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# EFFECTIVE TOOLS AND INSTRUMENTS FOR ENERGY EFFICIENCY IN BUILDINGS

INTERNATIONAL MAGAZINE FOR BUILDING MANAGERS

FINANCIAL TOOLS FOR IMPLEMENTING MORE ENERGY EFFICIENCY MEASURES IN BUILDINGS



# ABOUT EFFECT4BUILDINGS

EFFECT4 buildings is part of the implementation of the EU Strategy for the Baltic Sea Region (EUSBSR), being a flagship project under policy area Energy and the horizontal action Sustainable development. Flagship projects demonstrate the progress of the EUSBSR especially well and serve as pilot examples for desired change.

**The goal of EFFECT4buildings is to increase the number of energy efficiency measures implemented in existing public buildings in the Baltic Sea Region.**

The target group is public building managers who often know what actions are technically possible and sometimes have calculations that show that these investments are profitable, but despite that fails to implement the measures due to financial barriers.

The project has produced a toolbox with financial methods that can improve profitability, facilitate funding and reduce the risk of energy investment in public real estate. Examples of tools are profitability calculations, action packages, contribution optimization, EPC, multifunctional agreements, green leases and economic models for both production and energy use.

EFFECT4buildings connects public property owners with suppliers of solutions to achieve more efficient use of energy in the Baltic Sea Region. Financial tools and methods have been developed through various real cases among partners participating in the project.

## Project Financing

EFFECT4buildings is implemented with the support from the EU funding Programme Interreg Baltic Sea Region 2014 -2020 (European Regional Development Fund) and Norwegian national funding.

## Project budget

2 637 013 EUR.

## Project Duration

October 2017 – December 2020

## Project partnership

-  County Board of Dalarna
-  Environmental office of Lappeenranta region
-  Inland County Council
-  Vidzeme Planning Region
-  Gate 21
-  Tallinn Science Park Tehnopol
-  State Real Estate Ltd
-  Byggdialog Dalarna
-  Association of Communes and Cities of Malpolska Region

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# WHY WE SHOULD CARE ABOUT BUILDINGS?

The EU's climate goal is to be fossil-free by 2050. Reaching this goal requires a big reduction in energy use. To use less energy has become more and more important challenge over the last decades, and at the same time a strategic priority for the EU Member States.

Therefore, investment in energy-efficient technologies and renewable sources of energy is treated as the way to reach the EU objectives in terms of energy and climate protection at the same time as supporting economic growth through investments.

40 % of the energy use in the EU is related to buildings. Buildings can be both private and publicly owned, for either private or public use and for many different purposes, e.g.: housing, offices, schools, sports, shops, religious activity, industry etc. Less than 3 % of the building stock in the EU qualifies for the A-label, meaning 97% of the buildings are wasting money and need to be upgraded. Renovating buildings can be resource-intensive but with a good knowledge of the real estate it is easier to make the right decisions on what energy efficiency measures to apply.

The EU Directive on the energy performance of buildings creates a common framework of measures across Member States and contains provisions at improving the energy efficiency of both new and existing buildings. The existing buildings which undergo renovation work must be adapted at least to a minimum degree to the requirements in respect of energy performance. Moreover, all newly erected buildings must have almost zero energy consumption by 31 December 2020.

More and more new requirements and regulations are being developed and implemented at national and regional levels in respect of energy performance of buildings or building structures, periodic inspections of heating and air-conditioning systems, as well as independent control systems for energy performance certificates and inspection reports.

Although many guidelines and documents on the energy efficiency in buildings already exist - for example, Sustainable Energy Action Plans and energy audits of the buildings - the authorities and officials often lack support on their decision making. They need decision supporting tools that would help them start moving towards implementation of the energy efficiency measures.

Lack of knowledge and the absence of track records of accomplishment and experience are significant elements in the field of energy investments which increase the perceived risks and contribute to high transaction costs. Consequently, the implementation of energy efficiency measures is hindered and transformation towards energy efficient buildings is slow and often unnecessarily expensive.

Energy efficiency projects have a specific economic profile. Unlike renewable energy projects which generate a positive cash flow if producing its own energy, energy efficiency projects ensure their return on investment through energy savings (non-expenses) and not through an increase in revenues.

This largely explains the difficulty for financiers to consider this type of projects: culturally, they are trained to support the growth of the project developer, more rarely to take into consideration cost optimisation projects where the technical components play an important role in the feasibility and profitability of the operation. According to the Intelligent Energy Europe (IEE) report this usually results in an inadequacy between the cost of external financing (interest rates) and the project's profitability.

The project **EFFECT4buildings** aims at addressing both of the aforementioned problems by providing the target group with a decision support toolbox that includes means to calculate and plan the renovation projects most feasible and profitable way, as well as being able to convince financial decision makers so that the scope and return of investments would be clearly and convincingly presented.



The project main target group is employees at local, regional, national level in charge of the public building portfolio, as well as other building owners.

Their tasks include taking care of rental agreements, space management, everyday maintenance, upgrading, retrofitting, deep renovation of the buildings, as well as their finance.



# A TOOLBOX FOR IMPROVED ENERGY EFFICIENCY IN PUBLIC & PRIVATE BUILDINGS

Investments in energy efficiency are not currently happening at the rate needed, hindered by barriers such as high upfront costs, lack of access to finance, high perceived risk, lack of trust in new technologies, competing investment priorities, lack of knowledge, awareness and personal resources, and split incentives. Many of these barriers can be overcome, at least significant part, with well-designed financial tools and instruments.

Together with complementary measures like policies, regulations, awareness-raising activities, and behavior changing initiatives and business models for energy efficiency solutions a sustainable long-term impact will be reached.

The Interreg Baltic Sea Region Program 2014-2020 project EFFECT4buildings is providing building owners and managers with a set of financial tools and instruments for risk management to support the implementation of more energy efficiency measures, developed, and improved in real cases.

## Toolbox for financial calculations

92% of all interviewed building managers stated that financial calculation methods are extremely important when justifying energy investments, but only half of them found it easy to do or even to understand them.

Most common way for calculations of energy measures is pay-back-method, but it does not take aspects of technical lifetime and profitability demand in consideration. Conclusions from recalculations of measures has shown that using Net present value method or Internal rate of return, investments with longer lifetime will benefit and many more measures will be profitable.

Another particularly useful tool is the Total Concept method. When bundling several measures into a larger investment package, the profitability of the whole package can be calculated. Less profitable measures will then be covered by the more profitability ones, making it possible to implement more energy efficiency measures in total.

The toolbox also contain calculation tools for Prosumerism, helping building managers to find out the optimal size of a solar energy power plant as, both from financial and energy production perspective.

## Tools for partnering

Investments decisions will of course be facilitated by funding, green loans or bonds. Financial and technical risks can also be lowered by contracting partnership with an external service company. In the Energy Performance Contracting (EPC) model results are guaranteed by the Energy Service Company (ESCO), making sure that

energy savings cover the costs of the investments. The project introduces an improved EPC model with contract-based partnership for the analyses phase.

The Multi Service Contracting (MSC) model, based on some of the same ideas as EPC, includes several benefits except for energy savings, making investments more effective, lowering the risk of sub-optimization, and giving more value for money spent.

Also, with models for implementing Green Lease Contracts, users of buildings and tenants can be involved in increased sustainability.



## Technology solutions

Last, but not least, it is of great importance to lower the risk of investing in wrong technology. To make sure building managers invest in the best available solutions, more knowledge on different possibilities is needed as well as confirmation from colleagues that the solutions performs well.



# FINANCIAL CALCULATIONS

To predict the profitability of an investment, financial calculation methods are used. Since the traditional approach, based on pay-back time, is inefficient, the project proposes tools (in web and Excel versions) that enables one to employ several methods, either independently or in combination. In particular, Net Present Value and Internal Rate of Return prove efficient and helpful for building managers, energy auditors, and other investors. To use these methods wisely, however, they need appropriate training, and so the tools are accompanied by training material that is both informative and simple to understand.

Calculations with net present value and internal rate of return gives more fair answers on what investments to choose, than pay-backtime. To get a full and correct comparison between different solutions, more parameters that are included in the excel calculation tool should be used.

## ENERGY EFFICIENCY TODAY AND IN THE FUTURE – FINANCIAL CHALLENGES!

Author: Tanja Nyholm, Environmental office of Lappeenranta region, Finland

The financial profitability or even more unprofitability of energy efficiency measures has been recently an interesting topic under general discussion. The main reason behind the conversation is the reality, that CO<sub>2</sub>-emissions must be reduced in order to maintain the carrying capacity of world also in the future. However, comparing energy efficiency measures is challenging, as profitability must be described from many different perspectives:

- For one person, reducing emissions is the most important issue.
- For another person, energy self-sufficiency is the most important.
- For someone else costs matter the most.

The way of presenting the results must be also chosen according to the target group:

- For one group, the best way is presented results as numbers.
- For another group, the best way is presented results as visual and clear charts.

It is also important to observe, that different development options in the future, especially changes of energy and water prices, are interesting for all stakeholders.

### How should energy efficiency measures be compared?

When comparing the financial details of energy efficiency measures, the payback period is not the best way, although it is the easiest to understand.

Often 10 years is considered to be too long a payback period, although the measure may still be profitable in financial point of view.

The payback period does not take into account:

- The effect of change of energy prices.
- The impact of the technical lifetime to the profitability.
- The difference in the value of money now and in the future.



**However, these are very important factors, when financial profitability of measures shall be compared.**

In addition, non-energy benefits, which are not directly related to the financial aspects, are relevant to observe: such as the improvement of the indoor climate and long-term benefits based on better air quality. For example, these measures may provide decreasing of health costs.

To solve the above presented problems a financial calculation tool and guideline for financial calculation methods have been developed by EFFECT4buildings - project. The tool provides a better understanding of energy efficiency investment profitability, using several calculation methods for comparing alternative energy efficiency measures:

- Payback period
- Cash flow
- Net Present Value
- Internal rate of return
- Reduction of CO<sub>2</sub> emission
- In addition, the impact of non-energy benefits on the payback period can be estimated using a tool.

REDUCTION OF CO2-EMISSIONS	Ventilation system with heat recovery	Geothermal heat pump system
Reduction of CO2- emissions (kgCO2/year)	20 400	46 000
Reduction of CO2- emissions / CO2- emissions before measures (%)	16 %	35 %
Reduction of CO2- emissions during the Life cycle (kgCO2)	408 000	920 000
<b>NON- ENERGY BENEFITS</b>		
Decrease cost due the Non-energy benefit (€/year)	8 200	0
Pay back time 2 (year), includes the effects of non-energy benefit (for example decrease health costs)	7,96	8,64
<b>FINANCIAL RESULTS</b>		
Pay back time (year)	13,65	8,64
Internal rate of return, IRR (%)	2,06 %	8,28 %
Internal rate of return, IRR (%), Option 1. Energy/water prices change	5,24 %	11,39 %
Internal rate of return, IRR (%), Option 2. Energy/water prices change	8,29 %	14,43 %
Net Present Value, NPV (€)	-51 933	65 892
Net Present Value, NPV (€), Option 1. Energy/water prices change	-2 699	165 449
Net Present Value, NPV (€), Option 2. Energy/water prices change	63 833	304 738
Cash flow (€)	1 339	203 612
Cash flow (€), Option 1. Energy/water prices change	86 343	374 897
Cash flow (€), Option 2. Energy/water prices change	203 427	620 443

Figure 1: Results with numbers

- The tool also includes sensitivity analyses with two options for estimating energy and water prices changes. This smart functionality facilitates the comparison of different development options in the future.
- Results are presented both numerical and graphical forms (Figures 1 and 2)



**By presenting the results with many different visual options the needs of different stakeholders can be taken into account (building managers, municipalities, energy advisors, consumers, etc.).**

In addition the guideline of calculation methods provides for stakeholders comprehensive instructions how to use them. Guideline can be used also as individual material for educational purposes to all possible interested parties.

The Financial calculation tool has been made as part of the project EFFECT4buildings. Tool were made step by step:

- Developing financial tools themselves.
- Development work (by testing tools) within the target group.
- Providing training and developing guidelines for the use of tools.
- Making recommendations and presenting best practices.

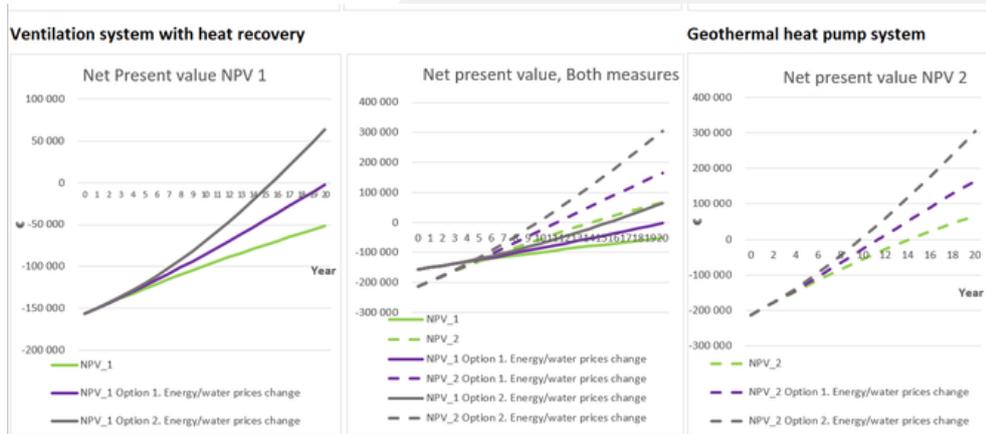


Figure 2: Results with graphs

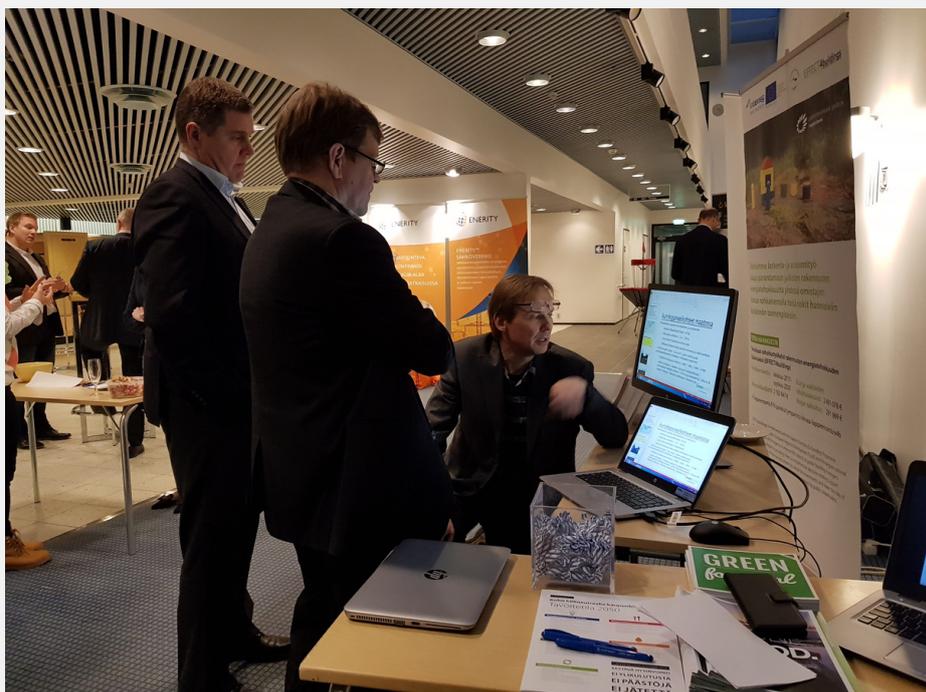


Photo from EFFECT4buildings archive

# WEB-TOOL FOR BETTER FINANCIAL CALCULATIONS LAUNCHED

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

Previous experiences indicate that different conclusions will be drawn, about whether an investment is profitable or not, depending on the calculation methods used. The majority of energy efficiency measures presented in energy audits is calculated with simple payback-time methods not taking in consideration technical lifetime of the investment.

The project has developed a web tool that makes it easy to do different types of financial calculation, just by adding a few parameters about the investment.

The tool calculates with net present value method, annuity value method, internal rate of return except for pay-back time.

The tool can be found: <http://www.effect4buildings.se/>

A group of private building managers was trained in using the different calculation methods. Conclusions was the need to use complementary financial calculation methods. When using net present value method, investments with longer lifetime will benefit. In many cases the use of internal rate of return will show that many more measures is profitable than when using only pay-back-time.

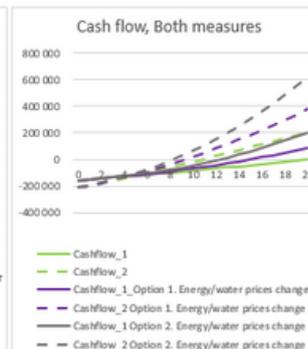
A new standard for presentations of measures in energy audit reports has been implemented in Dalarna with the requirement to present alternative financial calculation results for each measure, at least net present value except of pay-back-time (and preferable also LCC and internal rate of return). The project is now working to influence national policy level for implementing the same standard.



