Guidelines from the Danish Energy Saving Trust

PURCHASING

- Leaders and senior management
- Staff responsible for purchasing
- Staff responsible for energy
- Purchasers, technicians and operations and maintenance staff

INTERIOR DESIGN*

- Constuction clients
- Staff responsible for buildings and operations and maintenance
- Staff responsible for energy
- Architects, engineers and developers

CONSTRUCTION PROCESS

- Constuction clients
- Architects and engineers

COMMERCIAL KITCHENS

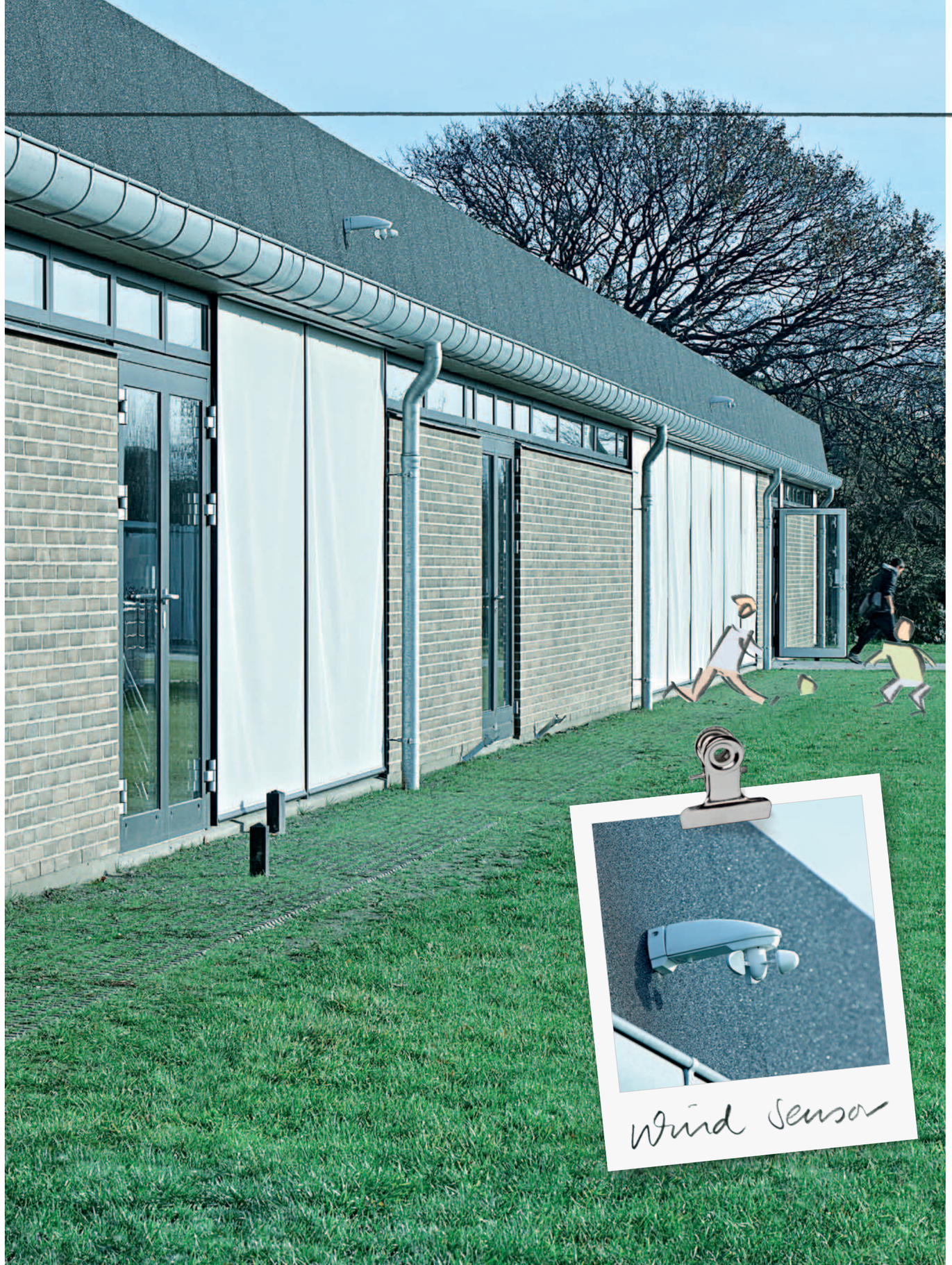
- Commercial kitchen consultants and designers
- Executive chefs, staff responsible for energy, staff responsible for buildings and others involved in kitchen design projects
- Purchasers
- Kitchen staff

SERVER ROOMS*

- Staff responsible for IT and system administrators
- Staff responsible for energy
- Staff responsible for buildings and operations and maintenance

* Only available in Danish.

Order the Guidelines you need from the Trust's Customer Service Centre at +45 70 26 90 09 or goenergi@goenergi.dk.



CONTENTS

FACADES with limited window areas are often far more energy efficient than glass facades. Glass facades are expensive in the long run because they require solar shades, automatic control systems, special glass, maintenance and frequent cleaning. Efficient solar shades also limit the view because they are activated when there is a risk of a high indoor temperature, i.e. in well insulated buildings on all slightly overcast or cloudless days. Many solar shade systems do not perform well under windy conditions, since the control system automatically retracts the shades. On sunny days, this results in a high indoor temperature or high energy consumption if there is demand-controlled ventilation and cooling. You are more likely to have well-lit rooms, low energy consumption and lower investments costs with less window area.

The target group for the Guidelines is construction clients who want to construct an energy efficient building. Construction clients are often one or more persons, whether in the form of a municipal committee or a private company. In some cases, a building will be constructed by investors who will subsequently rent out the building.

