air is assured and the ventilation losses are reduced at the same time. Such system can automatically adjust the quantity of inflow air.

Installation of controlled ventilation with heat recovery substantially reduces overall heat losses. In well insulated buildings ventilation losses usually have the largest share. Modern systems can save more than 75 % of the heat that would otherwise be lost by natural ventilation through open windows. Another option, less energy efficient though, but very effective in terms of providing suitable microclimate is a so-called hygro-sensible system, where fresh air intake is regulated by hatches above the window or on the outer wall, which automatically open or close according to the level of indoor air humidity. Special material incorporated in the system expands as the humidity starts to increase, and the hatch begins to open.

Installation of a mechanical ventilation system is not always possible. In existing buildings, central systems often can not be realized. Therefore we can try to bring up local systems (individual mechanical ventilation units with heat recovery). Here limitations can appear as well, for example due to construction of the external walls, type of facade panels or requirements of cultural and heritage protection.

4.5 Pumps for the heating system and DHW circulation

Pumps help to transport hot water from the heating system to the radiators. Additionally, most of the buildings have hot water circulation pumps installed, so hot water supply is guaranteed just after opening the water tap. Pumps can use a lot of electricity, and therefore should not be neglected in the calculation of energy flows. Very often pumps are oversized and operated at the highest level. Even up to 80% of energy and costs can be saved with installation of modern pumps designed for specific need and use.

4.6 Solar hot water and heating

All solar thermal systems work on the same basic principle: collection of solar radiation and transfer of heat via a heat transfer medium. The heat transfer medium can be used directly, e.g. hot water production, or indirectly using a heat exchanger. There are different types of solar collectors available.

- **Collector without glass cover / protection (“Swimming pool absorbers”)**

Swimming pool absorbers are usually made of black plastic. Because of their limited performance they are normally only used for water heating in swimming pools.

- **Flat plate collectors**

These collectors usually consist of an absorber, frame, insulation and a transparent cover (glass). The glass transmits the solar radiation to the absorber (coated metal plate). The absorber transforms the radiant energy into heat.

- **Vacuum absorber tubes**

With this kind of collector, the absorber is inside of vacuum glass tubes. Heat losses in such a system can be reduced to a minimum. Vacuum absorber tubes have a high efficiency at substantial temperature differences between absorber and surroundings, but they are more expensive than flat plate collectors.

- **Hot water storage tank**

With the hot water storage tank energy can be accumulated for periods with less solar radiation. Therefore the volume of the tank should be around two or three times of diurnal hot water consumption. In the lower part of the hot water storage tank heat from the solar collector is transmitted to the water by a heat exchanger.

- **Design of solar thermal systems**

Careful design has to be conceived for every individual location and every specific kind of use. Efficiency of these systems depends on availability of solar radiation, orientation and inclination of absorbers, shadow factors and on the size of hot water storage tanks.

4.7 Biomass heating systems

Biomass can be used for heating, hot water production, heating for technology processes and also for generation of electricity. Modern biomass heating systems are provided in many different ranges of performance and technologies. Depending on the fuel they can be divided into pellet heating systems and wood chips heating systems.

Pellet heating systems

Pellets are mainly produced from untreated wood residues from the biomass industry, such as sawdust. They are compressed at high pressure without addition of chemical binding agents.
At central pellet heating systems the pellets are transported to the central heating boiler automati-

cally. A pellets storage room is connected to the boiler by a conveyor system (mechanical feeding system) or a suction system (pneumatic feeding system), therefore pellets can be transported to the boiler in a fully automated manner.

With a mechanical feeding system the pellet storage room has to be located next to the boiler room. A conveyor system is the cheapest option in most cases. The conveyor belt system transports pellets via a back burning mechanism into the combustion chamber or a surge tank and from there into the combustion chamber. With a pneumatic feeding system a conveyor system is linked to a suction system. A surge tank is located in the boiler room and therefore the pellets storage room can have a distance of up to 20 m from the boiler room and can even be placed outside. With the suction system the pellets are transported from the conveyor system to the surge tank.