Building identification (name or address)	Building
Type of building	Housing/ Residential building
Heating system	District heating
Ventilation system	Other
Cooling system	None

EFFECT4buildings financial calculation tool

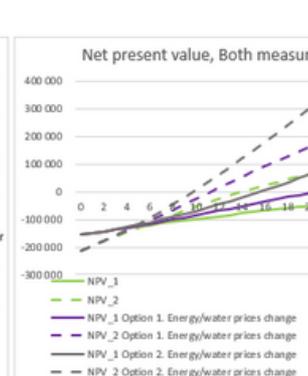
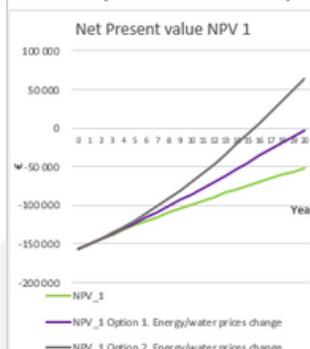
Ventilation system with heat recovery



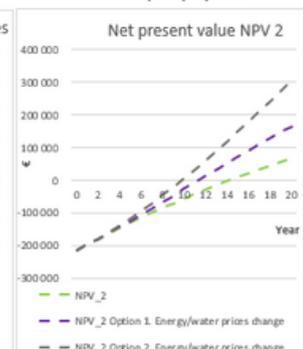
Geothermal heat pump system



Ventilation system with heat recovery



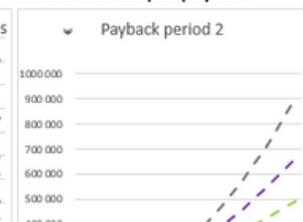
Geothermal heat pump system



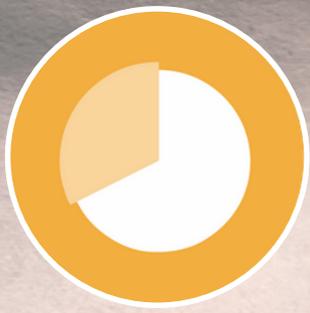
Ventilation system with heat recovery



Geothermal heat pump system



Screenshot from the Financial calculation tool on <http://www.effect4buildings.se/>



# BUNDLING

Taking care of many measures simultaneously in energy investments is difficult, but bundling can make it easier. It enables one to combine many small measures into one package, which can increase the profitability of an investment and make it look more attractive to potential investors. One of various ways of approaching bundling is combining Total Concept Method (TCM) and Total Tool, which can help illustrate the economic profitability of individual measures. Being cost-effective and helping understand energy investments, bundling can also be used as a standard in energy audits, and it can help find an optimal funding source and receive financial aid.

Its basic idea is to make a planned investment more profitable and more interesting from an economical point of view, especially for potential investors. Bundling can also be used for agreements with companies receiving state aid.

## INCREASE OF ENERGY EFFICIENCY MEASURES THROUGH BUNDLING

Author: Matti Pylkkö, Environmental office of Lappeenranta region, Finland

An interesting option to increase energy efficiency measures is to bundle many smaller investments into a bigger investment package. Bundling combines several measures, which makes the total investment more profitable and more attractive in funding point of view. In this way can be facilitated the implementation of energy efficiency investments. One of the most useful way to bundle investments is known as **Total concept method**.

Detailed information of renovation - project implementation can be presented as **scorecards**. Project scorecards can be divided in separate parts according to same principles as work process of the Total Concept Method.

By filling in scorecards all the important details during the implementation, this valuable information is collected in the same document for easy review of success assessment of project.

Total Concept Method gives an easy and valuable method to illustrate the economic profitability of individual measures. TCM provides an action plan comprising a package of energy efficiency improvement measures, which fulfills the property owner's profitability requirements. The profitability assessment in TCM is based on internal rate of return method.

The work process of the Total Concept is divided into 3 steps:

1

A Total Concept project starts with a comprehensive technical inventory in the building and to identify all conceivable energy saving measures. At this stage, all possible measures for improving energy efficiency are identified and costed, and the subsequent energy savings are calculated.

2

The energy saving measures in the action package are carried out. The focus here is on the quality of the work and on making sure that energy savings will come true.

3

This phase consists of the following up the effect of the action package after it has been implemented. The energy use during at least one year after renovations is compared to the energy use before implementation of the action package.

The overall assessment of profitability of the whole renovation project is easy to be convinced with clear charts provided by Total Tool. In some cases, however, it is useful to interpret the background of the graphical charts. Especially shall be taken into account the target group reviewing the material produced by Total Tool.

As an **example of successful use of Total concept method** is renovation of **Tampere Hall** in Finland. Detailed information of Tampere Hall - project implementation is presented as **scorecards**. In addition, that has been successfully utilized **Total Tool** during the implementation of the Tampere Hall project.

In step 1 the internal rate of return for the entire package of measures was calculated to 7,78 %, which is slightly higher than the profitability target of 7%. The energy consumption is estimated to decrease by 24 %.

However several changes to the package were made in step 2 (Corrected baseline and several changes were made to the package) and that's why after completing all the measures the energy consumption is estimated to decrease by 23 %. Profitability of the whole action package will be 8.5 %, which is higher than 7.8 % that was calculated in Step 1. See Total tool diagram (Step 3: follow up).

As a whole, Tampere Hall is a brilliant example of a successful implementation of using Total Concept Method in a practical energy efficiency project.

## The status of the building and its technical systems before measures

### Building envelope

[Describe briefly the technical details of the building envelope and its current status.]

### Ventilation

[Describe briefly the current status of the ventilation system(s) in the building and their current status.]

### Heating

[Describe briefly the current status of the heating system(s) in the building and its current status.]

### Cooling

[Describe briefly the current status of the comfort cooling system(s) in the building and its current status. Describe also if the building has any process cooling systems, e.g. refrigeration chambers in restaurant kitchens, cooling of server rooms, etc.]

Figure 1. One part of Scorecard template (Step 1.)

insulation and bitumen finish. Windows display a wide scope of variations (glass walls, fixed/open windows, aluminium/wood framed windows).

The building envelope is protected by the Finnish National Board of Antiquities, so changes to the structure and to the outside appearance are impossible. The envelope is also of good condition. Due to this reason the main focus was on the windows for which the improvements would be possible without interfering with the protected appearance.

### Ventilation

The ventilation devices are mostly original ones. 119 devices are distributed along 10 ventilation circuits leading to different areas of the centre. The system works with variable air flows. Only 5 devices are fitted with a heat recovery unit. The ventilation system fulfils the current requirements but is nearing the end of its service time. Concepts for renewing the system have been drafted but not implemented yet.

The ventilation is manually controlled by timing it to operate according to planned use/events in the building. Due to this reason there is no regularity in the use times as they depend on the events and use of the facilities each year.

### Heating

The building uses the district heating network to heat the premises. All areas are heated by hydronic radiators and warm supply air. The heating system is original from the construction. In the large building the heating/cooling requirements can differ between spaces and thus the building might be heated and cooled at the same time.

Figure 2. One part of the scorecard of Tampere Hall

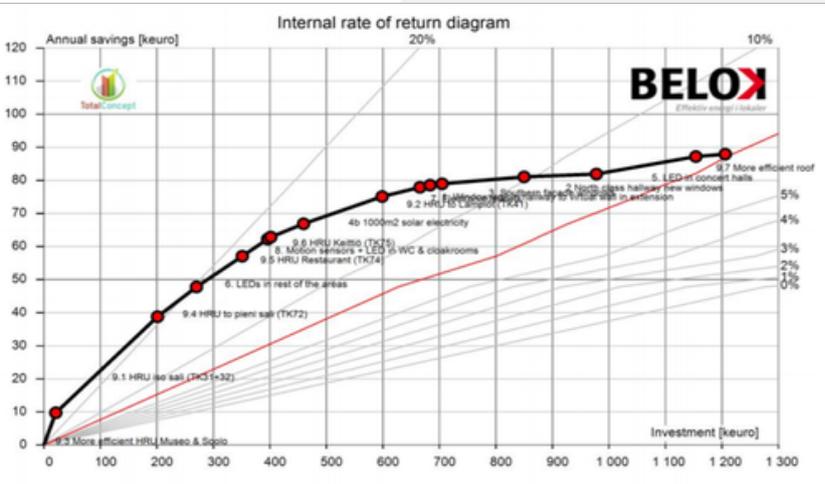


Figure 3. Total tool diagram for Tampere Hall (Step 1)

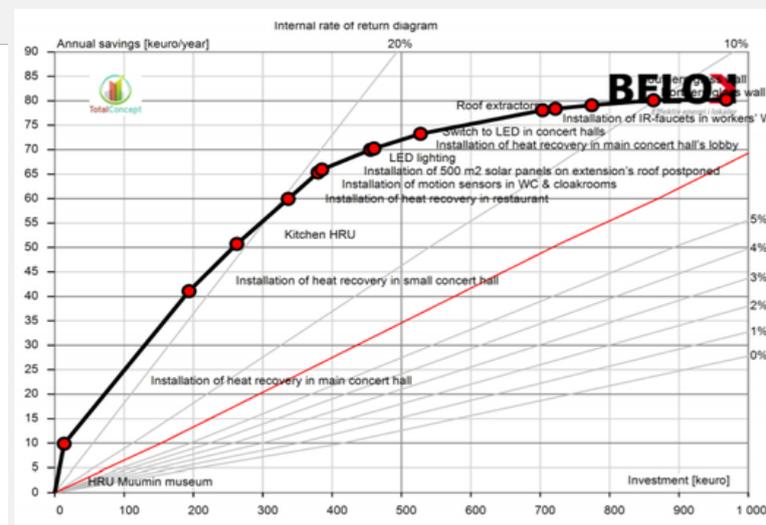


Figure 4. Total tool diagram for Tampere Hall (Step 3)

# GOOD PRACTICES ON BUNDLING METHODS FOR THE BALTIC SEA REGION

Author: Barbara Wos, Association of Communities and Cities of Malopolska Region, Poland

1

## Condensing gas tankless water heaters

Condensing gas tankless water heaters forgo a storage tank by providing hot water only when needed, thereby eliminating standby losses. The condensing type is able to achieve efficiencies greater than 90% by also extracting additional heat from the exhaust gases.

2

## Occupant responsive lighting

Lighting systems including sensors, management systems, and/or control components allow facility managers to provide high quality lighting that meet individual preferences and light needs while reducing energy demand and costs. Control methods include occupancy sensing, timer scheduling, and dimming.

3

## Heat pump water heaters

A heat pump moves heat from the surrounding environment into a tank to heat water. Since heat pump water heaters move heat rather than generating it, they are 2-3 times more energy efficient compared to traditional electric resistance water heaters.

4

## LED downlight luminaires

LED downlight luminaires can deliver significant energy and cost savings as a replacement for incandescent and fluorescent technologies in the residential sector.

5

## Building energy management and information systems

These systems provide facility managers with the capabilities to monitor, control, adjust, and manage energy performance of various systems such as HVAC and lighting.

6

## Window attachments (non-adjustable)

Windows are the main factor that causes heating and cooling loads in buildings. Windows with low heat transfer coefficient and other window accessories that are able to save energy from heating, cooling and even lighting.

7

## Plug load control devices

Plug load control devices, such as a power strip, can reduce energy consumption of both residential and commercial devices through load sensing and/or timer schedule controls.

8

## Comprehensive attic update

A bundled package of attic insulation attic ventilation, duct sealing, air sealing, and air barriers makes a comprehensive attic update that can significantly reduce the heating and cooling load of residential buildings.

9

## Dynamic solar control systems

Window shades, when used effectively, can save energy from heating, cooling, and even lighting. Shades can reduce unwanted solar heat gain in the cooling season without affecting useful solar heat gain in the heating season. Insulated shades can also reduce heat transfer through the window.



# ENERGY PERFORMANCE CONTRACTING

Energy Performance Contracting (EPC) is a well-tested and successful tool that has been helping building owners reach their energy and climate targets more quickly than with traditional implementation of energy saving measures. Still there is potential for more use of EPC to reach unrealised saving potential in public sector.

The EPC model is a well-tested and successful tool that has been helping public building owners and local and regional authorities reach their energy and climate targets more quickly than with traditional implementation of energy saving measures.

Reaching our energy and climate targets in a rapid and efficient manner should be an overriding public goal in today's climate situation. Yet recent findings show that many public building owners are reluctant to implement EPC despite large documented saving potential and prior successes with the EPC model.

Increasing the use of EPC requires efforts to introduce it among building owners, deepen their knowledge about EPC and hence raise their interest and trust in the model.

## EPC PREE CHECK TOOL

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

Stakeholders working on energy efficiency in Sweden has found that they need a simpler way of finding out if EPC is a relevant tool for a specific building owner.

EPC can be a great tool for some actors, but spending time introducing the model just to find out it is not relevant in the actual case is a waste of time.

For EPC to be relevant a few basic components need to be in place, for example:

- Energy cost need to be enough high.
- There should be a need for energy efficiency measures.
- The legal rights to contract an EPC provider.
- The acceptance of outsourcing the service.
- Enough financial capacity.
- Acting on the basis of long-term ownership.

The EU project guarantEE has previous developed a web-based tool for target groups in an easy and quick way to find out if EPC is relevant for them. EFFECT4buildings has developed the tool further to suit with Swedish conditions, based on dialogue with EPC providers.

The tool contains of ten questions. Based on the answers a results are presented with conclusions about EPC and recommendations how to move forward.

The tool can be found here: <https://byggdialogdalarna.se>



**"The web based pree check tool will help building owners/managers to find out themselves if EPC is relevant or not for them,"** says Marit Ragnarsson.



*"We need to be as highly relevant as possible, when promoting tools for energy efficiency towards building managers,"* says project manager Marit Ragnarsson from Sweden.

# EPC IN ELVERUM MUNICIPALITY, NORWAY

Author: Liv Randi Lindseth, Contracted by Inland County Council, Norway

The Energy Performance Contracting project (EPC) in Elverum municipality was initiated by an intermunicipal project called "Energy efficiency in municipal building in Sør-Østerdal" consisting of 5 municipalities in Hedmark County aiming to reach new and challenging municipal energy- and climate targets. Elverum was the largest of the five and started the EPC project ahead of the four others to gain experience and make it easier for the four smaller municipalities to follow suit.

Elverum implemented more than 300 energy efficiency measures in 38 municipal buildings. They have also reached the guaranteed savings so far. The municipal project leader is positive to the EPC concept and claim that neither the large amount of energy saving measures, the guaranteed savings nor reaching the municipal energy- and climate targets would have been possible without EPC.

The main goal of the EPC project in Elverum municipality is cost and energy saving, increased comfort and renewal of technical equipment and systems using energy performance contracting as a tool. The contract-based guarantee was perceived as important or even crucial in the decision-making process.

The contract was made between Elverum municipality, the customer and the Siemens, the EPC provider in 2012. Both tender, negotiations and the contract agreements were facilitated by an EPC consultant (Siv. Ing. Kjell Gurigard AS).

The Energy Performance Contracting project (EPC) in Elverum municipality was initiated in 2009 by an intermunicipal project called "Energy efficiency in municipal building in Sør-Østerdal" consisting of 5 municipalities in Hedmark County.

These were aiming to reach new and challenging municipal energy- and climate targets. Elverum was the largest of the five with its 21 000 inhabitants, 160 000 m<sup>2</sup> of building mass. The cooperation partners decided that Elverum should start ahead of the four others to gain experience and make it easier for the four smaller municipalities to follow suit. The cooperating parties also got support via an international project called "ENSAMB" focusing on Energy Saving in Municipal Buildings in Small Communities in Rural Districts.

## Experiences and results

One of the most important success factors was the fact that the contract covered all 300 measures that was implemented in a relatively short time period. The municipality invested 40 MNOK in 38 buildings, 95 000 m<sup>2</sup> with an estimated saving of 4,3 GWh with a payback time of 9 years. The contracted guarantee ensures little risk for the municipality and safeguarded the investment. They reported large energy- and costs savings from day one and increased standard on technical equipment and systems. Some of the measures also reduced the need for planned maintenance and hence freed budgeted funds.

A more unexpected advantage was the increased competence on energy efficiency and own technical equipment and installations by own municipal persons. This came because of the involvement in the project and training given by the EPC supplier.

The main challenges were having enough resources for the follow up and involvement in the project in the municipality – both in the energy analyses phase and during implementation of measures.

Own involvement and ownership were a success factor, but it proved to be more time consuming than first anticipated.

*"We would recommend municipalities considering EPC to allocate enough persons and resources in all phases," Svein Arild Nyhus says, as the internal ownership of the project is paramount.*

*"Furthermore, the EPC supplier had their main focus on energy saving and the municipality hence had to make sure that implemented measures also had users of the buildings and maintenance personnel in mind," he continues.*

Now, five years into the guarantee period there are still some confusions due to maintenance agreements and operational issues with heat pump installations, but the municipality expect to find solutions and come to mutually beneficial agreements in a dialog with the EPC supplier. Energy savings have been achieved and the municipal energy- and climate targets have been met. Due to motivated operation personnel and close dialog with the EPC supplier they expect the positive results to continue in the years to come.