Energy efficient, future proof construction

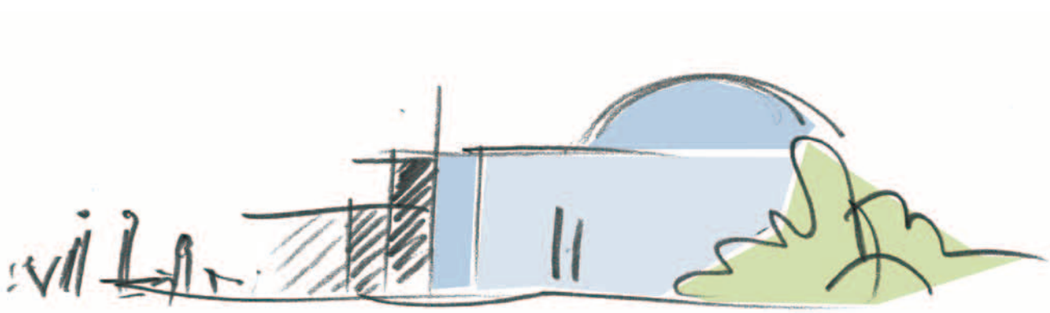
First and foremost it is the occupants of the building, who will use the building and pay for the energy consumption during its subsequent operation, who have a vested interest in ensuring that the completed building is energy efficient. Investors who are considering renting out a completed building can often also take advantage of low energy consumption – especially in periods of declining demand. Buildings last a long time, and as a result of generally increasing energy prices, buildings with low energy consumption will naturally hold their value better compared with buildings with high energy consumption. The important thing for a tenant, or building user, is the total cost of the building, including the energy costs. Energy efficiency is therefore a sound financial basis for a future proof building.

Focus on energy in the construction process

The energy characteristics of a building are predominantly established when the first drawings leave the architect's office, but these are also influenced by decisions taken during the construction process. Meticulous attention to detail and possibly additional materials are required to optimise a building's energy efficiency. The parties involved in the construction will therefore normally only plan and construct a building so that it can exactly fulfil the energy requirements of the Danish building regulations. However, with early-stage input, the right choice of components, effective follow-up and fault rectification, as well as target management, construction clients can be sure of getting an energy efficient building.

It may not be possible to rectify faults once the building has been completed if these involve excessively high costs for the contractor. Construction clients will nonetheless be entitled to a reduction in the price. However, the reduction will scarcely offset the increased energy costs that will result from the higher energy consumption over the lifetime of the building, even though this might in theory be possible. Construction clients can thus establish their own independent monitoring. Nonetheless, the contractors should be clearly made aware that the construction client's monitoring regime does not relieve them of their responsibilities. The normal rules applying to construction work in Denmark are set out in AB92 "Standard terms and conditions for working in construction and plant companies".

Be ready from the start	Comments
What results do you want?	In order to achieve a measurable low consumption it is important to be clear about the needs that the building should fulfil. Actual consumption will be higher in a school with lots of activities in the evening than a school that is not open at night. However, energy efficient equipment will have a shorter pay-back time in a school with long opening hours and higher consumption.
Who is responsible for putting energy savings on the agenda?	Many decisions taken during the construction process will have consequences for the energy consumption in the completed building. You should decide how you can ensure that energy consumption is on the agenda during the process.
How much time are you able to use during the construction process?	You can base your process on finished concepts and all-inclusive contracts. In this situation your input will be restricted to the initial phases. If you have more time, and want to have more influence, you can choose separate contracts covering different phases that are less restrictive. Conversely, you should be aware that you will have to contribute more in order to achieve the finished result.
Will you use an energy evaluator to help you formulate your requirements and follow them up?	It makes sense to use an energy evaluator in the same capacity as a consultant. A good energy evaluator needs to be highly qualified in many areas. The individual concerned needs to work closely with construction client consultants at all levels of the planning organisation. Consider whether the energy evaluator should be independent of the other parties involved in the planning process. Ensure that the reference frameworks for the energy evaluator are precisely set out, e.g. how the finances will be affected when alternative solutions are evaluated. Remember that energy optimisation is an iterative process, which involves repeatedly going back and reassessing the project from scratch as the requirements change and new conditions are set.



6_Can we afford energy efficiency?

Finances are one of the first questions that arise when starting a construction process. Most public sector construction clients and many private sector ones have adopted a policy for implementing energy savings, which can be used when a specific choice is made. For example, it is standard practice to require that all new construction should fulfil low energy requirements, or that all improvements with a maximum repayment term of five years should be carried out.

The Danish Energy Saving Trust's recommendations:

- Agree early in the process how the finances should be weighted when evaluating alternative ways of improving energy efficiency.
- Prioritise energy savings on the basis of the overall finances. Use, for example, the return on investment as defined in the Danish building regulations instead of a simple repayment term. In this situation the return on investment is calculated on the basis that the total savings over the lifetime of the improvements should be greater than the investment. Focusing on the pay-back time alone does not always result in the most energy efficient solutions.
- Consider whether current energy prices are relevant for use as the basis of calculations. Some parts of a building are replaced at a 10-20 year interval. Typically, this applies to energy supplies, electronic control (automation), some installations and windows. Other parts, such as the building envelope generally last longer. Is it relevant to use current prices to inform decisions that have consequences many years in the future?
- Consider alternative methods of financing. Energy efficient solutions may be cheapest over both the short and the long term – if financing is optimal.