A pellet heating system normally has an automatic ignition and a blower to get the necessary flux. Using special equipment - a lambda probe - the air supply can be measured.

Wood chips heating systems

Wood chips are mechanically chipped wood of different size. The main quality criteria are bulk density (weight), chip size and moisture content. The combustion of wood chips is done by an automatic feeding of the chips with a conveyor system from the storage room. The combustion is done either by a dual chamber furnace, underfeed furnace or retort furnace.
The size of the wood chips storage room should be adjusted to the annual fuel demand and the designated number of fillings per year.

Log wood heating systems – wood carburettor systems

Wood carburettor systems in combination with buffer storage ensure high operating comfort and a good performance adjustment. Requirements are a big filling chamber, dry wood logs and a buffer with 10-fold content (in litre water) of the filling chamber of the boiler.

4.8 Cooling of buildings

In many countries heating is not the only or even the major source of energy flows in a building. Therefore buildings should be designed in such a way that the need for cooling in the summer time is minimized. During the planning phase it is necessary first to take into account all possible **passive solutions** to solve a problem of additional cooling of buildings. When passive solutions are not sufficient, then one may plan mechanical cooling.

Thermal comfort in buildings during summer time is nowadays a recognized need, contributing to quality of life and its productivity. The aim of sustainable summer comfort methodology is to provide new and existing buildings exactly the thermal comfort they need at low or no conventional energy consumption. This implies choosing the best path, which minimizes life-cycle energy consumption at an affordable net cost, from a variety of technological or design options, ranging from architectural choices to appliances.

Costs should be analysed using the life-cycle approach (LCC), taking into account not only lower operational costs due to reduced energy consumption but also avoided capital cost related to investments in large cooling systems, reduced cost of maintenance, and, eventually, accounting for the surplus available floor area (and space) otherwise used by machinery. Reduced system complexity, i.e. friendlier cooling systems, for users is an intangible advantage. Reducing energy consumption for cooling of course reduces also environmental impacts.

Sustainable summer comfort can be achieved if the following steps are considered when planning, constructing and operating a building:

- Defining thermal comfort objectives explicitly, using the Adaptive Comfort model where possible.
- Intervene on the site layout and features of the surroundings of the building affecting summer comfort.
- Control and reduce heat gains through the building envelope and at its external surface.
- Reduction of internal heat gains.
- Use passive cooling methods in terms of removing energy surplus from the building, for example evaporative cooling, radiative cooling, night ventilation, earth to air heat exchangers, probes, groundwater/sea/river/lake water cooling, cooling towers.
- Use active solar assisted cooling plants. There are several technologies available where solar thermal can be used to drive the cooling process instead of electricity. The basic principle behind thermally driven cooling is a thermo-chemical sorption process: a liquid or gaseous substance is either attached to a solid, highly porous material (adsorption) or is taken up by a liquid or solid material (absorption).

- If still necessary to reach the stated comfort objectives, use high efficiency conventional active cooling plants (air systems, air-water systems, water systems, refrigerant systems…). Active cooling systems may be defined by the opposite way of passive cooling systems. In active cooling systems, the main cold medium is produced by mechanical equipments consuming significant amounts of conventional energy. In passive cooling systems, conventional energy consumption only occurs in relatively small amounts caused by the operation of auxiliary mechanical equipment like water pumps and fans.
- Train building managers and occupants on how to behave inside the building and how to

use, monitor performances and adequately operate and maintain the building.