The project leader in the municipality, Svein Arild Nyhus, hopes the experiences made in Elverum can be of help for other municipalities considering EPC.

## Case EPC in Elverum municipality – in short

### Target:

20% energy savings compared to previous consumption.

### Achieved savings:

24% energy savings compared to previous consumption.

### Project partners:

Elverum municipality and Siemens AS.

### Duration:

2012 – 2023

### Planned outcome:

Energy saving, cost and energy efficiency, increased comfort and renewal of technical equipment and systems.



*"To other municipalities I will say: Go for it! Stop contemplating and pondering. Large municipalities might have the resources to do a lot by themselves, but the guarantee is the alpha and omega for smaller municipalities. We implemented almost 300 EE measures in Elverum. We would not have had the resources for this without EPC," Svein Arild Nyhus, Elverum municipality.*

# SUCCESSFUL EPC PROJECT ENDED AHEAD OF TIME

Author: Liv Randi Lindseth, Contracted by Inland County Council, Norway

Formerly Oppland, now part of Inland County Council, completed its EPC project four years before the guarantee phase was over. The project has been successful, so why end a successful project ahead of time?

In 2013, the former Oppland County started the work of preparing and starting up an energy saving project with a guarantee of results (EPC project).

Morten Hoff, an engineer in the real estate department in Inland county, has been the project leader throughout the project period from start to finish. The building analysis was carried out in 2014 and measures implemented in 2015. A total of 128 measures were implemented at 12 upper secondary schools with a total area of 156,000 m<sup>2</sup>.

Morten Hoff says that the process generally went well. The hired EPC facilitator Siv. Ing. Kjell Gurigard led a good and orderly process in the start-up phase in the form of mapping of buildings and launching of the EPC tender. Gurigard was also involved in the selection of the EPC supplier, AF Energi og miljøteknikk AS (AF EMT).

Although experiences from the initial phases were good, Hoff would like to make some recommendations to other municipalities that want to invest in EPC.

*"The municipality must prepare and follow up the project in such a large contract. This kind of project cannot be left to others. In our case, it turned out that the preparations were more time-consuming than we had anticipated," he says.*

Hence, it is important to set aside sufficient time and resources for follow-up internally. Good preparation and knowledge of own buildings is crucial. It is also important to remember that the political process takes time. It requires knowledge of whether the project is suitable in relation to overall processes and structural changes - both in the municipality and in the political system.

It is thus Hoff's recommendation to be involved throughout the project. In the analysis phase to ensure that the municipality meets its expectations for the project, in the implementation phase to be able to follow up all details that must be coordinated between users of the building and the energy contractor, but

also in relation to notifications of deviations and other paperwork. Finally, in the warranty phase, it is important to have an orderly process and spend time on measurements and settlements regarding under- or over-performance.

*"In short, I would say that the biggest surprise for us was probably how much time was spent on follow-up in all phases," Morten Hoff states.*

*"The EPC project has now been formally completed after three years in the savings guarantee phase. The duration of the contract was longer, but there was an option to terminate after three years and we chose to take it," says Hoff.*



Morten Hoff, project leader

## So why end a successful project ahead of time?

In collaboration, the county council and the EPC supplier have over-achieved when it comes to energy savings. A luxury problem, you might say, but this is something that requires a thorough follow-up and assessment. Each of the three years, the savings were higher than the guarantee stipulated. The guarantee was a 20 % saving compared to pre-consumption, while those in the EPC project achieved an estimated 24 %. This was of course very well received in the county. As an incentive to better performance, it was agreed that the profits of the EPC project be shared between the parties. This means that every year an invoice of between NOK 100 - 150,000 was received from the EPC supplier. In a county, it is not natural to budget for bonus payments. It was therefore necessary to prepare a written case and present it to the county council in order to finance the payment. The understanding that this was contractual case and money that had already been saved was absolutely present, so when the county council chose to end the contract after three years, the main reason was that they have control.

*"We have a stable project organization and a well-established energy management system gained through the project. We also have skilled operating personnel at the schools who contributed both before, along the way and who still do an important job now that the project has ended. Their competence and interest in optimizing the operation of the technical facilities has been crucial," says Hoff.*

Good follow-up of buildings and energy use through EMS (energy monitoring system) means that the operating personnel have been given the necessary competence to follow up the energy use themselves. This is also thanks to good training and transfer of knowledge about the new technical installations from the EPC supplier.

*"The project worked according to plan and AF EMT has enabled us to manage well without them," Hoff concludes.*

He does not hesitate to recommend EPC to other municipalities and county municipalities that aim for rapid implementation of energy saving measures and reduced CO<sub>2</sub> emissions.

## Key data for the EPC project in Oppland county 2014-2017

Total investment	MNOK 35 / MEUR 4.2
Investment grant from Enova SF (Norwegian energy agency).	MNOK 4,4 / MEUR 0,53
Pre-consumption	25 GWh
Guaranteed savings	Appr. 4,5 GWh
Achieved savings	Appr. 24% årlig
Buildings	12 upper secondary schools
Area	156.000 m <sup>2</sup>
Contract duration	7 years with building owner's unilateral option to end contract after 3 years

# REORGANIZATION OF OPERATIONS PAVES THE WAY FOR EPC IN HAMAR MUNICIPALITY

Author: Liv Randi Lindseth, Contracted by Inland County Council, Norway

Hamar is a growing city, the infrastructure around it is strengthening and making the city a natural centre in the region. Hamar municipality wants to follow up on this development by taking the climate challenges of our time seriously. The municipality has implemented several good energy and climate measures already and wants to continue to achieve the goal of a 40% reduction in greenhouse gas emissions by 2030. Now the municipality is investing heavily in solar energy. A reorganization of the technical operation of the building stock will also pave the way for energy savings with a guarantee of results (EPC) in the near future.

"The building stock in Hamar municipality is not bad compared to others," says Arne Arnesen, head of the property department. His department manages and operates administration premises, schools and kindergartens, institutions and municipal sports and cultural buildings with a total area of about 160,000 m<sup>2</sup>. In 2019, the total consumption of electricity and district heating in these municipal buildings was about 31 GWh.

The municipality has adopted a strategy to meet the climate challenges anchored in the municipal plan for climate and environment. The goal is a 40% reduction in total greenhouse gas emissions by 2030.

"When you set such ambitious goals, it goes without saying that you must focus on many areas," says Arnesen.

## Funds earmarked for solar energy

The municipality focuses especially on solar energy, says Arnesen. The municipality's solar energy projects will facilitate learning and awareness. In addition, they will strengthen the municipality's own competence in the area.

"This is something we want to be good at. 2 million kroner is earmarked for solar energy in existing buildings each year. In addition solar energy systems will be installed in some of the new building projects," Arnesen adds.



Solar cells on rooftop, Hamar municipality

On the roof of Ankerskogen swimming hall, 1156 panels have been installed over the 50-meter-long pool. The plant will produce 287 MWh a year and is expected to save energy equivalent to 10 single family houses each year. So far, this is Hamar municipality's largest solar cell project and the only one that has been established in the existing building stock. Everyone who visits the facility will be able to get an overview of the production on a display screen that will be set up at the reception.

## New organization of operations paves the way for EPC

"It is written down in the municipality's climate budget that it should pursue energy savings with guaranteed results - an EPC project. According to the goals, this project will contribute to a reduction of the climate footprint from energy consumption by 20%," says Arnesen.

This will amount to 1000 tons of CO<sub>2</sub> equivalents. If all the municipality's buildings are included in the project, this means an annual energy saving of about 6.2 GWh. With an energy price of 70 øre, this will correspond to NOK 4.3 million saved each year (about 401.000 Euro). The municipality has recently undergone a comprehensive reorganization of the technical operation of the building stock. They previously had a decentralized organization where operating personnel were attached to one or a few buildings and only responsible for the technical operation of these. We have now been through a restructuring phase to coordinate efforts and centralize the technical operation of all the municipality's buildings.

"This is the reason why we have chosen to postpone an EPC project. When we are to engage an external actor in the form of an EPC supplier, our operating personnel will play a crucial role in achieving good results. Now that new routines and a more efficient organization of operators are in place, we should be well prepared for this. The idea is to start the process of putting in place an EPC project in the new year," says Arnesen.

The municipality has not decided on how much of the building stock will be covered by a future EPC project, but the wish is that very profitable measures can finance measures with a somewhat longer payback period.



"We have also had meetings with EFFECT4buildings and see that they have expertise that is useful to us in such a project. The municipality must be involved all the way and we must focus on courses and training of internal resources. I do not believe that an external actor should go through our buildings alone and find out what measures are to be implemented. We want to figure this out through dialogue and cooperation with a future EPC supplier," Arne Arnesen, Hamar municipality.



Lunden school, Hamar municipality

# PARTNERING NEXT STEP AFTER EPC

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

The municipality of Ludvika was one of the first municipalities to invest in larger EPC projects, which gave many valuable experiences. Now Ludvikahem has taken over the properties and instead wants to invest in partnering for the continued energy work.

## The municipality of Ludvika was out early with EPC projects

Evaluation of EPC projects in Dalarna and Sweden shows that there are both advantages and disadvantages to the model. Municipalities that have tested the model in particular point out the challenges that you have to be very active in the project in order to get the right quality and the risk of sub-optimizations where the energy measures are not integrated into other operational issues. Economically, it is questioned whether it really is the most economical way to carry out energy investments, especially as municipalities usually do not have difficulty borrowing money at a favorable interest rate.

The municipality of Ludvika has been pioneers in Sweden with long experience of the EPC. In two projects of 5 million Euro + 5 million Euro, the goal has been to reduce energy use in the municipality's premises by 22% by 2020, while at the same time ensuring long-term value of the properties and technical standards for requirements for functionality and indoor climate. The municipality financed the investments through Kommuninvest (financial institutions for municipalities).

The supplier has been paid with a fixed basic price and, in addition, an reimbursement if promised energy savings have been achieved.

Contractor and client share 50/50 of the saving of total energy cost that exceeds the 22% stated as reference value. After the final inspection of the turnkey contract, the partners have moved on to a management contract of 11 years, adapted to the measures pay-off and loan period at Kommuninvest.

Stefan Andersson and Birgitta Parling at the municipality of Ludvika are satisfied with the pioneering work that has been done and which inspired many others. They confirmed, in the evaluation that Byggdialog Dalarna made of EPC projects in Dalarna, that energy savings could have been achieved.



Photo from Marit Ragnarsson archive

It was, however, believed that the 22% savings guarantee was too low as it included many measures that were easy for the contractor to do. It was also found that the contract period for fixed compensation in the management phase was too long.

## Ludvikahem takes over management of buildings and the EPC projects

During the EPC project period, the management of the municipality's properties has been taken over by the municipal company Ludvikahem, which manages both housing and premises.

Jan Hedberg, who is the construction manager at Ludvikahem, confirms that they have saved a lot of energy through the EPC projects and that it has contributed to building up increased interest and expertise for energy issues, but notes that there have also been problems along the way.

*"The municipality was not sufficiently involved in the solutions that were made and more resources had been needed to demand the correct technical documentation and carry out proper inspections. It is now lacking in several places and we have received some strange and cheap solutions that do not feel sustainable in the long term. We have a competent operating department that had to have been involved in a more active way than just taking over other people's solutions. Otherwise it will be a resistance from persons," says Jan Hedberg.*

One advantage of the EPC model is that the measures are actually implemented. Without own expertise in the own organization, measures might not be implemented. And the EPC project has meant a lot of education in energy and property management issues. It was a good start.

The municipality of Ludvika was one of the first municipalities to invest in larger EPC projects, which gave many valuable experiences. Now Ludvikahem has taken over the properties and instead wants to invest in partnering for the continued energy work.

Jan Hedberg also does not believe that the EPC model has been the most profitable method of carrying out energy renovations.

*"You should be able to run this project more economically. The municipality was responsible for the financing itself and the contractor managed to renegotiate the reimbursement model during the implementation period, in a way that became more favourable to them. I understand that they have made good money on this contract. Initially, the contractor got to pay a penalty, but with the new model they both got paid and received half of the energy savings," says Jan Hedberg.*

## Ludvikahem wants to invest in partnering instead of EPC in the next step

The conclusion from Ludvikahem, after learning a lot through the EPC project, is that they want to seek other forms for the continued energy work in the company and the form they are interested in testing is partnering. Ludvikahem has previously tested partnering on construction projects and sees that it can be a suitable model also for renovations in order to achieve energy savings and better indoor environment.

Partnering is another way of interacting with external actors in major rebuilding and more complex projects. This means that Ludvikahem, instead of defining the entire construction project and procuring contractors and craftsmen after that, includes a partnering agreement with an entrepreneur who has the right skills. Together, it will be a team to jointly find the best possible solutions with a common budget, which gives a security to the building owner.

*"The most important part of partnering is openness. If you do not understand this, and continue in the traditional model with the view of each other as counterparts, then the model will never work, says Jan Hedberg. Therefore, it is so important to really choose the right partners with the ability to cooperate. Evaluation of partners can be done based on how competent staff they have instead of the lowest price. From our side, it demands great involvement."*

**The Swedish organization Byggherrar have produced a contract template and regulations for partnering (in Swedish)**

<https://www.byggherre.se/>

# ENERGY PERFORMANCE MAINTENANCE CONTRACTS

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

Many building owners don't have their own qualified knowledge in operating the building systems, such as heating, cooling and ventilation. The consequences may be that the building consumes more energy than necessary, and that the lifetime of technical systems is shortened.

To contract a service provider for maintenance of the building is often the solution, but even then, the building owner need to have quite a lot of own knowledge to assess whether the best possible maintenance of the building with the most optimal energy use is provided. For that, some kind of control is needed.

Service is often contracted as a specific number of visits or hours, without agreement on a specific function to be achieved. For that an other type of service contracts would be needed. To add an incentive for energy savings and high performance would increase the chance of optimal building management.

To solve this, County Board of Dalarna has together with the experience from professional building managers in the stakeholder group and a consultant that has worked for several years as a service provider, developed a tool.

The advantages of partnering are that everyone works towards a common goal, a common organization and common financial interests, which differs from the EPC. The model is also suitable for renovations that often contain many uncertain parameters that have to be solved along the way and ensure that function is not compromised for the cost to be kept low.

## Partnering is implemented in 3 phases

1

### Phase 1: Planning

The client writes a framework contract with the partner (turnkey contractor) with an option to call for implementation and follow-up phase. At the same time, an inquiry is ordered for the objects in question. Energy and maintenance measures are developed and priced.

2

### Phase 2: Implementation

(Option) Call-off for the implementation of the projection and procurement of subcontractors. Joint calculations for target prices are produced. Technical documents are produced. A target price for the contracts is produced. Purchased at cost with negotiated profit in % . (Option) Call for implementation of the contracts.

3

### Phase 3: Follow-up

The tool consist of a template for purchasing of services regarding ventilation, heating, cooling and controls in buildings, with the purpose of achieving best possible energy efficiency and system function, has been developed. The document contains suggestions for contents in both RFP:s (request for proposals) and final contracts.

The model that has been chosen, is based on a contract where the two parties - building owner and provider of services - agree upon which functions that shall be maintained and how the service provider can prove that he has succeeded.

For results above or below agreed level of performance there will be a fine or a bonus. The contract can thereby be denoted as an "Energy Performance Maintenance Contract, EPMC" (compare EPC for investments).

In addition to template for contract and reporting template, 4 checklists have been developed that is optional for the service provider to use when visiting a building for service.

Tools can be found on: <http://www.effect4buildings.se/>



# MULTI SERVICE CONTRACTING

In Multi Service Contracting (MSC), the building owner takes a holistic approach to the renovation process, adding value to planning and contracting by including parameters such as indoor climate, maintenance and operation management in energy renovation. When involved early in shaping the project together with the building owner, an MSC supplier can take responsibility for the performance of the parameters.

The MSC concept also helps determine key performance indicators and methods of monitoring and evaluating this performance, thereby increasing the quality of internal or external services delivered.

Multi service contracting exploits EPC's essence, i.e., cooperating with a professional supplier, shaping clear objectives, and focusing on expected performance. But it also enables the contract to include other important services helping to increase energy efficiency, satisfy the users, and optimize building operation. The model ensures a holistic view, thanks to evaluating performance indicators for each service and allocating responsibility for the performance between the parties.

## RISK MANGEMENT WITH MULTI SERVICE CONTRACTING

Author: Louise Ellegaard Fich, Gate 21, Denmark.

The Multi Service Contracting (MSC) model includes several benefits, makes investments more effective, lowers the risk of sub-optimization and gives more value for money spent. MSC can include all relevant services for a renovation project such as energy, maintenance, indoor climate, operation etc. The purpose of MSC is to become aware of how different services are interlinked and how a unilateral prioritization of one can impact on others. An MSC does not have to include all services but the building owner makes an informed prioritization.

Furthermore, MSC focus more resources and time into the planning phase and cooperation with the MSC supplier.