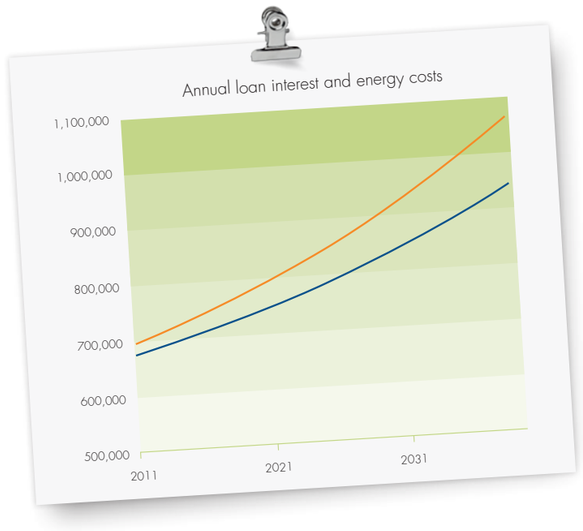


Figure 1. Energy improvements can be cheapest in the long run

The overall loan interest and heating costs of the building can be less in total if the energy efficiency of the building is improved, even though the interest on the loan is greater as a result of the improvements. The example shows a project costing DKK 60 million. The graph shows that by spending 15% more on energy improvements it is possible to save 25% of the energy costs, with the total costs of the loan and heating already being lower in the first year than if no energy improvements had been carried out. In short, the savings on heating are greater than the additional cost of financing a larger loan. With the expected rise in energy prices, the finances will gradually look even better.

Assumptions: Costs are calculated as fixed prices. 3,000 m^2 building, cost of building without and with energy improvements are DKK 60 and DKK 69 million respectively. Fixed interest loan at 4%. Energy costs reduce annually by 25% from DKK 300,000 to DKK 225,000. Energy price rises are assumed to be 3% including inflation.

The Danish building regulations define that a project is viable if:

$$\frac{\text{lifetime} \times \text{annual savings}}{\text{investment}} > 1.33$$

The method ensures that savings are reflected over the lifetime of the components. Improvements, which over their lifetimes save more than they cost, are thus an advantage compared with improvements that have a short lifetime.

When does the process go wrong?_7

Construction clients start many projects with the best intentions of having a building with low energy consumption. Nonetheless, consumption in the completed building is often surprisingly high. Here are some of the most common reasons.

The parties do not pay enough attention during the planning process to the way that the building will actually be used. The energy and indoor climate simulation programmes that are used are not suitable for a planning situation. The project is not sufficiently detailed.

Consultants focus solely on the things that are included in the energy framework. Other activities are not taken into account. Lifts, escalators, server rooms, IT equipment, telephone systems, etc. are examples of equipment that are not covered by the energy framework.

Contractors and consultants provide insufficient information at the hand-over to the construction client. The written instructions are deficient and contain no information on energy efficient operation for different times of the year. The users of the building are not informed how they can use the installations energy efficiently.

The parties do not systematically assess the economics of alternative solutions. Consequently, high energy efficiency can be unnecessarily expensive.

The constructing parties amend the project at the planning stage, but do not carry out an energy audit of the consequences before taking a decision. There is no consistent follow-up of agreements.

Construction clients and consultants do not formulate the energy requirements sufficiently clearly from the start – so the individual parties are not aware of the expectations associated precisely with their delivery.

Those carrying out the project are short on detail, or do not implement the project as planned, but choose "easier" solutions on the construction site. In this situation, there is a risk that you choose solutions which are not sufficiently thought through from an overall perspective.

Installations are not correctly installed, and control systems are not programmed or configured properly.

The construction parties fail to ensure that the installations are designed in a way that allows relevant part consumption to be measured. This way, it is impossible to work out why consumption is high.

Construction clients and consultants forget about energy requirements when inviting tenders for turnkey projects, or the requirements are not sufficiently followed up during and after construction.

As construction clients you are more than a simply a buyer. Construction clients participate in one part of a process for which they have placed an order, and which leads to a result. The process has many participants so it is up to you to decide how the responsibilities should be allocated between the different parties. Irrespective of how the project is implemented, it is important that responsibility for energy efficient design is clearly delegated.

Establish frameworks, and set requirements

Low energy consumption does not happen on its own. You need to establish frameworks for the planning and construction phases, and set requirements for the suppliers with whom you make agreements.

Many building projects are carried out on the basis of a tender. Some building projects, however, are undertaken by private investors in partnership with a turnkey contractor. When you use a turnkey contractor it is essential to think through the whole process up to the commencement of operations, and it is important to consider how you can get the contractor to stick to the requirements on high energy efficiency. This requires a lot of supervision, with energy efficiency easily becoming the joker in the pack in this interplay, in which competitive pricing can adversely affect optimal solutions.

Use an energy evaluator

An energy evaluator with a wide range of expertise can maintain the focus on energy efficiency throughout the construction process. However, you are responsible for ensuring that the energy evaluator is continually involved in the process, so energy related consequences of decisions are visible, before it is too late. Decisions taken in subsidiary areas can have unforeseen consequences for the whole. This is why there should be fixed procedures for dealing with project changes – both during the planning and construction phases of the project – so you can immediately see the effects of the choices made. In addition, the basis of the calculations and other issues should be scrutinised for any mistakes or misunderstandings.

Be ready from the start	Comments
Do you have a well-defined energy analysis plan in connection with the project?	A good idea is to clearly describe an energy analysis plan early in the project and amend it on an ongoing basis. The plan should briefly describe how you will ensure energy efficiency in all phases – also at the construction stage. Who will do what, and when?
Have you allowed for enough time and resources for unbiased energy analysis during the design and construction process?	Do not expect that the energy requirements will be automatically fulfilled. Include energy analysis in the time plan. Management should ensure that energy analysis is given sufficient weight in relation to other decisions.
Have you made all parts of the organisation aware of the energy requirements?	Planning is delegated to many persons with individual specialisms, who do not have a complete overview of the whole building. Sometimes an individual may believe that other parts of the project fulfil the energy efficiency requirements. Make sure everyone is aware of the energy frameworks that apply to the planning of their specific area.
Have you ensured that the energy characteristics are evaluated in connection with planning changes and on completion of the individual phases?	Be especially meticulous when putting turnkey projects out to tender – the requirements for construction, control and documentation should be established very early on in the process. Evaluate the energy consequences of project changes before you take a final decision, and before the project moves to another phase. Ensure that the basis of all calculations is analysed in connection with the project.