PLEASE NOTE:
There are many other RUE and RES materials, systems and technologies available, which can play an important role depending on the concrete practical case: various types of heat pumps, geothermal probes, solar combo systems, photovoltaic *systems, small wind power, and other. Their technical and financial feasibility should – as with the above described ones – be considered taking into account all relevant boundary conditions. Detailed description exceeds the scope and volume of this Annex, however practical information is available from manufacturers, engineers, and also from dedicated internet pages.*

5. Relevant European labels

Valuable **sources of green criteria** are various eco-label schemes for construction products and services. It is however not easy to set common or equal indicators for all EU countries. There are different climates and different methods to calculate energy demand of buildings or quantitative green indicators. There are also different social and traditional factors that affect these criteria as well. Different ways of construction, sustainable materials availability, etc. make it difficult to set a common methodology to measure sustainability in construction and to set criteria for green procurement. In some countries there is also a lack of data related to LCA and LCC, and consequently it is difficult to set this approach to establish GP implementation.

The most important energy- and environmental labels are briefly introduced in the following section. Eco-labels in the field of buildings mostly only cover building products and not buildings themselves as a whole. In many countries some additional national labels exist.

A good **overview** of eco-labels related to construction, buildings, and building products is accessible on this site: http://www.ecolabelindex.com/ecolabels/?st=category,building_products.

The **Background report on GPP in construction** prepared as a part of the GPP Toolkit also contains a chapter on international and national labels. The following are analysed and compared:

- **International**: EU Ecolabel and Nature Plus
- **National**: Nordic Swan, Blue Angel, IBO Quality Mark; Austrian, Hungarian, and Dutch Eco-label

Besides these two groups the wood product labels and international and national building assessment labels are presented, too.

The report is freely downloadable from this address:
http://ec.europa.eu/environment/gpp/pdf/toolkit/construction_GPP_background_report.pdf

Some of the important labels are presented also in this Annex in the following paragraphs.

5.1 The EU Ecolabel

The EU Eco Label scheme was introduced in the EU in 1992. It is a label awarded to products fulfilling a comprehensive set of criteria. Manufacturers, distributors and retailers apply for the EU Ecolabel award on a voluntary basis. Ecolabel criteria are defined for each product type in specific Commission Decisions.

Website:
http://ec.europa.eu/environment/ecolabel/index_en.htm

http://www.eco-label.com

Target:
The aim of the EU Ecolabel is to induce manufacturers in using more eco-friendly materials in order to reduce the polluting emissions and to put on the market high energy efficient and performing products.

Relevant product groups:

- hard, soft and wooden floor coverings,
- indoor and outdoor paints and varnishes,
- heat pumps.

Awarding Institution & criteria:
The EU Ecolabel is administered by the European Ecolabelling Board (EUEB) and receives the support of the European Commission, all EU Member States and the European Economic Area (EEA). Criteria for the EU Ecolabel are based on the product's impact on the environment throughout its life cycle and include those used to determine whether a product is fit for use, as well as the extraction of raw materials before the appliance is built and their disposal, reuse or recycle once the appliance reaches the end of its useful life. They also include the energy that manufacturers use to produce the appliance, and the possible impact on user health.

Control mechanisms:

All products bearing the Ecolabel are tested by independent Competent Bodies for compliance with the awarding criteria. The EU Ecolabel logo indicates that the specific model has been independently assessed and found compliant with the environmental criteria covering all phases of its life cycle.

Charges:
An application fee and annual fees are care applied by the national Competent Bodies. The application fee covers the costs of processing the application with a min. of 300 Euro and a max of 1.300 Euro; annual fees for the use of the Ecolabel equals 0,15% of annual volume of sales of the product within the Community, from a min. of 500 Euro and a max of 25.000 Euro per product group per applicant. 25% reduction for SMEs and applicants from developing countries and 15% for companies registered under EMAS or certified under ISO 14001 are applied. Other reductions are possible via the relevant national Competent Body.