Thus, using more time to map and analyze the building or project at focus, minimize unexpected challenges later when implementing the project. More so, the building owner and MSC supplier continuously follow up by setting clear requirements to the building's performance, key performance indicators and a performance verification program and thereby lowering the risk of unexpected cost in the operation phase. Overall to reduce project risks, MSC requires that the MSC supplier is involved from the very beginning of the planning phase.

## TOOL FOR MAPPING OF INDOOR ENVIRONMENTAL QUALITY IN SCHOOLS BY STUDENTS

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

To make investments in energy efficiency more profitable it is essential also to take in consideration the additional values that the investments will lead to. One positive effect is very often the possibility to, at the same time, improve indoor environmental quality. A new ventilation system with heat recovery can both save energy and improve air quality.

LED lightning improve the quality of light at the same time as it saves energy. A good indoor environmental quality is of great importance also for well being and better production. Research has showed that the time for learning in schools can be reduced by 2 weeks per year if the indoor environmental is improved.

In Sweden student representatives is part of the required systematic environmental management work in schools, from year 7 in primary school.

The project has together with the Swedish student organisation, Sveriges Elevkårer developed a tool for mapping of indoor environmental. Experiences from other/previous mapping tools from other partners have been used. By providing these representatives with the templates and instructions for mapping they can more actively participate in their assignment.

The two tools, in English, can be found <http://www.effect4buildings.se/>

# GUIDELINES FOR GOOD INDOOR CLIMATE IN PRE-SCHOOLS AND SCHOOLS

Author: Hans Ahlin, County Board of Dalarna, Sweden



New guidelines for light, acoustics and air have been developed by the EFFECT4buildings project in Dalarna in cooperation with experts from White Architects, Saint Gobain and By Demand.

The purpose of the new guide is to provide assistance in the day-to-day work of building managers in their planning, procurement and follow-up of projects.

The guidelines show how good light, acoustics and air quality can be achieved when new schools are built or when schools are renovated.

Project manager Marit Ragnarsson from the County Administrative Board of Dalarna gives a background to the initiative:

*"Today, people spend more and more time indoors. On average more than 21 hours in a day. The quality of the indoor environment is extremely important for our health, and for our ability to focus and work effectively. This is extra important in schools and pre-schools. Healthy students need a healthy school environment."*

We discovered early a need in our target group to get answers for the following questions:

- How can we build smart and have both energy efficiency, health and well-being in mind?
- How can we increase innovation and use the latest knowledge, among real estate companies and politicians, when procurement is prepared for rebuilding and new constructions?

Energy and good indoor climate are closely related. By counting more added values that you can get through an investment, the motivation to make the investment increases.

## The schools of the future

Existing schools and schools of the future require varied learning environments and flexible room usage.

The guide gives examples of co-usage and how we can build with flexibility.

It is common to have more or less open areas designed for individual focus work and/or working in groups.

The requirements will need to be further tightened up in order to achieve environments that are sustainable from a climate perspective, while also supporting healthy and toxins-free indoor spaces.

## Facts about the guide

The guide focuses on Light, Acoustics and Air

Within each area guidelines are presented for:

- The value of good quality
- How good environments are achieved – technical aspects
- Specification of requirements during procurement
- Evaluation and follow-up
- Laws, regulations, and guidelines

Technical aspects and specifications for procurements are described both for new constructions and refurbishment.

Other chapters are:

- The school of the future
- School premises through the ages
- and a short chapter about the building process.

For more information, send mail to: [marit.ragnarsson@lansstyrelsen.se](mailto:marit.ragnarsson@lansstyrelsen.se)

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# PUPIL PROTECTION OFFICERS - IMPORTANT FOR THE SCHOOL ENVIRONMENT

## SOLTORGSGYMNASIET IN BORLÄNGE A MODEL TO FOLLOW

Authors: Hans Ahlin and Marit Ragnarsson, County Board of Dalarna, Sweden

Untidy toilets, poor environment in showers and changing rooms and generally a high level of noise characterize the indoor school environment for many school students. Students' wellbeing is a prerequisite for being able to learn and perform in school and it is therefore important that pupils are allowed to participate in developing the quality of the school environment. The students are the ones who first and foremost suffer from poor school premises. Therefore, it is important to bring the students into the work of creating the best possible conditions. Here, student safety representatives can play an important role. They act as a link between the other students and the school's management.

At Soltorgsgymnasiet in Borlänge we meet **principal Hans Carlson**, **assistant principal Anita Brandt** and the **student Emilia Malm**, who in a couple of weeks finish her three-year program.

Since the second year in high school, she has served as a student protection officer at the school together with Linn Svård.

Emilia Malm:

*"I was elected through the school's student council and had to attend a training organized by Sweden's student associations. At the student council meetings, which are conducted once a month, I receive input from the other students and at the same time I tell them what has been said at the collaboration meetings and the annual safety round. At local collaboration meetings, which take place every month, school management, safety representatives, student safety representatives and union representatives participate."*

*"At Soltorgsgymnasiet, the sports hall Maserhallen is used for the school's physical education. For a long time, there have been problems with the environment in changing rooms and showers, which has been up for discussion both at the student council and at the collaboration meeting."*

Emilia continues: *"In Maserhallen, there are no shielding's between showers, and mirrors and the ventilation is poor. Many students do not shower after the P E lessons."*

Principal Hans Carlsson:

*"At the school, Anita has meetings once a month with the student council and between the meetings the classes have class councils. It is very important for the students to be involved influencing the indoor environment."*

Emilia Malm:

*"The furniture in the foyer has also recently been up for discussion where we agreed on new furnishing."*

One outcome is that decisions have recently been taken by the municipality to invest SEK 32 million in new ventilation in the sports hall, improved entrance, new hygiene facilities, changing rooms and energy systems.

Anita Brandt emphasizes that some things are repeatedly addressed by the students:

*"It is really hot during parts of the year in some parts of the school. Also, there is high noise level outside some classrooms. We now have a document called "Error reporting", where both students and staff can note problems that are then passed on to the property manager."*

Principal Hans Carlsson says the school, in addition to student councils, also has a student union that primarily focuses on social activities and, among other things, arranges film nights and discussion forums.



### The Work Environment Act and the Swedish Student Council

All schools should, according to the Work Environment Act, have several student safety representatives and the school boards should encourage students to appoint representatives. Principals are therefore urged to ensure that there are trained student safety representatives at each school and that they receive the training needed for the role.

The Swedish Student Council educates student safety representatives on how to work with both the physical and the psychosocial work environment, and how students can cooperate with school management. Without the students' perspective, it is easy to miss problems.

### New research shows the importance of the indoor environment

Many studies show that light has direct effects on mood, alertness and attention. The lighting often consists of fluorescent lamps in the ceiling and lack of daylight inlets. The right lighting that can also be adjusted based on the type of activity benefits pupils' learning, especially children with ADHD. Danish research shows that poor air quality and indoor temperature can lead to as much as 30% lower level of performance among pupils in schools. But the solution is not just ventilating more, because then the humidity becomes too low which causes problems with dry mucous membranes and skin irritations.

Moisture and mold damage in buildings increases the risk of respiratory problems and asthma by 30-50% and the proportion of children with asthma increases.

It is also important to keep track of the level of particles in the air. There are no guidelines for particles in indoor air, only for larger particles of outdoor air. Small particles are carriers of bacilli and viruses and are also difficult for allergy sufferers. So, with particle cleaning more people would be healthy.

Poor sound environment is not only a problem for those with hearing loss, it affects learning for everyone, but it is especially important for students with a different mother tongue than Swedish.



## Survey

The County Administrative Board, together with Sweden's student associations, have conducted a survey looking at how the pupils' safety representatives work.

There are 40 upper secondary schools and about 50 high schools in Dalarna. Of these, only 20 schools have trained a Student Safety Officer.

### Conclusions of survey

A survey conducted among these 20 shows that the students participate in the systematic work environment collaboration in 75% of these schools. The students participate in the staff's safety rounds and in the student council's activities. In some upper secondary schools, the student protection officers work independently, on their own initiative, with work environment issues.

The school management perceive that the communication with the communication with the student protection officers works well and that the problems that the student safety delegates point out are taken care of. Among positive experiences, it is emphasized that it facilitates dialogue with pupils, contributes to joint responsibility for the work environment and that many small things are addressed more quickly.

Almost every school has problems with indoor temperatures and poor air. Other common problems identified in the safety rounds are in descending order: broken things and littering, the environment in toilets /showers / changing rooms, lighting, and noise. Half of the schools show concrete examples where the student protection officers helped to make improvements, such as paper bins, earplugs, seating in the corridors, parking lots etc. They have also been instrumental in getting lighting replaced and getting access card systems for increased security.

# RESULTS FROM MAPPING OF INDOOR CLIMATE IN DALARNA

Author: Hans Ahlin, County Board of Dalarna, Sweden

How can we build smart and keep both energy efficiency, our health and well-being in mind? A key factor is awareness and knowledge among real estate companies and politicians, who make the decisions regarding procurement for rebuilding and new constructions.

The County administrative board of Dalarna therefore decided to map the indoor climate in schools in four of our municipalities.

In addition to interesting information for the participating municipalities, we gained important insights for the seminars we subsequently conducted and knowledge when we next year will design and formulate our planning tool/guide for good indoor climate in school buildings.

Mikael Larsson, property manager at Gagnef municipality, explain the importance of continuous measurement and comments on the measurements made in Gagnef:

*"For the municipality, measurements are very important to ensure a good working environment for staff and children. The measurements have led to both operational, energy saving and environmental related actions.*

*Parameters measured were for example room temperature, relative humidity, air turbulence, CO2, noise level, light and particles.*

*Below the tools we used and a picture of the Air quality monitor."*



Mikael Larsson (to the right) and our consultant Stefan Lysén during measurement in Gagnef



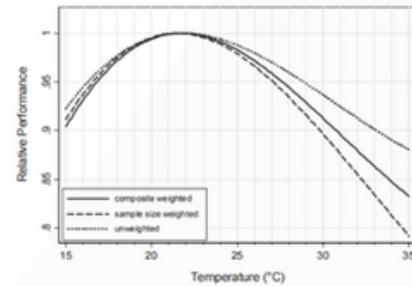
# Overall experience from four municipalities in Dalarna



## Temperature

Usually high temperature problems occur during summer months. Our experience from the measurements shows that ventilation is usually not the problem, but instead the temperature in the premises. The limit value of 1000 PPM CO<sub>2</sub> was never exceeded in any of the measurements.

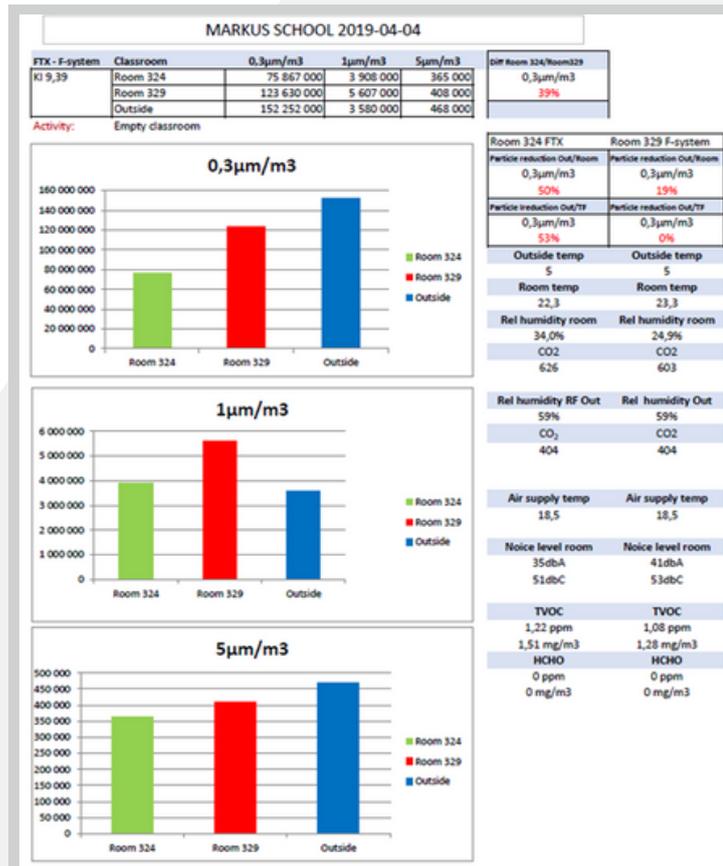
A study called Assessing Indoor Climate and Occupant Productivity, by Konstantinos Vretos KTH 2017, show the relationship between relative performance and temperature. The slope of the curve indicates that every 1°C change (increase or reduction) of temperature from the reference point 22 °C corresponds to a decline of performance by almost 1%.



## Indoor air quality

Dry air is a major problem during winter season in Sweden because of too much ventilation and/or particles. High levels of particles also bind moisture, which is vented away.

Experience from our measurements shows that during certain periods of high activity in the premises there are high values of both small and large particles. Even when measurements show low values of PM 1, PM 2.5 and PM 10 (µg/m<sup>3</sup>), the content of the smallest particles (0.3 µm), is high in number (millions/m<sup>3</sup>) in most of the school measurements we have made. See diagram →



## Lighting

Not enough light in classrooms gave low lux values. We saw many old installations and dark interiors that dim the light in the room.



## Acoustic

Too much noise from ventilation in many rooms. Causes may be incorrectly designed air flows and sound attenuation in ducts as well as incorrect type of flow devices.

The design of the interior is also of great importance for the sound level in the rooms.

Our recommendation is to measure more than once and during longer periods because conditions differ depending on season (pollen, temperature) and ventilation solution.

## Example from our mapping at Marcus school in Avesta - April 2019

This example shows clearly how important a good ventilation system is, especially for very small particles. We compare two classrooms. Classroom 324 with a ventilation system with heat recovery and a PM1 filter and classroom 329 without filter. The difference between the two rooms are for particles 0,3 µm 39%. The particle reduction of particles 0.3 µm/m<sup>3</sup> between outdoors and indoors in classroom 329 is 19% according to the chart on this measurement occasion. Compared with 50% in room 324. You can clearly see that particle concentration increases with higher activity and more persons in the classroom. At this measurement occasion it was very high particle concentration in the outdoor air.

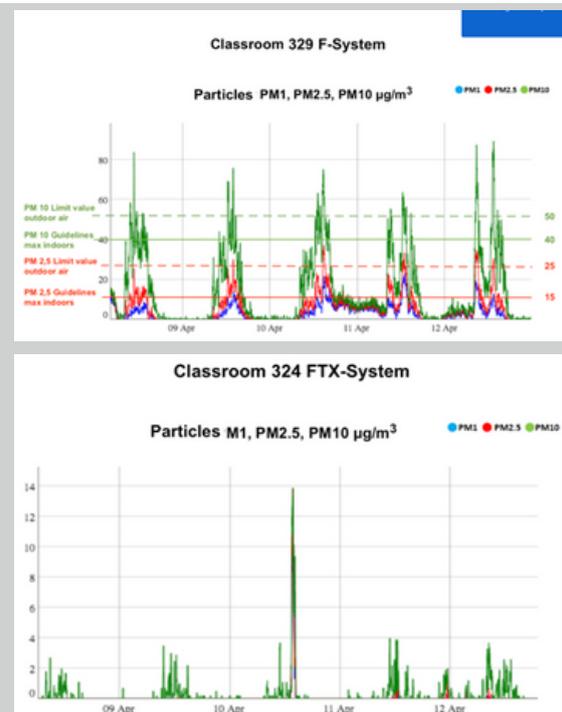
In Sweden we have limit values for outdoor air, aimed at protecting human health, but not for indoor air, only guidelines. For example:

PM 2,5                    25 µg/m<sup>3</sup> (day) and 12 µg/m<sup>3</sup> (year)

PM 10                    50 µg/m<sup>3</sup> (day) and 40 µg/m<sup>3</sup> (year)

The municipalities are responsible to verify that the environmental quality standard is met.

In the pictures to the right we show the differences between the two classrooms in comparison with recommended values.



## An interesting study

In November 2018 a study "Building 4 People: Quantifying the benefits of energy renovation investments in schools, offices and hospitals" was published by the Buildings Performance Institute Europe (BPIE) showing how poor indoor environmental quality, can affect student's health, attendance, concentration and learning performance.

### Effect of temperature

The BPIE report identified six studies that provided a correlation between certain temperature ranges and students performance. The summary of these studies reveals that: Every 1°C reduction in overheating increases students learning performance by 2.3 %.

### Effect of indoor air quality

(In the BPIE report, CO2 concentration is used as an indicator of indoor air quality)

In summary the **Effect on performance** was:

For every 1 litre per second per person (l/s/p) increase in the ventilation rate up to 15 l/s/p, academic performance increases by 1%.

In summary the **Effect on absenteeism** was:

Every 100ppm decrease in CO2 concentration is associated with a 0.5% decrease in illness-related absence from schools.

## Ventilation system with filter really matters

Dust acts as a reservoir for a variety of harmful agents. It can be outdoor particles that penetrate indoors, viruses, bacteria, chemicals, allergens (pets, mold spores, pollen), building materials, fabric fibers, and paint with lead.

In the report Schools for Health, produced by the Healthy Buildings program at the Harvard T.H. Chan School of Public Health, the authors present the effects of student health, thinking and performance.