If you want the building to be energy efficient you will go a long way with these eight important steps.

1_Take responsibility – it is in your interests. Be aware that because you will be paying the energy bill you have an interest in low consumption in the building. Low energy consumption does not happen on its own, so you should therefore establish frameworks for planning and implementing the project. Low energy consumption can be achieved in many ways. Remember to identify how the economy of alternative energy improvements should be evaluated so that the most appropriate solution is chosen.

2_Use an energy evaluator. He or she will often be a great help in the work to achieve low energy consumption. Energy evaluators are energy demand specialists and should keep an eye on the overall project. An energy evaluator's task is to have a multi-disciplinary insight into running a building, and the activities and processes that take place in it. Sometimes it can be an advantage to choose an energy evaluator from within your own organisation. However, consider whether the energy evaluator should be independent from the other parties.

3_Define your needs. The more precise these are, the more efficient the building will be. Use sufficient time to identify your future needs, but also consider if you can reduce some of the needs. Optimise the building and energy supply on the basis of the special circumstances that actually apply. Wherever possible avoid using "standard" scenarios.

4_Focus on what is most important. Mapping out energy consumption often leads to an "ah ha" experience for those involved. Appliances that run over long periods, or appliances of which there are many examples, can suddenly go up and down in the estimate that the parties previously made in terms of whether these have a bearing on consumption. Remember the special functions: Showrooms, meeting rooms, canteen facilities, server rooms, etc.

5_Factor in energy efficiency from the start, and when switching phases. Energy efficiency should be integrated into the design from the start. It is important to make your goals visible – before the process starts, and in all later phases.

6_Define goals clearly. Remember the golden rules for setting goals: Specific, Measurable, Achievable, Realistic and Time Delimited.

7_Try new solutions. Maybe it is time to try something new? The energy efficiency of buildings is continually improving because new solutions are constantly being developed. Perhaps you will be the one to try a new solution?

8_Make your requirements visible, specific and binding. All parties should be made aware of the special requirements established for your building. In order to fulfill them, they should be as specific as possible, and the parties should enter an agreement covering what has been decided. Follow-up and control measures are important elements in this process. Remember that you are required to make the material available for energy analysis, and this should be included in the time plan. Preferably use the tools available from the Trust as the basic platform when setting the requirements for the new building.

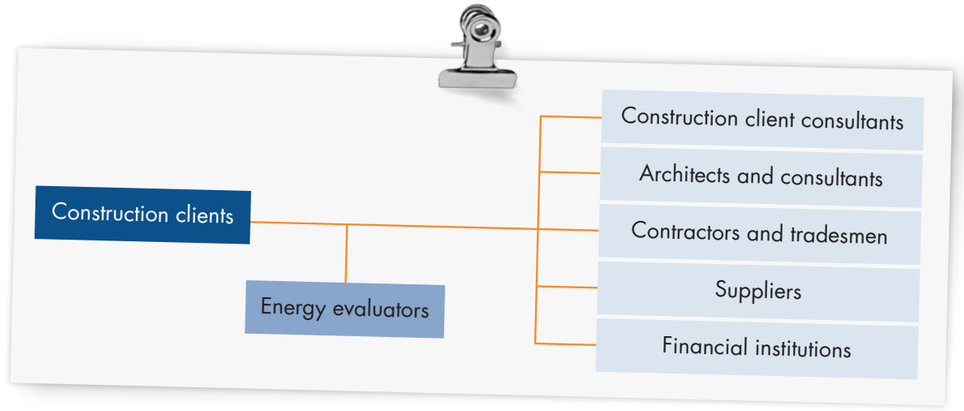


Figure 2. Energy evaluators should be at the heart of the organisation

Check list

At the ideas stage and during the building program phases, focus on:

- ☐ Making sure you have reliable data on future energy needs.
- ☐ Allocating responsibility for energy consumption.
- ☐ Identifying the most important design parameters.
- ☐ Minimising energy needs during the operational phase.
- ☐ Identifying the best technology.
- ☐ Proposing alternative energy efficient solutions and evaluating the overall finances of these.

At the design stage, focus on:

- ☐ Designing energy efficient building envelopes and installations.
- ☐ Integrating energy efficiency into solutions across all areas of the project.
- ☐ Evaluating the requirement to measure, control and regulate.
- ☐ Choosing energy efficient components.
- ☐ Ensuring that there is sufficient space for insulation of the technical installations.

During the tender and bid process, focus on:

- ☐ Setting requirements for energy efficient solutions in the tender documents.
- ☐ Setting requirements for quality control and follow-up on the construction site in the tender documents.
- ☐ Setting requirements for the expertise of the tenderer and their quality control systems.
- ☐ Setting requirements for the guarantee of operational efficiency in the completed building.
- ☐ Ensuring that the energy requirements are legally binding when signing the contract.
- ☐ Ensuring that it is possible to carry out impartial monitoring during the construction phase.
- ☐ Involving yourself in establishing the basis for evaluating alternative solutions for both energy and the indoor climate. Insist on user guidelines, and if necessary courses on the energy optimal operation of buildings.
- ☐ Ensuring that it is possible to carry out sensible energy management of the completed system, including that the system is built in a way that allows for the measurement of relevant part consumption.
- ☐ Ensuring where possible that installations are demand-controlled, and that you consider the most energy efficient method when reducing output.
- ☐ Ensuring, in particular, that installations are operated efficiently during normal output, especially if peak loads only occur for short periods of time. A system running at half power does not necessarily consume half as much energy.
- ☐ Receiving the buildings and the installations in accordance with the written specifications.
- ☐ Ensuring that operating manuals and instructions are properly presented, and that energy efficient operation is described.
- ☐ Ensuring that you are ready to implement energy control of the installations.

Good planning is based on a firm foundation that describes your needs and requirements, which are itemised when preparing the building program. Needs can be contradictory, so it may be necessary to prioritise them. Needs identified late are often expensive to fulfil. You should therefore set aside enough time during the start-up phase.