Relevance on the market:
At the beginning of 2009, more than 750 companies were awarded the Ecolabel for their products. Italy and France have the greatest number of Ecolabel holders, with more than 240 and 140 licences respectively. They are followed by Denmark and Germany who each have more than 50 licences. By the end of 2008 the Ecolabel was awarded to about 3000 products and services, ranging from tourist accommodation services, home appliances, cleaning materials, and mattresses to office supplies, gardening and so called “Do It Yourself products”.

5.2 Solar Keymark - The Quality Label for Solar Thermal Products in Europe

The Keymark for solar thermal products will assist users to select quality solar collectors and systems. This "Solar Keymark" is the result of a voluntary certification scheme supported by the European Solar Thermal Industry Federation.

Website:
http://www.solarkeymark.org/
http://www.thermomax.com/Downloads/Keymark%20Simulator.pdf

Target:
The CEN certification mark - The Keymark - is a general voluntary mark, developed by the European Committee for Standardisation (CEN). The clear and simple message of The Keymark is that the product complies with the European Standard(s) covering the product. The Keymark for solar thermal products will assist users to select quality solar collectors and systems.

Product/service group:

Products covered by the Solar Keymark Certification scheme:

- Solar thermal collectors - as defined in EN12975-1 : Only "liquid heating solar collectors". Excluded are: Collectors "in which the thermal storage unit is an integral part of the collector", and "tracking concentrating solar collectors",
- Factory made solar thermal systems - as defined in EN12976-1: "Factory made solar heating systems are batch products with one trade name, sold as complete and ready to install kits, with fixed configuration.

Awarding Institution & criteria:

The basic elements in the certification scheme are:

- certificates are delivered by Keymark empowered certification bodies,
- test reports are delivered by accredited test laboratories,
- the products are delivered by Keymark licensed manufacturers fulfilling the requirements for factory production control.

Control mechanisms:

The "Solar Keymark Test Institutes" are the institutes having declared to ESTIF that they have accreditation for testing according to the European standards for solar thermal systems :

- EN 12975-2: Solar thermal systems and components - Solar collectors - Part 2: Test methods,
- EN 12976-2: Solar thermal systems and components - Factory made systems - Part 2: Test methods.

Charges:

Certification costs for one collector/system:

- First year costs approx: € 2000-3000
- Annual costs following years approx: € 2000

Relevance on the market:

The Solar Keymark has been developed by the European Solar Thermal Industry Federation (ESTIF), with the support of the European Commission and was introduced by CEN earlier in year 2003.

5.3 Energy performance certificate - energy labelling of buildings

Energy certification (labelling) of buildings is among the key topics of the EPBD and its recast. The

Member States are obliged to ensure that when buildings are constructed, sold or rented out, an Energy Performance Certificate (EPC) is made available to the owner or by the owner to the tenant or potential buyer. The certification shall also include advices and information on how to improve energy performance of building.

The detailed calculation methodologies of the buildings' energy performance and standardized building energy certificates (building energy labels) should follow determinations and appointments of standards or norms applied in Member States individual legislations. Also, the precise form and content of energy certificates depend on relevant national regulations of member countries.

Website:
www.epbd-ca.org
www.buildup.eu

Target

The EPBD is considered as a very important legislative component of energy efficiency activities of the European Union designed to meet the Kyoto commitments. Originally made estimations of a cost-effective savings potential realisable of around 22% within the building sector – if realised – showed that around 20% of the EU Kyoto commitment could be met. This reduction was estimated to be equivalent to around 3% of total final EU energy consumption. Transposition of this Directive by 2006 has had to allow a portion of this potential to be translated into reduced energy consumption. Another important objective for introduction and implementation of the EPBD was to contribute the measures in order to prevent the EU against increase the dependence on external energy sources, which is according to the current forecasts expected to reach approximately 70% in 2030.

Product/service group

Energy performance certificates concern the whole building as an assembly of many closely connected components essential for its energy consumption and influencing on its energy performance. It concerns such elements as building envelope, windows, heating, electrical and ventilation instillations, lighting, heat sources (incl. boilers, CHP units) cooling systems and others.