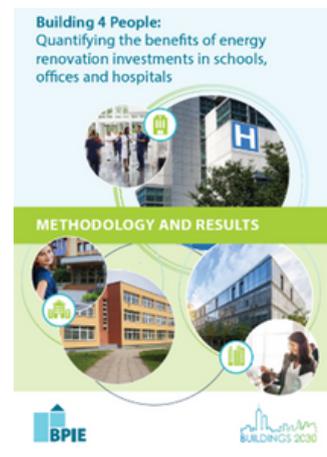
Students cannot perform well if they are not present physically. The presence of visible mold, humidity and poor ventilation were all independently associated with absenteeism in a study of schools in New York State (Simons 2010).

## Changing ventilation system has great saving potential

Example from Enåbacken elderly home in Rättvik

In an elderly home in the municipality of Rättvik we saw from the measurements before and after changing ventilation system that energy consumption from the ventilation units has dropped by an average of 58% after the conversion. Total savings from three units estimated to 6400 dollars per year. The degree of particle separation between outdoor air and supply air also increased for the better by 10% after the conversion of the ventilation units.

Price: 1 Kwh= 1 SEK



### Effect of lighting

In order to compare different studies with different results, the report standardised the performance improvement as follows:

Every 100 lux in improved lighting in schools is associated with a 2.9% increase in educational performance.

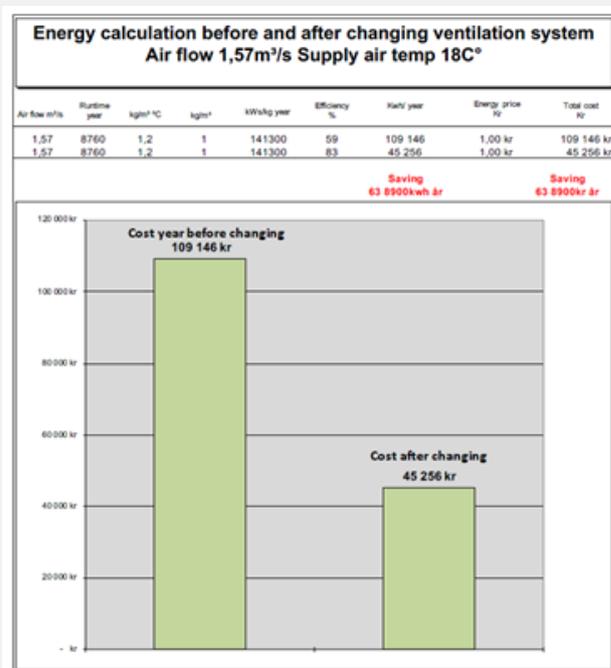
Better daylight is associated with a 9% to 18% increase in educational performance.

### Effect of acoustics

For every 1 dB decrease in excess noise, academic performance increases by 0.7%.

In another study of over 1000 students, the concentration of molds in floor dust was associated with concentration problems, headache and dizziness (Kim 2007). Similar impacts were observed in studies of teachers. In a study of 500 New York State teachers, the most commonly reported allergens and irritants were dust and dust reservoirs, followed by moisture problems.

An ongoing American research program MA SMART compares surrounding greenness and ambient air pollution to chronic absenteeism rates, defined as the percent of students that missed 10% or more of the school days in an academic year. Schools with more surrounding greenness, were found to have lower absenteeism rates. A similar trend was found with particles concentrations: a 1 µg/m<sup>3</sup> increase was associated with a 1.58% increase in chronic absenteeism rates.



# SEMINARS IN DALARNA ABOUT GOOD INDOOR CLIMATE

Author: Hans Ahlin, County Board of Dalarna, Sweden

Today, people are spending more and more time indoors. In the urbanised western world, we spend around 90% of our time in an enclosed space. Studies show that time spent in the home is increasing and can represent up to 19 to 20 hours per day for children and the elderly (1). Thus the importance of being comfortable during these hours is increasing. Research reveals that there is a clear link between indoor climate and health.

The four main factors that affect people's perception of indoor comfort are:

- thermal comfort (air temperature, humidity, draughts, etc.)
- visual comfort (view, luminosity, glare, etc.)
- acoustic comfort (noise from outdoors, vibrations, intelligibility of speech, etc.)
- air quality (fresh air supply, pollutants, odours, etc.)

During four seminars in Dalarna during September 2019, our project EFFECT4buildings asked the following two questions:

- How can we build smart and have both energy efficiency, health and well-being in mind?
- How can we increase innovation and re-thinking among real estate companies and politicians when procurement is prepared for rebuilding and new constructions?

Energy and good indoor climate are closely related. By counting on more added values that you can get through an investment, the motivation to make the investment increases. For example, demand controlled ventilation saves energy and more daylight reduces need for lighting.

To raise awareness and knowledge among our target group politicians, business executives and property managers, we decided to organise four half-day seminars in three municipalities during September 2019. Two in Falun, one in Borlänge and one in Gäddede.

We invited three experts on Air quality and thermal comfort, Visual comfort and Acoustics.



Seminar in Falun, Stefan Lysén speaks about air quality



Jonas Christensson, Reine Karsson in the middle and Stefan Lysén to the right

## Air quality and thermal comfort – Stefan Lysén

Stefan Lysén raised 5 factors for a good air quality. All parameters are important since they affect each other and individual actions can have a negative impact on others. The key factors are temperature, humidity, CO<sub>2</sub>, particles and foreign substances.

The level of humidity is important. When the humidity is between 40% and 60%, the risk of unwanted microorganisms and symptoms is lower.

Recent studies also confirm that the transmission of viruses, e.g. cough, decreases significantly at a humidity above 45%.

During spring and summer this year, Stefan conducted surveys in four schools that was presented during the seminar. Some of the findings in summary:

- Too hot in the classrooms
- Dry air due to excessive ventilation and / or particles
- Too much particles and dust in shelves, furniture
- Not enough light in classrooms, many old installations
- High sound from ventilation in many classrooms
- High radiation temperature in fluorescent lamps
- Low awareness among personell of the status of the buildings
- Also measure wintertime is important

## Visual comfort – Reine Karlsson

Reine Karlsson explained that the quality of the lighting affects health and well-being much more than most people are aware of and that there is a big difference in customer value and society value between different LED lamps and between different light environments. Premises that appear to be not so esthetic and not so attractive have low customer value. Schools with inappropriate lighting have lower society value.

The quality of indoor lighting is important because indoor lighting is important for people's health and well-being. Investing in LED lighting that provides good and appreciated lighting environments is a cost-effective way to show that a school cares about its students and teachers.



*A classroom in Malmö before and after installation Human Centric lightning*

The spectral distribution and the proportion of directed light are also important to be able to interpret people's facial expressions. The quality of light is important for our visual function, how we see things and our emotional experience, interpretation of facial expressions, security, well-being and stimulation. For example is intense bluish light good in the morning, but not in afternoons and evenings.

## Acoustic comfort – Jonas Christensson

It's important that classrooms provide good conditions for both listeners and speakers. To listen without effort is important for learning, and we know that a poor sound environment is a burden that impedes learning and have a negative effect on teachers voice health. The sound reflections have a great impact on both the speaker and the listeners. In most languages the information is carried out by the consonants, looking at the speech spectra we see that most vowels are low in frequency and high in strengths and most consonants are low in strength and higher in frequency. If the room reflections amplify the lower frequencies the “strong” vowels will be “stronger” and have a masking effect on the consonants.

These rooms have low speech intelligibility. To create good speech intelligibility it is important that the surfaces in the room amplify the higher frequencies.

A place that amplifies the higher frequencies is the Swedish forests. Jonas have done several listening and speaking tests in different forests. Most people feel that it's very easy to understand what the speaker says, good speech intelligibility, and it's also very pleasant to speak in a forest, good speak comfort. The results are interesting and he means that “forest acoustics” should be the goal in terms of acoustic conditions in classrooms.

How to order a good sound environment? Jonas explained that the Housing Agency places demands on the sound environment in buildings. The requirements are obtained from SS 25268.

SS 25268 is a Swedish sound rating standard for classrooms, care rooms, offices and hotels. For more information see [www.ljudskolan.se/ljudfakta/](http://www.ljudskolan.se/ljudfakta/)

# FOLLOW-UP HELPS ACHIEVE AND MAINTAIN SAVINGS AND IMPROVEMENTS IN RENOVATION PROJECTS

Author: Sofie Hougard Nielsen, Gate 21, Denmark



How do you make sure that you get the actual savings and improvements you intended when you carry out a largescale renovation project? Egedal Municipality in Denmark found out that the answer to that question is to follow-up and test the performance of the installations continuously.

As a part of the overall energy plan the municipality set out to reduce the energy consumption which included renovation of the technical installations in the municipal buildings. Instead of just focusing on lowering the amount of energy being used, it was decided that the project should focus on improving the indoor climate and level of maintenance as well. This decision is built on the Multi Service Contracting mindset (MSC), which means that several services are included in the renovation project.

The results from a public school, Boesagerskolen, serves as a good example of the results this way of thinking can bring.

## User experiences are valuable input

Before the renovation process started Egedal Municipality hired a consultant, Dansk Energi Management, to map the possible energy renovation initiatives. Dansk Energi Management also measured the indoor climate of ten schools and completed surveys among 500 employees about their experience of the indoor climate. User experiences are valuable because some aspects can be difficult to measure quantitatively. The results were used to help decide what solutions to choose in the renovation project and provided a baseline to compare

with after the renovation was completed. It was decided that the renovation project should include replacement of the ventilation system, optimizing the heating system and the building management system (BMS), implementing remote electricity meter reading, and deploying new artificial lighting.

## Several follow-up tests before one-year inspection

After the renovation was finished in Boesagerskolen in 2019 Dansk Energi Management followed up on the performance of the systems – this follow-up served as a case in the project, EFFECT4buildings. Traditionally a follow-up only consists of a one-year inspection. Instead several follow-up Performance Operation Tests were carried out, in between the handover and the one-year inspection, with interesting results.

Energy consumption and the quality of indoor climate largely depends on the season of the year, so the continuous testing was also done to check that the installations work, not only right after the handover but also over time and in different kinds of weather. By following up and checking the performance of the systems, both quantitatively and qualitatively, the municipality can achieve and maintain the energy savings and the improvements of the indoor climate.

# ENÅBACKEN GETS A BETTER INDOOR CLIMATE WHILE SAVING ENERGY

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

Rättvik public real estate company, RFAB manages all buildings for Rättvik municipality. Enåbacken elderly home was built in the early 1990s with a ventilation system which was then modern, but which now needs to be replaced.

"One reason for the investment is that we also want to install comfort cooling," says CEO Björn "Ebbe" Evbjer. "It is not an acceptable working environment for the staff with some days over thirty degrees indoors and the elderly should not have to experience such a summer again."

Another problem is the noise from the ventilation, especially in some rooms. To get a fresh air, the ventilation is forced, which causes a disturbing noise.

The solution chosen is to replace the entire ventilation unit with a new one that has fans with variable frequency drive (VFD) and with more efficient heat exchangers, while installing also comfort cooling.



Robert Lassar at Rättviks Fastighets AB shows the ventilation that will now be replaced by better and more energy efficient

## Tests helped identify defects sooner

The tests lead to identification of defects that otherwise might not have been discovered, and at least not so soon after the implementation of the systems. The energy savings were initially not as big as expected and the employees experienced big differences in the room temperature. Both problems stemmed from technical issues and wrong settings on the new energy control system. Primarily, the wrong settings caused the ventilation to work as the primary heat source and to operate outside of opening hours.

The tests also documented the achieved improvements caused by the renovation project. The renovation resulted in a lower concentration of carbon dioxide in both classrooms and staff rooms with a better indoor climate as a result. Students and teachers also experienced better air quality and acoustics. The latter was a bit surprising but might be a result of the ventilation being regulated so it produces less noise.

The case has given Egedal Municipality ideas on how to follow-up on performance and emphasized the importance of including this when designing the project and the contract. This knowledge will be brought into the upcoming renovation projects.

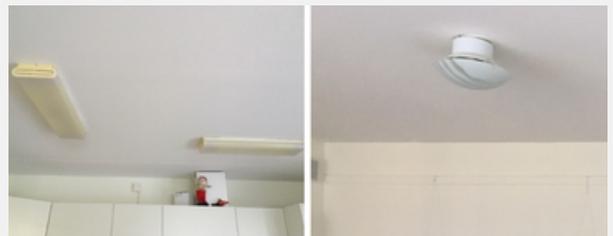
*"We made a similar solution in another property and saved 50% of the energy use and I think we will save a lot also here,"* says real estate technician Robert Lassar.

The ventilation is placed on the wind and the new units will be lifted in through a hole in the roof that we will make. In this way, less disturbance is created for the people living and working in the building.

The project EFFECT4buildings has mapped the indoor environment before the measures and will follow up with new measurements afterwards in order to be able to compare. What is mainly measured is carbon dioxide, draft, temperature, humidity and noise.

Energy consumption is followed up. "It gives us knowledge that can be used in the continued work to help building managers with advice and knowledge," says Hans Ahlin, project assistant manager.

"We do not yet know if we will bring down the noise enough from the ventilation. The channels can be too narrow, but we'll see that in the next step when this measure is made," says Robert Lasso.



To the left: lighting in the apartment's kitchen and to the right: lighting in the living room

The visit also stated that there is a need to review the lighting that probably does not correspond to the lighting needs of an older person. Also, here EFFECT4buildings can give advice and help improve planning.

# KEMP AND LAURITZEN WOULD LIKE TO DEVELOP A MORE FLEXIBLE MODEL FOR RENOVATION PROJECTS

Author: Sofie Hougaard Nielsen, Gate 21, Denmark



Photo: Kemp and Lauritzen

The contractor Kemp and Lauritzen is working to develop a more flexible model for large-scale renovation projects. In addition to energy savings, the model will also take into account parameters such as user satisfaction and indoor climate.

## Is the ESCO model too standardized?

When planning major renovation projects, the ESCO model is a well-known tool. ESCO is a model for financing energy renovation projects via energy savings, and has been applied to several major renovation projects in Denmark. In the initial stages of an ESCO project, specific goals for the energy renovation are set, which the contractor can keep up with during a given warranty period.

In the ESCO model, the contractor first prepares a thorough analysis of the building's current energy consumption. The potential energy savings form the framework of a negotiation with the developer, after which one or more performance guarantees are given. If the guarantees are not fulfilled, the contractor must either improve their renovation project or pay the difference between the predicted and real energy consumption. However, if more energy is saved than was expected, the parties will typically share the profits.

According to Esben Jacobsen from Kemp & Lauritzen, ESCO focuses exclusively on energy consumption, a slightly too standardized solution. He believes that customers are increasingly demanding renovation solutions that are more flexible and based on customer needs. The solution is called Multi-Service-Contracting (MSC), with the goal of changing the perspective from achieving energy savings to addressing the client's overall property challenges.

*"Where ESCO was a large unified package offered to all customers in the same way, MSC is a good way to meet an increasing need for individual renovation solutions, with the customer at the center,"* says Esben Jacobsen, Head of the ESCO department in Kemp & Lauritzen.

## It's about more than just energy savings

The thinking behind MSC is reminiscent of ESCO, but in addition to energy savings, a number of other parameters are considered, such as indoor climate, operation and maintenance. This means that the developer can get a package solution that is able to solve several challenges in a property. Although it often takes extra resources to include more parameters in the renovation planning phase, that money can often be earned several times over during the life of the building or project.

During the initial phase of a renovation project, Kemp and Lauritzen begin with a thorough analysis of energy consumption, but also of both the experienced and measurable indoor climate parameters. The actual indoor climate of the building is recorded, measuring moisture, sound levels, CO<sub>2</sub> levels and temperature, and these are compared with users' experiences of the same parameters. The data from this analysis forms the basis for a conversation between the developer and the contractor, where they jointly agree on which parameters the customer wants to include in the project.

According to Esben Jacobsen, beginning with the individual customer's needs and wishes is a way of securing the future of his business, a trend that is seen across industries.

*"When we move in this direction, it's because there is a need for it in the market. Our belief is that this is where the market is headed,"* says Esben Jacobsen, Head of the ESCO department in Kemp & Lauritzen.

## Measuring user satisfaction

When measuring user satisfaction, Kemp and Lauritzen have partnered with the company CLIMAID, which allows users to judge the building's indoor climate via an app. In this app, users can record how well the temperature or humidity of a room suits them personally.

Although users' ratings of the indoor climate serve as a starting point for negotiations with the developer prior to the renovation, the measurements do not stop there.

Users continue to re-evaluate the indoor climate after the renovations, and often throughout the warranty period. The user satisfaction survey is a useful tool for the contractor, because it can help identify which problems the developer has and how they can be solved. The builder also benefits from ongoing user ratings as they provide an opportunity to follow up on whether the indoor climate improvements have had the desired effect for the users.



Photo: CLIMAID

## Hard to offer indoor climate guarantees

Although it is important to include users' perspectives in the process, Kemp and Lauritzen are still reluctant to provide guarantees on indoor climate or the perceived ease of use. This kind of project has not yet been trialed in Denmark, although several contractors are working to make their offerings more flexible and user-oriented.