Think your needs through

Buildings last a long time, and needs changes over the years. This applies to homes where the size of the household changes, but also to public and commercial buildings, where expansion is followed by contraction. It makes sense to factor different scenarios into a building, so that parts of it can be rented out or sold, when there is no need for a large area.

Avoid areas of wastage

Some buildings are very uneconomically designed with poor space utilisation, e.g. large areas which are unusable in practice. This can be as due to insufficient light, excessive noise or because the location is under a dusty staircase, or the space is not adequately screened off and therefore cannot be used for confidential work undisturbed, for example in a public sector administration building or a private company development department. The Danish building regulations calculate energy performance by m^2, but it is possible to work out the requirements using other measurement variables such as: Per staff member, per room or similar depending on what is relevant in a specific context.

Be aware of the temperature

Temperature conditions are another very important theme for the indoor climate. Be clear about the heating requirements in different parts of the building. This is especially topical for secondary space such as entrance areas, corridors, etc. It is just as unfortunate for these spaces to be located outside the building envelope, and subsequently heated up, as it is when inside areas are not heated at all. Both situations lead to unnecessary energy consumption. You can get plenty of helpful advice about energy efficient design of buildings in the Trust's Interior Design Guidelines (Indretningsvejledning 2011).

Be ready from the start	Comments
What do you expect in the future? The design of many commercial buildings cannot be adapted to the upturns and downturns that nearly always occur. This means that there are periods when staff are sandwiched together in small spaces, with rather too much space available at other times.	Too little space results in a poor indoor climate, while too much space can lead to unnecessarily high consumption. Ensure the building is laid out so parts of it can be easily partitioned. Configure installations so they can match future performance requirements.
To what degree is it necessary for the system to deliver maximum output? This is significant when dimensioning the system,	Installations will often be more efficient if they are optimised on the basis of normal output, which can be significantly lower than maximum demand. For example, it makes no sense to dimension ventilation based on a situation where all workplaces are manned throughout the day if this scenario hardly ever occurs in practice.
What are your requirements for the indoor climate?	Use existing standards when setting requirements for the indoor climate. Use Danish Standard DS 474 for specifying the indoor climate. Request that consultants carry out indoor climate calculations using a recognised simulation programme with enough detail, e.g. BSim. The Be06 programme is rarely sufficient for public and commercial buildings.
Are there special needs and alternatives in the building?	Some buildings have special functions which present particular opportunities. For example, these can be opportunities for using surplus heat from processes, server rooms or freezer rooms.

It is important to summarise the processes that will take place in the building in the early stages. It is annoying to work out optimal specifications for windows, only to discover that the main area of the building's consumption lies in a completely different location.

Summarise energy consumption

It is important to be aware of "special" energy consumption. Perhaps one part of a room is used for different purposes on a daily and yearly basis. Perhaps server capacity is unusually large, or perhaps there is medical equipment that has special uses and energy needs. Or perhaps there is a particularly large number of appliances, which together have a big impact on total consumption.

This can present a major challenge because it requires a lot of work to produce a summary of energy consumption – and you should not assume that the data will be easily acquired. It will often be necessary to ask for an estimate of the part consumption from a qualified person. Remember to get as much input as possible from the users of the building.

Look at the operating hours

It is important to look not simply at the energy consumption of the individual appliances and functions, but also at the operating hours. There is an important difference between an appliance which is on for three hours a week, or 24-hours a day. It can often come as a surprise to staff responsible how much energy is used as a result of long operating hours. It is important to focus both on energy efficient purchasing and shorter operating hours.

Compare the overall finances

When evaluating the financial situation for alternative options you should compare the overall finances, i.e. the investment including 20-30 years of operations and maintenance (depending on the lifetime of the product), and not just the cost of the investment. Remember that there are often many alternative options for energy efficiency. For example, it may be cheaper to reduce the south-facing window area rather than installing and maintaining external solar shades, even though the energy savings in this situation are estimated to be the same.

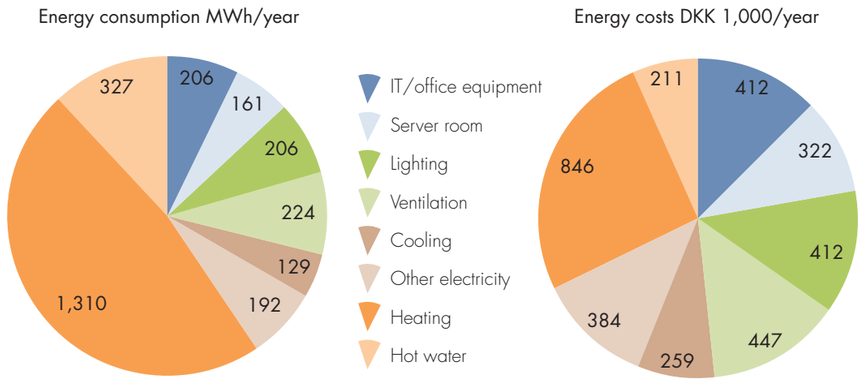


Figure 3. Same office, different calculations: Low energy consumption or low energy costs – which parameter is relevant in your case?

A visualisation of the expected consumption as shown above will often make it easier to decide how best to achieve your energy efficiency targets. If, for example, you decide that you want low energy costs then it is this calculation that you should focus on. You can also choose completely different parameters – e.g. low consumption per member of staff/beds/pupils, or low CO_2 emissions. In this situation it is worth visualising the situation based on these goals. The choice of goal can have a significant bearing on the choice of solution.

As previously mentioned, it is important focus on energy requirements early in the process. Energy efficient design does not happen on its own, and planning changes are expensive and do not produce better results. Remember also that energy optimisation is an iterative process, which involves comparing individual decisions against the total energy consumption, again and again. Supplementary decisions, which may appear advantageous in isolation, can have some unfortunate consequences for the whole process. These consequences should be identified, before it is too late.