Awarding Institution & criteria

Member States are obliged to transpose the EPBD and further (i.e. Recast EPBD) requirements into national legislations. Each Member State is responsible for introduction of its own specific legislation and establishing of supervising mechanisms and institutions on national or regional levels. EPCs should be based on calculated energy demand for energy or on measured energy consumption using devoted CEN standards. Member States shall ensure that all measures, including EPCs are carried out in an independent manner by qualified and/or accredited experts.

Control mechanisms

Each Member States administrations are obliged to implement adequate control and monitoring mechanisms and procedures.

Charges

Energy Certification is a self-financed scheme based on the market rules in the most of Member States.

Relevance on the market

EPCs - if implemented as intended - can significantly influence the real estate marked due to strong connection of energy performance of buildings with their market value in most cases. Concerning energy certificates, it has to be pointed out that a higher energy performance class (according to the national energy certificate scheme) of a particular building will most probably increase its market value this building. To agitate higher public awareness and to increase public sensitivity to this issue large public buildings and public service buildings with high visiting frequencies are obliged to visibly display their certificates.

Additionally, market pressure for modernisation of building stock in EU will beneficially influence the development of building construction sector and development of producers of building components.

5.4 Nature Plus

natureplus is an international association for future-oriented building and accommodation with around 100 members in many European countries. The aim of the association is sustainable development within the building sector.

Website:

http://www.natureplus.org

Target:

The association set itself the aim of promoting the use of building and accommodation products, which incorporate the highest levels of sustainability in economic, ecological and social terms. Regarding this *natureplus* primary scientific goal is development of objective criteria for the definition of sustainability and high levels of environmental and health-related quality for all types of products in the areas of building and accommodation. Further, from an economic point of view, the main aim is to increase the economic strength and competitiveness of innovative, sustainability-oriented industries through a reduction in their transaction costs. Finally, using the correct communications strategy, it is association's aim to enthuse new target groups for the subject of sustainable building, restoration, renovation and modernisation.

Product/service group:
natureplus is an international quality seal for high quality, sustainable building materials, building products and furnishings. Included are especially the following product groups: floor coverings, roof slates and tiles, insulation from renewable raw materials, mineral-based insulation, paints and varnishes, timber and wood materials, adhesives and sealants, masonry elements, mortar and plaster renders and adhesives, dry-wall construction boards, ETICS-composite insulation systems.

Awarding Institution & criteria:
On 20.04.2001, the International Association for Future-Oriented Building and Accommodation – natureplus e.V. was formed at the founding assembly in Frankfurt/Main and listed in the official register of associations. In June 2002, the first products were certified with the *natureplus* Quality Seal. Within a period of five years, *natureplus* has been able to develop quality requirements (guidelines) for around 30 types of products and to certify approximately 150 products from a significant number of manufacturers. Today *natureplus* is following the aims of the European Community in promoting sustainable development, an integrated product policy and the inclusion of the social actors in environmental politics.

The *natureplus* sign stands for only those products which are comprised of a minimum of 85% of renewable raw materials (a detailed definition can be found in the issuance guidelines) or mineral based materials which are almost unlimited in their availability. These have a proven positive influence upon the interior room climate. At the same time the synthetic component is strictly regulated and reduced to the minimum level that is technically possible. This way on one hand harmful emissions can be avoided and on the other, the use of fossil fuels and limited natural resources can be minimised. The origins of the raw materials are carefully checked.

Life Cycle Analyses, visits to the production facilities and demanding guidelines and standards, for example for energy consumption, guarantee that the products are produced in an environmentally responsible manner. Strict limits on harmful substances, which far exceed the statutory requirements, ensure that no health risks are posed by these building products. Specially selected laboratories are responsible for ensuring compliance with these limits. Additionally, suppliers of certified products must comply with the current legal requirements of their particular country in respect of the production, sales and usage of the products.