*“We are still working on developing how we technically implement these parameters,”* says Esben Jacobsen, Head of the ESCO department in Kemp & Lauritzen

The fact that binding guarantees can be made for energy savings provides confidence for the developer, who gets fairly accurate forecasts for both energy savings and the time it takes to see financial returns. In theory, the MSC model should also be able to offer guarantees on other parameters, too, but providing performance guarantees on, for example, indoor climate, is in many ways more complicated than providing energy savings guarantees.

Kemp and Lauritzen emphasize that in order to work with the MSC model, it is important that a partnership develops between the builder and contractor based on trust, where both parties understand that the MSC model is still under development.

*“We know from ESCO that it can offer really good results, but of course the model needs to be built right,”* says Esben Jacobsen, Head of the ESCO department in Kemp & Lauritzen.

## On the right path

Although the MSC model is not yet the standard for major renovation projects, the increased focus on flexible solutions and the involvement of user surveys is a big step on the path to a more holistic model. Although there are no examples of guarantees beyond energy savings, there is a move towards offering customers holistic renovation projects that look at the interaction between the building's technical installations.

*“When you're doing renovations today, you only look at the part you are renovating. You don't think about the connection between a window, a ventilation system and a heating system,”* says Esben Jacobsen, Head of the ESCO department in Kemp & Lauritzen.

Like the ESCO model, which made its debut 12 years ago, according to Esben Jacobsen, the MSC model requires that all parties are informed about any new opportunities and willing to cooperate in new ways. However, due to procurement rules, the contractor must not influence supply itself. Therefore, the tender advisors play an important role when implementing the MSC model.

Whoever it is that takes the next step, it is crucial that there is an incentive to complete holistic renovation projects. The EU project EFFECT4Buildings works purposefully to create greater incentives to implement holistic models for renovation projects.

## About Kemp and Lauritzen

Kemp & Lauritzen is a Danish installation company with almost 2,000 employees across the country. They provide solutions in the fields of electricity, plumbing, ventilation and refrigeration and offer everything from everyday service to large contracts and unique specialties.

Kemp & Lauritzen has been providing complete technical solutions for both private traders and public customers for more than 135 years.



# GREEN LEASE CONTRACT

Reaching energy and climate goals requires involving building users, to let them understand what energy savings can be achieved thanks to changes in their behaviour. Green lease contracts (GLCs) offer a model providing a structural platform for cooperation between building owners and tenants. Contracts are always energy-related, but they are often supplemented with information about choice of materials, waste management, information and training activities, and paving the way for more sustainable buildings. GLCs stimulate dialogue and continuous improvement, reaching for financial incentives if such a need arises. Various forms of GLCs can be developed for different kinds of buildings.

A green lease contract can be applied for to all buildings in which energy efficiency can be increased. Signing a contract is fairly easy, but keeping it useful and alive is not. Key implementation challenges include a lack of time and motivation as well as poor communication.

To overcome them, a contract should set up clear goals and impose an open and continuous dialogue between both parties. Collaboration is key to get the most out of the agreement and it will lower the buildings climate impact if its achieved. Keeping the dialogue alive increases the likelihood that the agreement and lowered energy use in the building will last.

## VANSBROS FIRST GREEN LEASING CONTRACT

Author: Benny Magnusson, Sustainable Building Cluster in Dalarna, Sweden

In May, the municipality property manager, Olle Wiking and Camilla Andersson, the principal of the Smedsbergsskolan, signed the municipality's first green lease contract.

It is a major step towards more conscious environmental work for both the school and the municipality. The agreement means, that both parties will work to reduce energy and material use. It also states that both parties promise to choose environment friendly materials when refurbished or repaired the facility.

A green lease contract gives the property owners the opportunity to contribute to a better environment. The municipality going to do an energy audit of the school, that will help them to priorities which energy measures will be best suited to implement.

The school will focus on education on sustainability this will help teachers, students and parents to make greener choices and save energy. One project is to develop their recycling stations. In May 2020 the school organized an environmental day to celebrate their accomplishments.

Vansbro municipality is proud taking this step and looking forward to signing more contracts in the future.



*Photo: The principal of the smedsbergsskolan, Camilla Andersson, and the municipality's acting property manager, Olle Wiking, have just signed their first green lease agreement.*

**Target:** Municipality's, landlords, tenants, schools

**Planned outcome:** Lower energy use and sustainability.

# PROFITABLE, SIMPLE AND CONTAINS LIMITED LEGAL ISSUES

Author: Liv Randi Lindseth, Contracted by Inland County Council, Norway

Entra develops, rents out and manages properties of around 1.3 million square meters in 90 buildings in several of the largest cities in Norway. In order to establish good cooperation for energy and environmental smart solutions with tenants, they have offered Green Leasing Contracts for several years.

"Environment more frequently outweighs energy savings in these agreements," says Trond Simonsen, environmental manager at Entra ASA.

Entra started offering its tenants Green Leasing Contracts already in 2011. So far, they have signed more than 100 agreements, and we wonder what these agreements entail and who saves the most - Entra, the tenants or the environment?

The principle of Green Leasing is that the landlord - in this case Entra - maps energy and environmental measures in the building. Then a decision is made to invest in measures. In this connection, a calculation is set up that shows what energy savings the measures will entail and how long it will take before the savings have financed the investment. Entra covers the costs of energy analyses and invests in the implementation of measures.

The tenant enters into an agreement on repayment of the investment in the form of increased common costs or another form of repayment. The agreed sum must always be lower than the savings in energy costs. In other words, net profit for the tenant right from the start. Once the investment has been repaid, the tenant keeps the savings from the measure in full in the form of lower energy costs.

"In addition to lower energy costs, the advantage for tenants will be upgraded technical facilities and equipment, a more modern building and a better indoor climate," says Simonsen.

The question then is what motivates Entra to enter into this type of agreement.

"It is our overall strategic goal to be an environmental leader in the industry," says Simonsen. "We use this in or marketing both to existing and new tenants. In addition, I must highlight the upgrading of the building stock and technical facilities and the increase in value it gives us. An example is installed BMS systems (building management system) which have given our customer center a better overview of operations.

Hence they can provide tenants with better and faster service than before. Sometimes they can detect discrepancies before the customer discovers it and thus save them unnecessary costs. The simple truth is that we strengthen the relationship with our customers through such agreements," he states.

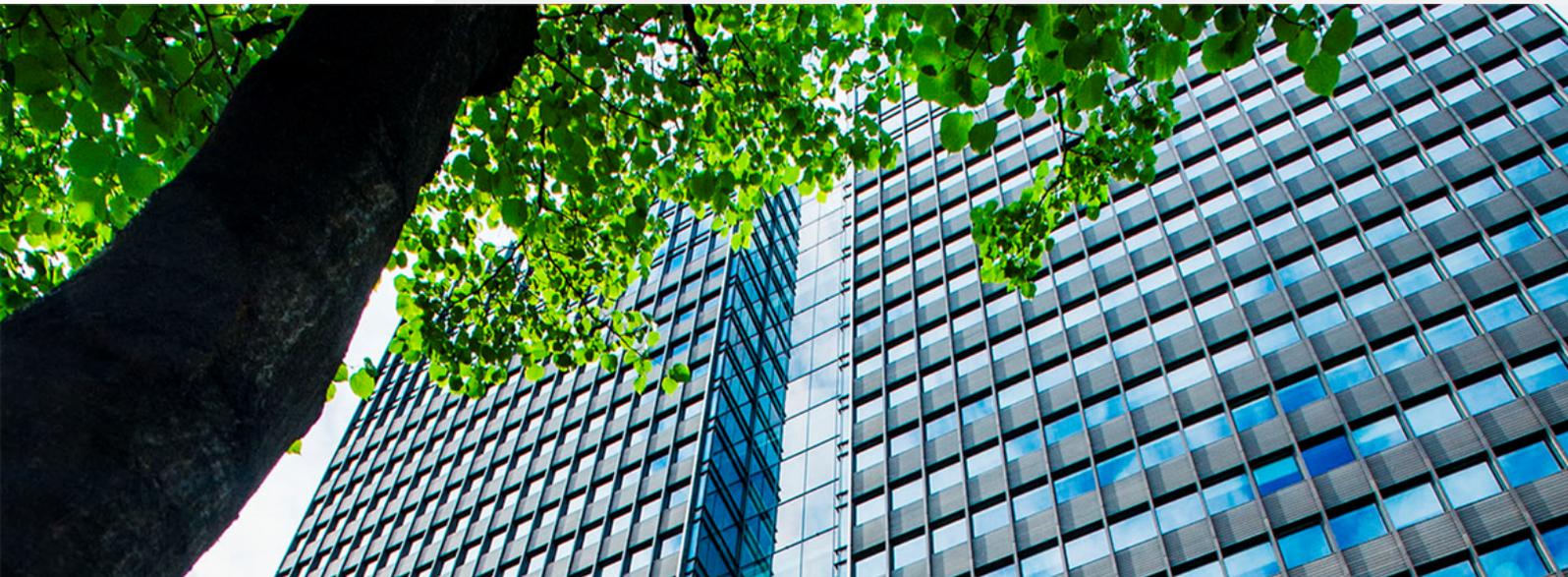
Entra has also gained other experiences along the way. Changes have been made in the design of the agreements from 2011 until today. In some cases, the savings were not as large as expected and discussions arose. The reason was most often changes in use such as the desire for increased indoor comfort, longer period of use, more users of the buildings or other conditions that make it difficult to make the savings visible for tenants. It is often unsatisfactory to be told that without measures, energy consumption would have increased even more. Entra has therefore been careful to specify how important the use of a building is, as well as go through other important clarifications of expectations together with the tenants in advance.

Finally, we ask what Simonsen thinks the tenants are most satisfied with in this type of agreement.



**Trond Simonsen, environmental manager at Entra ASA**

"I experience that the tenants are satisfied that we take the initiative," says Simonsen, "and that we are responsible for the actual implementation of measures. They get more environmentally friendly buildings with a better indoor climate as an extra pluss. The fact that they save costs is of course also something they appreciate, but it turns out that many tenants are happy to enter a "ready made" agreement when it comes to environmental measures. Several are already involved in environmental certification and other climatel projects and we see more and more often that these aspects outweigh the savings themselves. This may indicate that our tenants are better updated on the importance of environmental and climate issues now than they were when we started up."



# IN VIDZEME, 21 SCHOOLS TESTED THE GREEN LEASE CONTRACT

Author: Baiba Šelkovska, Rūta Ročāne, Vidzeme Planning Region, Latvia

In 2019, a total of 21 educational institutions from 8 municipalities of Vidzeme Planning Region (VPR) tested the green lease agreement in their schools, participating in the school competition “**Efficient energy consumption in educational institutions**”. Schools committed to reducing their school's energy consumption by changing their habits and introducing regular energy-saving measures.

The aim of the program was to promote rational energy consumption in the municipalities of VPR by motivating educational institutions to cooperate with their municipalities and to involve students in reducing wasteful energy costs. Educational institutions mainly competed with themselves to achieve energy savings, but healthy competition was also created by having a school top. VPR made an agreement with local governments and educational institutions that most of the achieved cost savings will be used for school needs.

At the beginning of the competition, each participating school and local government submitted energy consumption data for 2017 and 2018 to the VPR, which allowed to determine the baseline for future calculations. Because of the changing weather conditions, VPR also collected data on energy consumption each year, and on climatic conditions - outdoor air temperature and number of heating days.

"For example, heat consumption has been compared to what it would have been if the climate had been identical in all years, in other words, the data have been adjusted to the same climatic conditions," adds Jānis Ikaunieks, Energy Efficiency Expert of VPR.

In order to motivate students to become knowledgeable and responsible energy users, as well as to support teachers and other school staff, a team of experts from VPR developed a study material on 10 topics:

- Energy consumption in buildings
- Heating
- Electricity
- Types of energy
- Climate change
- Lighting
- Ventilation
- Water
- Energy Planning
- Waste

Each member school received monthly study materials for students and support materials for teachers during the program.

Each member school received monthly study materials for students and support materials for teachers during the program.

"Teaching materials are mainly intended for students in the primary school stage, but they can also be adapted for students of other ages. The place and time of using the materials in the teaching process is chosen by the teacher. Most of the topics fit into classroom lessons, natural sciences, physics, social sciences, but some topics can be used in biology, geography, home economics, technology and other subjects, as well as other school activities," explains Ingūna Irbīte, VPR expert in preparing the study material.



Photo: School program's award ceremony in Kocēni municipality, Latvia

## Reduction of energy consumption in schools during the program

In the group which collected data on both consumed electricity and heat, the 1st place was won by Kocēni Primary School of Kocēni district, reducing energy consumption (electricity and heat) by **18.52 %** in 2019. In the group where schools counted only electricity consumption, Bilška Primary School of Smiltene region took the honorable 1st place with a reduced energy consumption of **14.91 %**.



Study materials in Latvian are available on Vidzeme Planning Region webpage: [www.vidzeme.lv](http://www.vidzeme.lv)



# PROSUMERISM

Prosumerism targets a group of energy consumers that not only consume energy but also produce energy and can give back the surplus to the grid or other energy consumers. There are many reasons for becoming a prosumer, both economic (reduction of electricity bills and gaining profit) and environmental.

Before deciding whether to become a prosumer, one needs to analyse the current situation in terms of legislation, laws, and support mechanisms in one's country.

Existing tools, including the EFFECT4buildings tool for prosumers, can help calculate the project's profitability. Deciding to become a prosumer, one should follow existing guidelines and instructions to implement the chosen PV system.

## SOLAR ENERGY CALCULATOR HELPS TO PLAN OPTIMAL SIZE AND PROFITABILITY

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

For calculation of solar PV plants, several national tools for calculating the production potential is available, but to plan for an optimal size of a PV plant more than that is needed. A tool is needed to compare the production with the energy use of the building, to choose the optimal size. Also a better tool for financial calculation is needed. Existing tools for that has most often very rough calculations without the possibility of changing different parameters.

**EFFECT4buildings** has developed an excel-tool for solar energy calculations that can be downloaded from [www.effect4buildings.se](http://www.effect4buildings.se)

The result is an excel-tool to calculate optimal size of solar PV plant and the economical profitability in 3 steps:

1

### Find out the optimal size of the PV plant

If the roof can produce more electricity than needed, step one helps to calculate the optimal size. In this step a few data input is needed. Individual data for energy use can be inserted or general data can be used.

2

### Find out how much electricity your roof can produce

A list of national web calculation tools to calculate the production capacity of a roof.

3

### Financial calculation

In the last step the profitability can be calculated.

# HOW TO MAP POTENTIAL SOLAR PANEL GROUND AREAS?

Author: Matti Pylkkö, Environmental office of Lappeenranta region, Finland

Renewable energy sources have a key role when decreasing CO<sub>2</sub>-emissions and preventing climate change. Solar energy is one of the most potential option to produce energy in a clean way. PV-panels can be for example installed on the roof areas of the existing buildings or new buildings under construction. But when planning to implement a big scale PV-plants, the most convenient choice is to locate panels on the appropriate ground area. Process how to identify the most suitable ground areas for solar panel plant shall be conducted in a structural way step-by-step.

Before starting to map potential ground areas, some preliminary work is needed to be done, discussed and finally decided. There exist several optional business models, which are possible when implementing the PV-plant. In practice external funding is always needed, when PV-plant of MW-size is under planning process.

Funding can be available both from commercial partners and public sources as form of subsidies. The business model may be based for example on the idea, that the ground area for PV-plant is located on the very nearby of potential (for example industrial) end user.

Always the main issue under discussion is, that implementing of PV-plant shall be profitable and attractive in the funding point of view.

Furthermore an appropriate template for evaluating identified ground areas shall be available. The template shall be comprehensive and include relevant versatile categories in aiming to create the final rank list of identified areas. The categories could be for example following:

- area registration and identification details \*)
- name of area \*)
- exact address of area \*)
- total square-m<sup>2</sup> of area \*)
- estimation square-m<sup>2</sup> of area, which can be utilized \*)
- owner of area (priorized city owned & other public owned areas) \*)
- evaluation of ground & soil quality
- city master plan exists (yes / no)
- current usage
- existing obstacles
- potential energy user located in the neighborhood
- master power line (min 110 kV) located in the neighborhood
- threat of vandalism
- nature issues, flora & fauna, endangered species
- opinion of neighbors and citizens
- public visibility and imago issues
- historical values
- logistical issues (roads etc...) easiness for maintenance work
- capability to survive of extreme weather conditions
- sun light shadowing conditions

\*) =basic information of identified area

The template itself can be quite simple, for example excel based sheet as presented in the chart below. Criteria for evaluation are in separate columns and written judgement for each column shall be filled, when reviewing ground areas. It is preferable to use written evaluation instead of pure numeric, especially when amount of evaluated areas is rather large.