A good design and construction process is vital

In a classic planning process, architects complete the drawings before engineers evaluate the energy characteristics. This is impractical. Instead, calculations of the energy characteristics should be made early in the process.

The design and construction process comprises many phases, with each one having an impact on the finished result. It is important to set and publicise the requirements and expectations that you have for the individual phases and the finished product. You can choose to put one or several of the phases out to tender. In this way the processes and tasks in the relevant phases concerned cannot be altered.

Program → Proposal → Design → Construction → Delivery

You should therefore be clear what your interests are from the start. This way you can ensure that they will be considered during each of the relevant phases.

The temperatures in a building can very different on the north- and south-facing sides. Rooms facing south and east may require cooling, while north- and west-facing rooms may require heating. Even if a building does not on average require heating, it may turn out that in practice energy is used for both heating and cooling. The standard Be06 calculation program does not take account of this. You should therefore set requirements based on more sophisticated indoor climate programs such as BSim, and play an active part when the calculation parameters are set. Fix the functional requirements for each room and be aware that the requirements may be different, for example in meeting rooms that do not face the same direction.

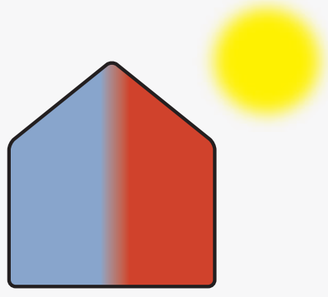


Figure 4. The sun often contributes to different heating and cooling demands

Be ready from the start	Comments
Building program • Does the building program contain a clear description of the desired result? • What resources should be used? • What requirements are you setting for the design process and the construction phase? • How do you want to be involved in the decisions? • Where in the organisation is responsibility for energy efficiency placed? • What documentation and how much follow-up should the project have?	As the construction client it is important that the process is clearly mapped out in the building program. In this phase you may decide how ambitious you want the project to be – also in relation to finances. You should think the process through right up to mapping out the operations and maintenance requirements in the completed building. You can possibly let an energy evaluator establish the calculation input that will be used when calculating the energy performance of the building to make sure that the needs are calculated on a realistic basis. It is usually not enough to use only the mandatory Be06 calculation program for public and commercial buildings. Normally it is necessary to supplement this with more detailed calculation programs such as BSim, or similar programs. These programs can divide the building into zones and take account of the fact that different parts of the building may not have the same energy needs.
Architect's proposal • Who will evaluate the energy characteristics of the project during the process? • What expertise is needed to do this? • Who should deal with the knowledge acquired? Has enough time for energy analysis been set aside in the time plan? • Have operations and maintenance consequences of the chosen solutions been clarified as far as possible at this stage?	It is annoying if the architects are too advanced with the drawings before the project has been submitted for energy evaluation. Early stage input can save a project from costly planning changes. Investigate whether it is likely that the energy goals can be achieved. Set requirements that are achievable. It is also a good idea to let your own operations and maintenance staff go over, and comment on the material. They often have an intuitive grasp of the operating conditions. Set requirements for the documentation covering indoor climate conditions and the calculation data in recognised calculation programs.
Design and tendering • What level of detail is necessary? • How will the installation be built? • What size of e.g. ventilation system is needed?	It is important that all those involved understand that: • Energy efficiency does not happen on its own. • The overall result is affected by a large number of conditions, so it is important that everyone should be familiar with the goals applying to their products. Ensure that those involved in the planning process are familiar with the calculation examples for the buildings, so these can be used as a basis for the planning.
Construction, delivery and start-up • Is monitoring and follow-up on the construction site properly organised? • Have requirements been set for delivery, start-up and follow-up?	Many systems are handed over without anyone giving instructions to the construction clients. It is important to specify that technical installations are delivered properly set up, and that automatic control systems are correctly installed. Installations should always be checked over together with operations and maintenance staff on delivery and written guidelines on energy efficient operation should always be provided. The manual should show how to run the installations energy efficiently in all weathers.

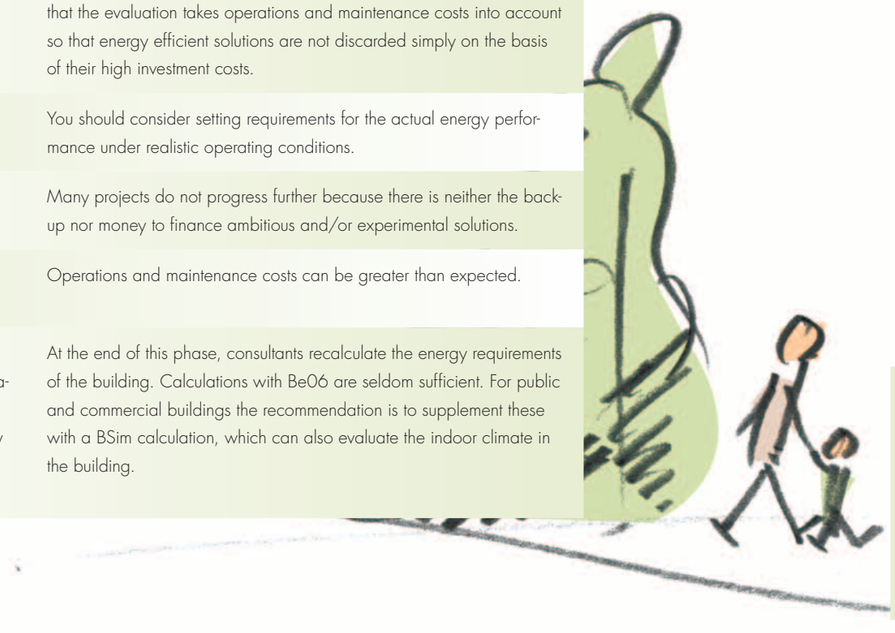
The Danish building regulations have a low energy class for the energy performance of buildings which, in most cases, can be used as a basis when specifying the finished result. It can also be beneficial to include supplementary requirements that the building should also be evaluated on the basis of the actual operating conditions.