Control mechanisms:
In order to answer specific scientific questions, the association created special subject-related commissions. An independent body for the issuance of the *natureplus* Quality seal was formed to review the conformity of the products submitted for certification with the corresponding issuance guidelines and decide upon whether the product should be licensed to use the Quality Seal or not. This body is composed of independent specialists from recognised testing institutions, who were not involved with the concrete testing of the particular products in question. The basis criteria for the issuance of a certificate are the test results reports from these recognised testing institutes. The issuing body checks the formal and content-related accuracy of these reports as part of the quality control process.

All test institutes or assessors involved in the process of certification or the review of certifications must be authorised by *natureplus* itself. Further, the Authorisation Commission is responsible for the establishment and application of the authorisation guidelines, setting a scale of charges, performing assessments upon the institutes and assessors and producing documentation to support decision-making process for the executive committee.

Charges:
Products are awarded the *natureplus* - Seal of Quality for a period of three years. For duration of this period a proposal of costs will be produced that includes the following services: Pre-testing procedure, Main testing procedure, LCA-Analyses, Production facilities testing, Laboratory test, Certification, License. All prices are available in the pricelist which enables a transparent calculation of the costs. In general, the testing costs are dependent upon the product to be tested and the scope of the testing required as laid down in the issuance guidelines. Where multiple products of a common product line are to be tested, the testing costs per product are generally reduced significantly. Additionally, low-priced conformity testing is performed on an annual basis.

Relevance on the market:
Products which carry the label *natureplus* pose no danger to health, are produced in an environmentally-friendly manner and are tested for their functionality. *natureplus* is currently the most comprehensive, innovative and forward-looking quality seal for building and accommodation products. Thanks to its broad support base, transparency, democratic consensus and it’s scientifically supported work, the name *natureplus* stands for absolute credibility. As a focus for attention it can help sus-

tainable products to raise their profile above the level of niche products and make them more accessible to the mass market.

natureplus is the only quality seal to have achieved a recognised market position among the private labelling systems.

5.5 Environmental Product Declaration (EPD)

When speaking about environmental properties of construction materials and products a very important role already now and even more in the near future is reserved for the EPDs – Environmental Product Declarations, which are **Type III ISO labels**, prepared on the basis of Life Cycle Assessment (**LCA**). They allow detailed inter-comparison of different products. EPD databases are growing, and being able to deliver an EPD for a product is becoming a market advantage, so they also represent a green (building components-) market driver.

Although occasionally today still referred to as “less reliable” or even biased EPDs have a firm background. They are in fact reports derived from careful LCA and tracking product performance across a variety of standardized metrics typically chosen by a third-party professional authority. The process of EPD preparation encompasses the development of industry-specific product category rules (PCRs). These rules evaluate environmental impacts both of product materials and manufacturing processes. EPDs are also an obvious basis for development of various green labels.

EPDs have a very valuable role in LCA on the whole building level, and in defining sustainability of buildings - a task currently still hard to tackle. The European Committee for Standardisation (**CEN**), in particular its technical committee 350, is responsible for the development of voluntary horizontal standardized methods for the assessment of the sustainability aspects of new and existing construction works and for **standards for the environmental product declaration** of construction products. The standards will be generally applicable (horizontal) and relevant for the assessment of integrated performance of buildings over its life cycle. The standards will describe a harmonized methodology for assessment of environmental performance of buildings and life cycle cost performance of buildings as well as the quantifiable performance aspects of health and comfort of buildings.

An EPD includes statements on the use of energy and resources and to what extent a product contributes to the greenhouse effect, acidification, eutrophication, destruction of the ozone layer and smog formation. In addition, details are given about the technical properties which are required for assessing the performance of the building products in the building, like durability, heat and sound insulation or the influence on the quality of the indoor air.