Potential solar panel ground areas in the xxx municipality																													
Basic area information										Criteria for evaluation																			
Area identification	Name of area	Exact address of area	Total square-m <sup>2</sup> of area	Estimation square-m <sup>2</sup> of area, which can be utilized	Owner of area	Evaluation of ground & soil quality	City master plan exists (yes / no)	Current usage	Existing obstacles	Potential energy user located in the neighborhood	Master power line (min 110 kV) located in the neighborhood	Threat of vandalism	Nature issues, flora & fauna, endangered species	Opinion of neighbors and citizens	Public visibility and imago issues	Historical values	Logistical issues (roads etc...) easiness for maintenance work	Capability to survive of extreme weather conditions	Sun light shadowing conditions	Estimated capacity <1 MW	Estimated capacity 1-5 MW	Estimated capacity >5 MW	Short justifying, why this area ranked on the top list						

The identifying phase of ground areas shall be started with desktop research. This means in practice deep study of all potential areas inside the defined land area (for example inside a specified municipality borders) by utilizing existing map material. By conducting this desktop work the main purpose is to find enough big number of interesting areas for more detailed investigation.

After preliminary study has been finalized, the next step is to take a practical walk and review of all identified areas. Remember to plan carefully the logistical issues of the review to avoid unnecessary travelling, especially when there is long distance between areas. The evaluation template shall be used when estimating all areas by filling criteria columns. It is also extremely essential to document all visits at areas by taking sufficient number of photos for further discussions.

When all areas have been evaluated and columns of template have been filled, the next phase is to summarize the results. This can be implemented for example by publishing "top ranking" of evaluated areas. The summary can be also divided in different categories based on the estimated MW-size of planned PV-plant, see sample template below.

Ranking summary					
Area identification	Identification details	Estimated capacity <1 MW	Estimated capacity 1-5 MW	Estimated capacity >5 MW	Short justifying, why this area ranked on the top list

All presented elements and information are needed to be provided as basic material, before starting to negotiate in cooperation with commercial partners to implement further steps of PV-plants.

# HOW ARE PROSUMERS SETTLED IN POLAND?

Author: Barbara Łuksik, Association of Communities and Cities of Malopolska Region, Poland

The prosumer is both a producer and a consumer of energy. In Poland, the rules of prosumers functioning are described and regulated in the Act on Renewable Energy Sources. According to the Act, a prosumer in Poland is the owner of a photovoltaic micro-solar system with a capacity of up to 50 kWp.

For today, prosumers are divided into enterprises and physical people.

Enterprises consume produced energy in real time, the excess can be sold to the network at the price of black energy - without any support.

Physical people are encompassed by a preferential method of settlement - the so-called rebate system, known in Europe as a net-metering system.

The rebate represents a method of cashless settlement of electric energy consumed by a prosumer and produced in micro-installations.

The settlement as part of the rebate is carried out after a one-year or shorter period depending on the provisions in the comprehensive contract with the seller of energy, wherein for installations with a capacity of up to 10 kW for 1 kWh sent to the network, the prosumer may receive 0,8 kWh.

In case of installations with a capacity of 10-40 kW, the settlement is carried out in a ratio of 1 to 0.7.

What does it mean? First of all, that in order to exploit the micro-power plant as efficiently as possible, it is necessary to consume as much energy as possible in real time. Then we use the produced energy in a ratio of 1: 1.

If we use our own energy, which the network shares with us we lose respectively 20-30% of the energy produced by us.

In dedicated for prosumers systems of a settlement is necessary to have signed a complex agreement for the provision of distribution services and sale of electricity.

While the formalities related to the implementation of photovoltaic micro-installation end with notification to an energy company.

At this time, a change to the provisions of the act on renewable energy sources is planned.

The changes are to include among other prosumers definition, more specifically is planned to extend it to small and medium enterprises. It will enable small and medium enterprises to settle in the rebate system.

# SOLAR ENERGY FAIR IN DALARNA - A GREAT SUCCESS!

Author: Hans Ahlin, County Board of Dalarna, Sweden

On March 4 EFFECT4buildings arranged a Solar Energy Fair in collaboration with University of Dalarna and Dalarna County in the municipality of Borlänge. We had 22 exhibitors and 650 visitors, well above what we expected. Many visitors came from companies in the region interested in solar energy solutions.

The fair was a meeting place for the new energy producer. Creating your own energy on your own roof is becoming very popular in Sweden for both private persons, companies and tenant-owner associations.

Visitors took part in lectures, offers and information on heat production, electricity generation, battery storage and electric car charging.



Photo: From left - Marit Ragnarsson, EFFECT4buildings project manager and David Börjesson, Coordinator



# LUDVIKA MUNICIPALITY IS INVESTING HEAVILY IN SOLAR ENERGY

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

The municipality of Ludvika has decided to invest 3 million Euro in solar energy. Several installations have already been made and they have learned a lot on the road, among other things, they have developed a model for tendering calls that will ensure that you avoid problems and get the right quality.

## Political decision behind a large investment in solar energy in the municipality of Ludvika

Ludvika municipality's environmentally committed politicians have decided to invest 3 million Euros in setting up solar panels. As a result, property managers have received a clear order that is at the forefront and which it is important to do something good about. There is a clear link to the large employer ABB and the companies around ABB with high competence in electric power technology. One goal is also to increase interest in solar energy among other actors.

The responsibility for implementing the investment is now at the public company Ludvikahem, which is taking over both the management and ownership of the municipality's properties. Ludvikahem already owns a portfolio of housing and premises.

## Experiences from the installations made



*Photo: Jan Hedberg, construction manager, Ludvikahem says that they have learned a lot from the solar energy projects that have been done and now developed a functioning procurement document.*

"We have learned a lot from the projects we have done," says construction manager Jan Hedberg. This is still a bit of a wild western market that is not sufficiently regulated. At the first installations, we can state that the contractor did not follow the regulations. It is mainly about electrical safety. The municipality also did not have sufficient own knowledge to request the right surveyor and understand what we missed. At a later check-up, we received 3 full pages of things that needed to be fixed, even though the inspector approved the facility. So, in the future, we know how important it is to hire an inspector with the right skills.

"We have also learned how important it is to bring the grid owner in the planning from the start," says Jan Hedberg. "They have their own rules for how the installations are to be made and after all, they are the ones who must approve the distribution of excess electricity. We have had a very good cooperation with our local grid company VB Energi. The Fire department demand clear signs that it is connected power installation. Standardized rules are beginning to emerge, but so far, local rules have to be followed in many respects, and responsible parties might not have enough knowledge and routines either."

There are also many contractors who sell and assemble solar energy without sufficient knowledge, which is not serious. You have to have contracts with them that they must follow. During the actual installation it is also important with staff that you can have a good dialogue with.

## Procurement document for tendering process

Over time, Ludvikahem has developed its procurement document, which can now be used advantageously by others as a starting point for the tendering process of solar power plants. The tender documents include a long list of which regulations the installer has to follow. Much is about ensuring that the plant meets the requirements for electrical safety. Requirements should also be set for the performance of the solar panels, inverters, switches and marking. After installation, the plant must be started and tested together with the client. The supplier must also provide a maintenance plan.

## Transfer electricity between buildings and real estates

Ludvikahem is already a company and has been registered as an electricity trading company. Rules that limit the possibility of using electricity in other properties than where the electricity is produced have been a constant concern and demanded to have a concession for electricity sales. Ludvikahem has now, together with the electricity grid company VB Energi, found a solution to this, at least when the properties are located next to each other. A DC power grid has been established that connects adjacent properties and technology from Ferroamp is used to power control etc.

## Continued installations

Now it is Ludvikahem who makes its own decisions about continued solar energy investments. They are not based primarily on economic profitability, but on political directives as it is a municipal-owned company.

Decisions have been made that it should be solar energy on all new buildings.

"We see solar energy as an important component in order to achieve the new EU directive on energy performance for new buildings," says Jan Hedberg.

Right now we are installing solar energy in one block with new housing, Tjädern. We are investing in traditional solar panels. We are also interested in testing roof-integrated solutions, but have not dared to jump on it yet.



*Photo: Solar panels on the sports hall's facade in Ludvika where 175 kW traditional solar panels have been installed.*

# PROSUMERISM AND EPC TOOLS HELP PROCURE AN EFFECTIVE SOLAR POWER PLANT SOLUTION IN GULBENE MUNICIPALITY

Authors: Rūta Ročāne and Jānis Ikaunieks, Vidzeme Planning Region, Latvia

The EFFECT4buildings prosumerism tool helps with calculations regarding PV system in the project planning stage. It helps determine the optimal size of the PV system, find out how much electricity can be produced from a selected area, make financial calculations, and helps find out how a storage system would improve PV system's efficiency. Vidzeme Planning Region tested the tool in Gulbene municipality in 2019 and helped with EPC (Energy Performance Contracting) principles when procuring the service provider.

Gulbene municipality was planning to install solar power plant on the roof of the local government administration building. This building had continuous electricity consumption to ensure uninterrupted functions of different electrical appliances which made it suitable for a solar power plant. Also, the roof of the building was well suited for solar panels, not having any shadow from the surrounding objects. Since the municipality already knew the area for PV system and the planned PV system's capacity, the Prosumerism tool was used for calculation of solar electricity production and for financial calculations.

One of the Prosumer tool results is given below, where total used electricity from PV are shown in green color but yellow color represent overproduction which in Gulbene case will be sold in the electricity grid.



Photo: Solar panels on Gulbene municipality roof. (Photo from Gulbene municipality)

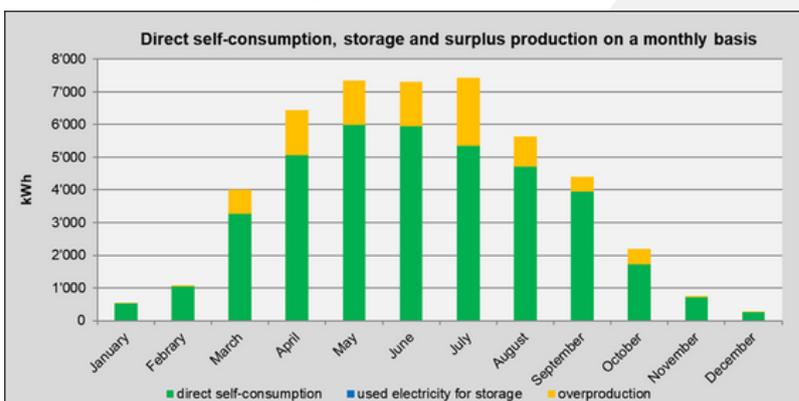
The profitability assessment in the financial calculations is based on:

- savings that come from the amount of electricity that no longer needs to be purchased
- income that comes from the amount of produced electricity that is sold to the grid
- investments that come from developing the PV system.

Internal rate of return and the pay-back-time is calculated from total investment costs and total savings plus income.

During the project development, data from the tool was taken in consideration. Based on the calculated amount of electricity that PV system can produce, procurement included energy efficiency guarantees and description of the measurement and verification methodology. Gulbene municipality's PV system procurements technical specification included that the system must produce at least 49,60 MWh electricity a year, system's capacity must be at least 54,60 kW and, when taking in consideration solar panels' 25-year capacity guarantee for 80% efficiency, PV system's efficiency in 5 years cannot go lower than 16,456%. During these 5 years once a year the produced electricity amount will be measured to see if it reaches the guaranteed amount at specific solar radiation. If the solar radiation changes, the guarantee changes according to the measured solar radiation data.

This approach helped to ensure that the municipality bought a system that will reach its energy efficiency goals. Gulbene municipality installed 158 solar panels and estimate that their investment will have a payback time of 6 years thanks to the 70% co-financing by the National Emission quota instrument.



The Prosumer tool can be used to answer two basic needs:

- 1 By using existing data of yearly electricity needs and energy load profile, entering planned PV system's capacity and the optimal production profile, the tool calculates energy production and consumption results.
- 2 By entering the energy amount the PV system can produce and use and other existing data about specific countries energy production/transportation/selling prices and data on the chosen area, the tool does financial calculations.

The evaluation tool can be used both ways - by knowing PV system's capacity and production profile you can calculate its electricity production and by knowing how much electricity you need to produce, you can calculate what capacity needs to be installed.

# IN LATVIA SOLAR ENERGY FOR ELECTRICITY GENERATION IS RARELY USED

Author: Baiba Šelkovska, Vidzeme Planning Region, Latvia

In the framework of the EU Sustainable Energy Week in the summer of 2019 in Cēsis Vidzeme Planning Region brought together local government specialists, energy managers, heat supply specialists, building managers and other interested parties to discuss the use of solar energy for electricity generation in Vidzeme and elsewhere in Latvia. The panel discussion showed that solar energy for electricity generation is rarely used.

The moderator of the panel discussion was Inese Dosē, Global Energy MBA, Business Intelligence Manager, expert with over 10 years of experience in energy sector.

The aim of the panel discussion "From Sun to Electricity" was to stimulate a discussion on the use of solar energy for electricity production, identify existing barriers and possible solutions for using solar potential. The event was attended by municipal experts, energy managers, heat specialists, building managers and other interested parties.

The the Ministry of Economics, distribution network owner JSC "Sadales tīkls" and Latvian Solar Energy Association were the keynote speakers but solar panel installers "AJ Power" and Gulbene municipality together with speakers participated in moderated discussion between all involved parties.

The Ministry of Economics presented existing situation and planned changes in solar energy legislation. Moreover, Ministry of Economics introduced with planned measures to promote the use of solar energy, for example improvement of net-system.

Currently, the Ministry of Economics is developing the National Energy and Climate Plan for 2021-2030, where the promotion of non-emission technologies in electricity production and promotion of self-generation and self-consumption of energy are among the goals.

"Sadales tīkls" JSC is the maintainer and developer of the electricity network in Latvia. It ensures power supply to over one million electricity users objects, with its services covering 99% of the country's territory. Representative of the company introduced the solar power plant connection process and the necessary documents step by step.



Photos: Seminar on the use of solar energy for electricity generation in Vidzeme in Cēsis, summer of 2019.

In turn, the Solar Energy Association in Latvia showed good practice examples here in Latvia, where solar panels for electricity generation are successfully operating. One such example is in Tiraine, where a company has solar panels installed on its own office and warehouse building.

Solar panel suppliers, energy companies in Latvia "AJ Power", as well as SIA "Enefit" emphasized that the sector has enormous potential for solar energy. Other participants of the discussion encouraged the creation of a unified power generation / consumption system so that electricity produced in solar panels, for example, in Liepaja, where solar radiation is higher, could be consumed, for example, in Aluksne. Households are also interested in installing solar panels, but there is a lack of knowledge on how to implement such projects, how to choose suppliers and how to determine the benefits of installation.

Gulbene Municipality, also participated in the panel discussion, sharing the experience of the municipality in the development of the technical specification and procurement of the installation of solar panels on the municipal building. The Gulbene Municipality is one of nine municipalities in Vidzeme that has appealed to the Vidzeme Planning Region's call for an assessment of the economic utility of solar panels for a municipal building within the EFFECT4buildings project.

Vidzeme TV news story about panel discussion "From the Sun to Electricity" is available at: <https://www.lsm.lv>





# FUNDING

The Energy Investment Funding tool deals with broadening the knowledge of the target group on existing energy-investment-related funding sources and mechanisms, other than public funding sources.

The tool helps also share the knowledge and experience among project partners on the existing funding mechanisms in their countries, which can help them promote and adapt similar solutions in their countries. It can also facilitate finding sources to finance energy efficiency investments, both public and private ones, in the project partner countries.

## HOW TO USE FUNDING IN THE MOST COST-EFFECTIVE WAY

Author: Barbara Wos, Association of Communities and Cities of Malopolska Region, Poland

### Conclusions resulting from financing in energy efficiency in relation to local governments and investors:

- Verification of grant applications is carried out by the COC - Competition Organizing Institution.
  - There are a number of substantive criteria that determine the award of points - the more points scored, the greater the chance of funding.
  - In order for the project to undergo substantive assessment, it must achieve a certain percentage level of points that can be obtained in total (often 30% of the maximum number of points). So it is necessary to analyze the material ranges and adjust the material scope to maximize the use of scoring.
  - The condition of co-financing is to ensure a reduction of CO<sub>2</sub> emissions by at least 30%. The key to the positive effects of both the assessment of applications as well as economic and functional aspects is therefore a properly selected material scope, carefully refined investment implementation details: specialists, audits, equipment, services).
  - A number of formal conditions must be met, including:
    - Submission of the application on time (with the proviso that the application submitted after the deadline indicated in the competition notice is not considered)
    - Preparation of the application on the applicable form
    - Completeness of application documentation: application and attachments
- 
- The scope of the undertaking of comprehensive energy modernization of the building must result from an energy audit and lead to a reduction of final energy consumption by at least 25% by meeting the technical conditions for building partitions.
  - The design should comply with the so-called a low-carbon economy plan and an Integrated Territorial Investment strategy.
  - The maximum level of EU funding in eligible expenditure at project level is 85%, subject to the methodology for calculating the maximum amount of funding - here you can see how much investment in energy efficiency is supported and how much the EU focuses on such modern technologies.
  - Often projects implemented in public buildings are not eligible for support, in which over 15% of the building's total area is used for business or housing.
  - Projects are positively assessed only if they meet all the required formal criteria - care for deadlines and appropriate documentation is very important.