Ensure that you carry out more detailed calculations of the indoor climate that those described in the mandatory Be06 program. This applies particularly for public and commercial buildings, for which you can use, for example, the BSim calculation program as documentation for the project.

Remember the golden rules for setting goals

S	M	A	R	T
Specific	Measurable	Achievable	Realistic	Time Delimited

Be ready from the start	Comments
How will you set goals?	Goals can be set: • On the basis of energy performance, energy costs or CO_2 emissions. • In relation to the building's area, lifetime or possibly per member of staff.
How will you evaluate the overall finances?	It is important to compare alternative solutions on a total cost basis, i.e. that the evaluation takes operations and maintenance costs into account so that energy efficient solutions are not discarded simply on the basis of their high investment costs.
How can the building be optimised in relation to its actual use?	You should consider setting requirements for the actual energy performance under realistic operating conditions.
Finances generally play a key role in how the final building is laid out.	Many projects do not progress further because there is neither the back-up nor money to finance ambitious and/or experimental solutions.
Operations and maintenance costs depend on the solutions chosen.	Operations and maintenance costs can be greater than expected.
Set requirements for those involved in the planning process about communicating the basis of the calculations to the construction clients and users, so that lay persons have the opportunity to assess the adequacy of the basic principles. The calculations must document that the goals have been fulfilled.	At the end of this phase, consultants recalculate the energy requirements of the building. Calculations with Be06 are seldom sufficient. For public and commercial buildings the recommendation is to supplement these with a BSim calculation, which can also evaluate the indoor climate in the building.



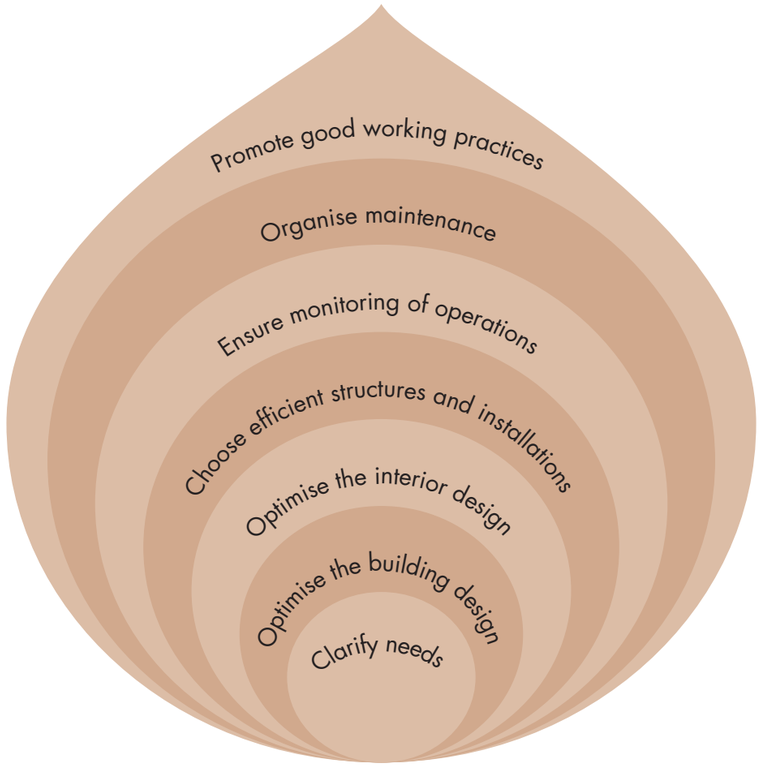
Energy efficiency is a hot topic and many organisations and individuals want to take the lead when it comes to new energy efficient solutions. However, you do not need research or demonstration projects to comply with the Danish building regulations. The basic requirements and the low energy classes can be fulfilled with "standard" solutions. New solutions are therefore characterised as solutions which surpass the basic, and which possibly point in the direction of standards in 2020.

Many new technologies for use in buildings have been tested. Some of them such as reduced water consumption, or less water run-off (e.g. green roof) solve other environmental problems. If you would like to try a new technology it may be possible to get financial support for the project. Applying for funds is often time-consuming and only a few applications receive support. It helps to use experienced individuals when applying for funds. You can find them in research institutes and private companies. You should also involve different parties, and establish a panel of experts who can contribute to qualifying the decisions you make. The parties will assess whether the idea has potential and whether a subsidy may be possible. You only receive support for the extra costs associated with the project, and you should generally assume that in the short term, construction clients will have to pay for heading off in a new direction.

Be ready from the start	Comments
Research or demonstration projects Are you prepared to bear the risk if a research or demonstration project does not deliver the expected savings?	Research projects by their nature may not have a positive outcome – a trial can fail. Demonstration projects start on the basis of a well-documented technology that has not been widely adopted. It is often the construction client that bears the risk if research or a demonstration project does not deliver the expected savings. You should therefore assess if you are prepared for this. Make sure that the maintenance requirements are documented before initiating the project.
Research project Can you involve independent researchers or other specialists in the process?	A research project involves something completely new. It is therefore a good idea to involve independent researchers or other specialists in the process. Evaluate the probability of success. Ensure that you have a plan B if the technology turns out not to be as good as expected. Evaluate the future maintenance requirements and the financial implications. Evaluate the expertise available, the solutions allocated to the future operational organisation, and possibly also the equipment required.
Demonstration project Will you include a communication strategy in connection with a demonstration project?	There is less uncertainty associated with demonstration projects than research projects. It may be a good idea to include a communication strategy with a demonstration project in order to publicise it. Future maintenance requirements should be well documented, and associated costs should be subjected to an overall financial assessment. Also evaluate the requirements for expert assistance that the installations will place on the future organisation of operations.