It is important to distinguish among labels, which already provide a certain kind of ranking, and labels, which allow comparison, but in itself do not contain any relative judgement about the subject matter, because there are no minimum or maximum target values set. These latter ones are the so-called Type III ISO labels. The key word here is **information**, which allows the purchaser to choose among different offers and their environmental performance indicators (EPI) on a uniform basis.

6. Practical tips for procurement and use of the group/product

6.1 Procurement

Depending on the subject and extent of procurement it is necessary to do more or less intense preparation activities beforehand. For example, reconstruction of buildings can be comprehensive and integral, or gradual and particular, depending on our priorities.
One important thing to always have in mind is the complexity of buildings and building-related activities. Procurement here does not necessarily start and end with a choice of a particular product. As opposed to some other product groups, procurement in the building sector can be viewed upon in a much broader sense.

For example, green requirements can be included in the basic item of public and private procurement ("construction of a new building"), in selection of designers, engineers and (sub-)contractors (required particular past experience and references from energy- and environment-conscious design and construction, EMAS practices, etc.), as criteria describing the required overall design level with regard to national technical regulation (detailed technical specifications of particular energy characteristics, maybe even prescription of an advanced calculation methodology, etc.), as green criteria for selection of materials (exclusion of certain materials from environmental reasons), through requirements for sustainable production and transport of materials and products, and numerous other options.
When **new construction or major renovation** is the subject of procurement it is useful to remember that „green" means also considering different **scenarios** and their energy and environmental outcome/impact as a basis for cost calculations (and founding award criteria on these parametres).

Combining such analyses with cost calculations (investment costs versus long term operational and maintenance costs – if sufficient data available!) can sometimes give results in favour of an initially less energy efficient, but also on the long term less costly (and maybe environmentally friendlier) scenario.

There exist many well-known building **certification and assessment schemes and models**, which were elaborated as a result of intensive and long-term multidisciplinary work. It is highly recommended to have at least a quick look at them at the very beginning of preparatory work for green procurement, maybe to get additional ideas for preparation of performance (must and target) criteria for particular cases of procurement.

Recommended sources of interest would especially be the following (please see relevant Internet pages):

- BREEAM (Building Research Establishment Environmental Assessment Method)
- LEED (Leadership in Energy and Environmental Design)
- DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen)
- CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)
- GREEN STAR
- AECB (Sustainable Building Association)
- APAT Study for the development of European Ecolabel criteria for buildings
- Passive house (different national and international web sources)

Some other practical tips and reminders:

- Remember that individual procurement decisions in the field of buildings or building components can among other significantly affect - positively or negatively - energy efficiency levels and environmental impact of buildings, but also indoor living and working comfort, costs, and durability and structural integrity of the building structure.
- Always think about possible interactions and influences following realisation of a certain measure, and keep in mind logical running order of provisions.
- For example, improving building air-tightness can result in an increased air humidity and mould growth if not accompanied by measures regarding ventilation. Another example: raising thermal insulation of the opaque envelope to the passive standard does not make much sense if maybe windows from several decades ago are not replaced simultaneously.
- On many occasions it can turn out that designing and constructing a new building is at least from the technical point of view an easier task than upgrading (renovating, refurbishing, reconstructing) an existing one. If we wish to renovate a building (partially or completely, gradually or all at once) it is very important to establish a clear picture of the existent state already beforehand. This may comprise everything from a simple walk-through inspection, checking of installations and mechanical equipment, to a comprehensive energy audit including infrared thermography and possible non-destructive (contact measurements of material humidity, positioning sensors for indoor microclimate etc.) or destructive (taking samples of building structures for laboratory tests, probing for endoscope monitoring etc.) tests.
- Depending on the extent of planned measures, i.e. the procurement volume, financial capabilities could become a serious question. It is very advisable to run analyses of various options to get

a more accurate picture of investment figures, and to try to find an optimum between investment and short- and long-term results.

- Checking out available co-financing possibilities can prove very useful and can facilitate realisation of many building projects. These options can include commercial bank credits for energy efficiency measures, eco loans from public funds, revolving funds, third party financing, and even sponsorship. In some countries local or national energy advisory offices are in operation, in others so-called Project Service Facilities have been established, i.e. financial and technical advisory points (clearinghouse support activities). These are useful sources of information, which should be used to realize projects in a most efficient manner.
- It is important to obtain several (comparable!) tenders. The integrity of the preparatory phase is crucial in order to be able to make a proper decision about the most appropriate offer. That is where we define boundary conditions and set quality and quantity target levels. Additional negotiations are always possible and sometimes a constituent part of the procurement process, but this should be restricted to brushing up details, not to discuss basic requirements.
- It is almost impossible to guess or make at least a remotely accurate out-of-the-head estimation about all short- and long-term impacts and results of various potential procurement decisions in the building field. That is why LCC analyses are an indispensable part of green procurement; their results may sometimes be unexpected, but will help you to get appropriate value for your money.
- Even if some specific national regulations exist with defined basic “must” criteria, purchasers can always set specific (additional, more comprehensive, stricter, etc.) requirements suited to their needs. Performance sheets from any field of product groups should also not be looked upon as closed or final versions. There is always room for changes and adaptations to adjust to particular procurement items.

6.2 Use

With the purchase of energy-efficient building materials, components and systems (or even when new construction or an integral renovation of buildings is in question) only one part of saving potentials can be opened up. To a large extent real practical results lie in the hands of building users and building managers. This includes regular maintenance and patterns of use (behavioural aspects). Even technically most advanced building components can not provide expected (and pre-calculated) results if not used and maintained in an appropriate manner. Only with responsible energy- and environment-conscious behaviour the saving potential can be fully exploited. Thereby following tips can be useful:

Ventilation

Ventilation of buildings is essential from health and hygiene points of view (indoor air quality). It also helps to regulate indoor air humidity and temperature. In the summer time natural ventilation during the night is a very practical and cost effective passive way of maintaining appropriate temperatures. In winter time the windows should be fully open for a short time, several times per day. If a building is equipped with mechanical ventilation system, clear instructions for use should be provided and respected.

Shading / prevention of overheating

In some countries provision of external shading on insolated transparent envelope elements is obligatory. In any case, shading, especially when combined with night ventilation, is an effective way of reducing the cooling load. In the same time it can prevent glare from direct sunlight and so improve indoor visual comfort. Shading devices can be fixed or movable; the latter can be operated manually, which requires active involvement of building users, or automatically (timer, temperature sensor, sensor for direct solar radiation, etc.), which eliminates some of the human-related obstacles, but can sometimes negatively influence visual conditions. That is why a possibility of a manual override is a necessary.

Ambient temperature / heating

Energy consumption depends also upon ambient temperature. Reducing indoor temperature for one degree can result in several (usually around 5) % of energy savings, depending on the overall thermal characteristics of a building. Of course, the ambient temperature should remain within a comfortable range, i.e. approximately around 20-22 ^{o}C for normal living and working spaces. This again depends on the overall U-value, on the type of the heating system used, on indoor air humidity, on velocity of indoor air movement, and of course on individual subjective perception of thermal comfort. An advantage of well insulated buildings is shown through noticeably higher interior surface temperatures. This allows reducing indoor air temperature while at the same time maintaining comfortable indoor conditions.

7. References and useful Internet resources

http://ec.europa.eu/environment/gpp/index_en.htm

http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm

http://ec.europa.eu/environment/gpp/pdf/toolkit/construction_GPP_background_report.pdf

http://ec.europa.eu/environment/gpp/pdf/toolkit/construction_GPP_product_sheet.pdf

http://ec.europa.eu/environment/gpp/pdf/windows_GPP_background_report.pdf

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http://ec.europa.eu/environment/gpp/pdf/thermal_insulation_GPP_%20background_report.pdf

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