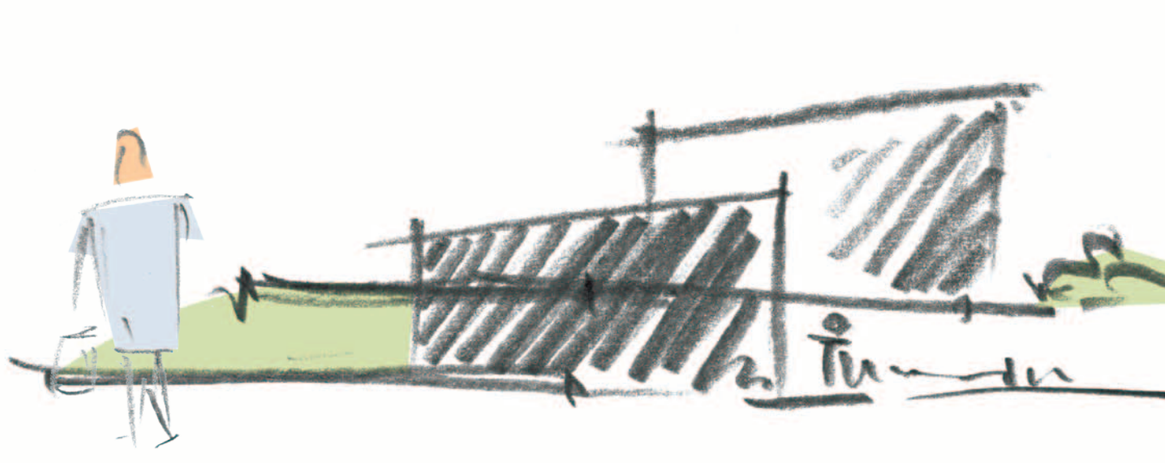
As the construction client you should set requirements for the project before entering into an agreement. It is important to have the requirements in writing. Be aware that just about any requirement you specify after signing the contract can have financial implications. Wherever possible you should therefore formulate the requirements in advance.

Be ready from the start	Comments
Construction goals Will you choose from existing concepts or look for completely new ones?	A lot of work goes into thinking through brand new concepts. Therefore, it may be an advantage to use one of the existing concepts. Low energy performance frameworks in the Danish building regulations and the Nordic Eco-label are well defined concepts based on building regulation procedures. If you choose other concepts then you should ensure that the basis is totally fixed.
Planning procedures What requirements do you want to set for planning and documentation?	You can take a view as to how the savings are prioritised, e.g. prioritising low heat consumption higher than electricity produced by photovoltaic cells. You can set requirements for the calculation program which should be used to ensure an optimal basis for making decisions. You can require that meters be installed to record relevant part consumption in large buildings. This places special demands on the construction of the installation. You can set requirements for the indoor climate in the completed building (e.g. use Danish Standard DS 474 norm for the specification of the thermal indoor climate).
Time plan Is the time plan realistic for the parties involved in relation to the scope of the task?	Ensure that there is enough time for the work of the energy evaluator. Also ensure that time is set aside for possible planning changes.
Documentation of low consumption Have you made sure you have documentation for obtaining low consumption in the completed building?	This is where dialogue about input to the calculation program is important for arriving at a calculation of the real consumption conditions. Ensure that as the construction client you make sure this happens.
Energy costs on the construction site Have you made sure that those carrying out the project are sufficiently motivated to keep the energy consumption on the construction site down?	Here you need to ensure that the contractor has an incentive to save during the construction process. Read more about energy efficient construction sites in "Gør byggepladsen energirigtig" (Make construction sites energy efficient).
Documentation of the completed building How can you set requirements for the way in which the low consumption of the completed building should be documented, and the possible inclusion of sanctions in this respect?	Provide documentation for the completed building with measurements of air tightness, detailing on the drawings, overheating, as well as location of meters for measuring part consumption. Specify how you want the completed building to be documented. Consider including: Air tightness measurements, detailed drawings, indoor climate, meter locations, etc.



The onion diagram is a good method for illustrating how to achieve low consumption:

- Start by clarifying the needs. What should the building be capable of? Be critical. Maybe some of the needs can be reduced?
- Then cover the best methods for fulfilling the needs. Decide the best technical installations. Make it possible to control processes and consumption in the ensuing operational phase.
- Finally, design and build an effective maintenance system, and encourage staff to be energy efficient.



READ MORE

- The Danish Energy Saving Trust, www.goenergi.dk and www.savingtrust.dk
- The Danish Knowledge Centre for Energy Savings in Buildings, www.byggeriogenergi.dk
- The Danish Energy Agency, www.ens.dk
- Energy Service Denmark, www.energitjenesten.dk
- The Danish Enterprise and Construction Authority, www.ebst.dk
- The Danish Building Research Institute, www.sbi.dk

ABOUT THE DANISH ENERGY SAVING TRUST

The Danish Energy Saving Trust (Center for Energibesparelser) is expanding the activities of its predecessor and is now responsible for promoting savings for all forms of energy, excluding transport, in the household, public, industrial and commercial sectors. The Trust is an independent, public sector entity with its own Board appointed by the Minister for Climate and Energy. The Danish Energy Saving Trust was established on 1 March 2010 and is financed by a special energy savings charge of DKK 0.006/kWh payable by households and the public sector. Total annual proceeds amount to about DKK 90 million.

One of the Trust's goals is that it should be easy to save energy. One element of this goal is that the Trust is continually improving its Guidelines, and is developing new tools to make it even easier to choose energy efficient solutions.

THE DANISH ENERGY SAVING TRUST'S CONSTRUCTION PROCESS GUIDELINES 2011

For construction clients, architects and engineers who want to build energy efficiently.

Published by the Danish Energy Saving Trust. January 2011.
ISBN: 978-87-92080-78-3

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