# FUNDING SITUATION IN DENMARK

Author: Louise Ellegaard Fich, Gate 21, Denmark

## Funding by KommuneKredit in Denmark

- KommuneKredit is an association with the purpose to provide funding for municipalities and regions in Denmark
- The purpose and possibilities for Kommunkredit is bind by law
- KommuneKredit offers loans with low interest rates for municipalities and regions
- KommuneKredit can only finance loans for municipal purpose not on an open and competitive market
- The terms of the loans are equal for all and do not differ depending on purpose
- The loans are funded by issuing bonds on the Danish and international bond market
- Green investments can get financed through green bonds within KommuneKredits Green Bond Framework.

## Funding obstacles in Denmark

- In Denmark there is a construction limit, which sets an upper amount per year, for the municipalities' investments in construction work
- The total amount for the construction limit is decided each year by the state and intends to prevent the public investments from overheating
- The public institution Association of Municipalities (KL), decides the construction limit for each municipality, so they altogether do not exceed the total construction limit
- Depositing rules in Denmark supplement the construction limit by ensuring that a municipality set aside funds equally to the amount of a private suppliers running costs when it replaces a municipal construction cost
- The depositing rules entails that an EPC project cannot be used as an expense neutral funding model, even though the municipality does not pay off the EPC supplier up-front they must deposit the running costs
- It is possible to get an exemption from the depositing rules but that will be assessed based on the individual project
- The construction limit and depositing rules means that the municipalities can experience prioritisations between constructing 10 new buildings or completing energy renovation of existing buildings even though loans/funding for projects are available.





# CONVINCING DECISION MAKERS

Convincing decision makers is in practice a summary of utilizing all other tools in the toolbox. The main message is that convincing decision makers needs really strong arguments and facts. Focusing on various issues, like energy saving potential, good and bad practices, local and national policies, the project addressed dilemmas of the three target groups: authorities, investors and users. The tool helps assess factors behind success and failure in convincing decision makers to fund energy investments, and to provide good practices.

## CLEAR OBJECTIVES ARE KEY TO BETTER RENOVATION PROJECTS

Author: Louise Ellegaard Fich, Gate 21, Denmark

Do you experience unclear or conflicting objectives from decision makers? This can complicate renovation projects and counteract a successful holistic renovation.

It is not enough for decision makers to provide an overall purpose; they must define clear objectives and break down objectives into sub-objectives. For example an overall purpose 'to save cost for energy on your budget' can be achieved in many different ways: produce sustainable energy, convert to a cheaper fuel, increase energy efficiency, reduce square meters of building stock, be flexible in your use or save money by buying when energy is cheap and so on.

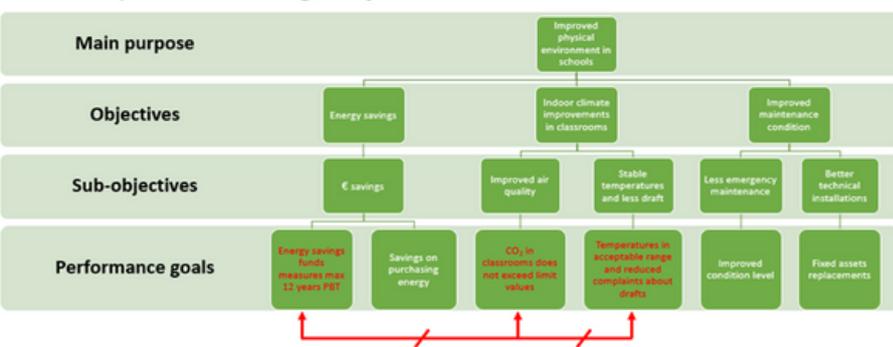
In Multi Service Contracting (MSC), a holistic approach to renovation projects, a key element is to get decision makers to decide and prioritise clear objectives and sub-objectives. Since MSC includes several parameters such as energy, indoor climate, and maintenance into one project, it is important to ensure that no conflict exists among objectives. For example, reaching a certain payback time with energy savings and obtaining a better indoor climate can create a conflict, if the latter objective can be achieved only by increasing energy use.

### An objective hierarchy is a valuable tool for building managers

Defining clear objectives and sub-objectives and prioritise among them will help building managers. Building managers can illustrate conflicting or unclear objectives to decision makers in an objective hierarchy. In an objective hierarchy the main purpose must be put at the top, and then all objectives should be included and broken down into sub-objectives. Whenever conflicting or unclear objectives occur, they must be highlighted, and decision makers must prioritise and redefine. If carrying out separate projects for each parameter, energy, indoor climate, maintenance etc., building managers would also benefit from this approach to ensure that the separate projects carried out do not conflict and sub-optimize. Further, having clear objectives and prioritisation from the start make it easier for building managers to follow up on whether objectives have been reached e.g. by defining performance goals for each sub-objective. Of course, building managers should revisit purpose and objectives throughout a renovation project and get the approval of decision makers to adjust if necessary.

If you want to know more about this approach find the MSC toolbox on: [effect4buildings.se](http://effect4buildings.se)

### Identify conflicting objectives



Example of conflicting objectives in an objective hierarchy: if more energy must be used to improve indoor climate, one must prioritise between objectives and redefine them.

# SUCCESS FACTORS, FAILURES AND GOOD EXAMPLES ON HOW DECISION MAKERS HAVE BEEN CONVINCED ON ENERGY INVESTMENTS

Author: Barbara Wos, Association of Communities and Cities of Malopolska Region, Poland

Energy efficiency is based on more effective production, management and further use energy resources. Increasing efficiency as part of investments brings many benefits in the near future and in the long term too. A very important aspect is convincing decision-makers to implement energy-efficient projects and the correct implementation of energy-related activities.

Frequent mistakes made during planning investments, block the possibility of increasing their profitability.

Investors are often afraid of increasing costs after implementing effective solutions.

They do not pay attention to the numerous benefits that such projects bring with them. Lack of knowledge about applicable regulations, including the possibility of using various forms of financial support, significantly limits the scope of investment capabilities. In addition, the problem is the improper use of available support. An important aspect is also the fear of public opinion about the implementation of a more expensive project. Another danger which appears during the implementation of the investment is the lack of qualified personnel and lack of awareness of the economical use of equipment.

Investments in which the possibilities to increase their efficiency have not been taken into account have negative effects, such as:

- Higher consumption of electricity and heat
- Poor quality of energy supply
- Excessive emissions
- Interruptions in fuel supplies
- Danger to the building if the external power supply fails for a long time

In order to prepare the best adapted project to effective work, it is worth monitoring all used elements. Education and information activities are also very important. As a result, people who using the facilities will carry out energy saving measures. In addition, increased awareness among people will reduce negative attitudes towards energy-efficient projects. It is worth getting acquainted with the investment support offer in a chosen area. Pursuant to Directive 2010/31/EU, Member States combine their financial resources to improve efficiency while the certain criteria will be achieved.

The Pałecznicza commune is an example of the proper use of the possibilities of implementing energy-efficient projects. The scope of the investment included:

- installing ground heat pumps using the financial resources of Małopolska RPO 2007-2013
- installing a solar farm
- installing solar installations on roofs and nearly seven communal facilities
- making thermomodernization of the building of the Commune Office building in 2018-2019



- replacement of old coal boilers with the use of financial support
- information campaign for residents encouraging the use of more beneficial solutions and technologies.

GPP Business Park in Katowice is a modern complex of energy-efficient office buildings, in which used solutions such as:

- Trigeneration system, which is a process of generating electricity from natural gas, during which heat is released for reuse
- BMS building management system adapting the work of individual elements to the building demand
- Temperature, CO2 and humidity sensor system help ensure proper conditions in the facility
- High thermal insulation of windows and facades
- Lighting systems with light intensity sensors and automatic controlled blinds adjusting the right amount of solar radiation access
- Fast and energy-efficient lifts with electricity recovery
- Rainwater recovery system
- Electric vehicle charging stations.

# SUGGESTIONS FOR IMPROVEMENT OF ENERGY EFFICIENCY AT THE AIRPORT AREA

Author: Matti Pylkkö, Environmental office of Lappeenranta region, Finland

An interesting option to increase energy efficiency measures is to create a comprehensive environment program for the organization. For this purpose can be utilized standards ISO14001 and ISO26000, which together provide easy understandable step-by-step advises how to establish a workable environment program and identify signified environmental aspects. Based on these elements can be achieved a list of clearly defined environment projects for further implementation. The number of projects shall be adapted according to capability and availability of resources in the organization. Even a program, which includes only one project is already a program at the standard requirements point of view. Being honest and realistic to yourself are the key words, which shall be taken into account when creating an environment program, which really can be implemented in the organization. The basic principle of environment program is to achieve continuous improvement and increase the level of environment protection.

The process of creating environment program proceeds always in the same way regardless the operative area of organization, so it can be easily to utilized at all kind of organizations.

Main phases of process are listed below including following topics:

- 1) create a visual process chart of continuous improvement and define the process owner
- 2) define environmental aspects concerning operations of organization
- 3) identify & separate significant environment aspects
- 4) define all needed categories to assess environmental impacts (observe, impact could be positive or negative)
- 5) create a preliminary environment program including suggestions for environment projects, which shall be implement according to specified & agreed timetable. Program shall be in line with strategy and policy of organization, especially regarding climate and environmental targets.

6) present the environment program to the top management to get acceptance and commitment. Convince them to make a decision to start to implement practical activities according to program

7) organize internal audits to control that all operations shall proceed as planned (this is not compulsory and will be conducted later, if needed)

8) organize the continuous follow-up of program (by management) and continuous updating/evaluation (for example annual) of aspects (this will be conducted later)

The whole environment process can be described in one picture (below). Yellow ones are identified to be signified and they will form the basis of environment program. Depending on resources availability aspects classified on non-signified category can be picked to complete the final version of environment program. Annual re-assessment of aspects and review of the whole program shall also be conducted and presented to top management of organization to ensure the achievements.

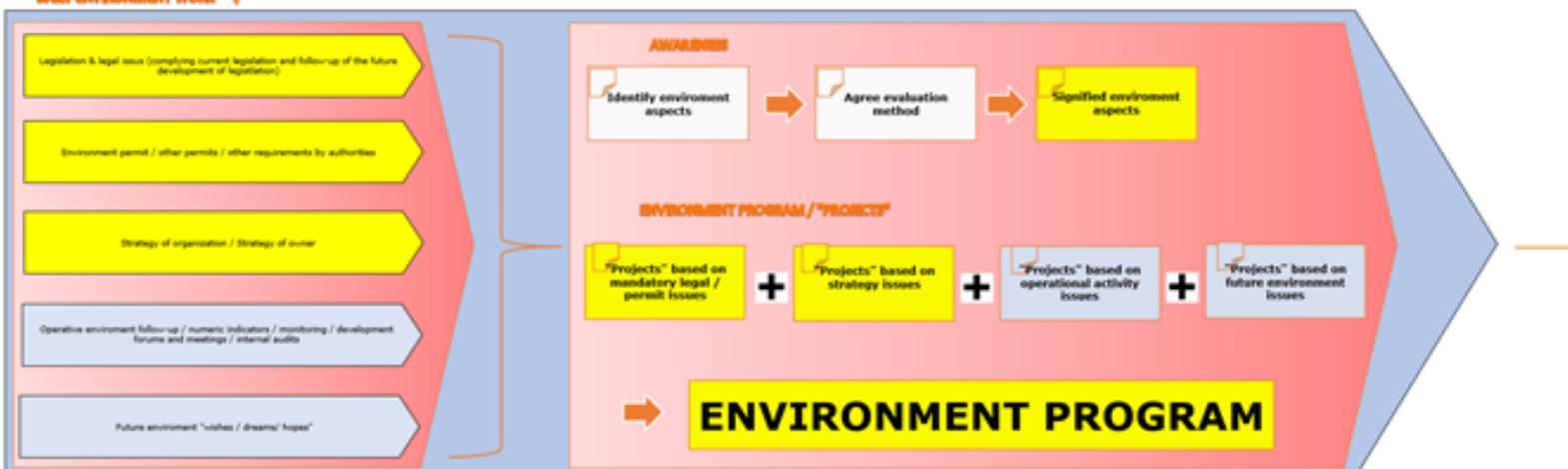
Ready and finalized projects shall be saved as historical data and new projects shall be raised up as part of updated version of program.

When identifying enviromental aspects, some of those are automatically signified. For example legislation & legal issues and all other requirements set by authorities, enviromental permits and other permits (if those exist) are also absolutely signified. Furthermore targets included in the strategy of organization and/or set by owner are classified as signified. Also normal daily operative issues may provide material for enviroment process. Furthermore, depending on organization operative area, risk assessment and emergency prepadness may be an essential part of identification results. And if there exists a "barrel of wishes" including future dreams, these aspects can be listed. Anyway, the evaluation method of aspects shall be kept as simply as possible.

## ENVIRONMENT PROCESS => CONTINUOUS IMPROVEMENT => INCREASING LEVEL OF ENVIRONMENT PROTECTION

OPERATIVE GUIDANCE OF DAILY ENVIRONMENT WORK

← Continuous evaluation process (for ex. updated once per year) ←



Process owner: N.N.

Strongly suggestion is to classify aspects only in two categories (signified or not signified) based on the best internal knowledge of the organization. For example different colours can be used to separate them.

Environmental aspects have various environmental impacts, which can be negative or positive. These impacts are easiest to describe and evaluate by creating simply columns in the appropriate template. All the possible and potential impacts depend on the practical operations of organization, but the most likely impacts are directly available and listed in the standard ISO14001 (see topics 6.1 and A.6.1) and ISO26000 (see topic 6.5). The list of impacts shall be completed based on special impacts due to own operations of organization. So, in practise more relevant special impact columns may exist and at the same time useless categories given in standards can be taken away as unnecessary ones. Most important is that all essential details are available and created templates are easy to use.

Below a simple template for identifying environment aspects, with slightly edited impact columns comparing to model of impacts presented in standards. The most of signified aspects are highlighted with yellow color.

ENVIRONMENT ASPECTS										
ENVIRONMENT IMPACT	emission to air / water / land	Raw materials / other material resources / energy / using natural resource sustainability	emitted heat / radiation / vibration noise / light etc...	Waste and by products (production, reuse, refurbishing, recycling, disposal)	Safety issues, which include or may include environment aspects	Mandatory environment reporting issues	Creating positive environment image (which can be utilized as communication and dissemination activities & purposes via different social media channels)	Observe, more columns to evaluate environment impacts can be added depending on the organization operative area. Furthermore, some of existing columns may be unnecessary and they shall be taken away.		
<b>ENVIRONMENT ASPECT / PROCESS PART</b>										
<b>Legislation &amp; legal issues / environmental permits / requirements by authorities</b>										
"Compliance & mandatory issues"	Legal issue_1									
	Legal issue_2									
	Etc...									
<b>Strategy / "owner's will" (Observe! Feasibility study &amp; time schedule based on that...)</b>										
"Operative issues"	Strategic issue_1									
	Strategic issue_2									
	Etc...									
<b>DAILY OPERATIVE "USUAL / NORMAL / COMMON" ACTIVITIES / PROCESS PARTS</b>										
"Operative issues"	Activity_1									
	Activity_2									
	Etc...									
<b>EMERGENCY PREPAREDNESS AND RESPONSE (RISKS ASSESSMENT)</b>										
"Emergency issues"	Emergency_1									
	Emergency_2									
	Etc...									
<b>FUTURE ENVIRONMENT "WISHES / DREAMS / HOPES" (Implemented somewhere in the future on year 20xx)</b>										
"Future issues"	Future issue_1									
	Future issue_2									
	Etc...									

In practice for each project, which have been picked as part of environment program and accepted to be as environment project, shall be defined following:

- 1) description, planned activities
- 2) clear target/goal (preferring numeric/quantitative)
- 3) resources (including profitability calculations/evaluation)
- 4) how and where shall be uploaded all relevant information regarding the project
- 5) primary responsible person (=project manager in the case of big projects)
- 6) time schedule
- 7) follow-up & reporting method

Observe, some projects included in the program may not be implemented at once. The time schedule may be allocated somewhere in the future, so again as reminder to be realistic and honest for yourself.

The template for environment program can be foreexample following:

ENVIRONMENT PROGRAM / PROJECTS							
PROJECT DETAILS	Planned activities (and achieved environmental impact)	Target / goal (numeric)	Resources (source etc...), and profitability (calculations of project [pay back time etc...])	Documented information	Primary responsible person	Time schedule (starting time & ending time)	Follow up method
<b>PROJECT DESCRIPTION</b>							
Name of Project_1							
Description of Project_1 main activities							
Name of Project_2							
Description of Project_2 main activities							
Name of Project_XX							
Description of Project_XX main activities							
Name of Project_YY							
Description of Project_YY main activities							

## Practical implementation at Lappeenranta airport

All the presented material and templates have been tested at Lappeenranta airport organization to establish a comprehensive environment program including detailed identified projects, especially for improvement of energy efficiency at airport premises and other operations.

As the result of all identified environment aspects and picking the signified aspects out of them, the following list of environment projects were gathered, reviewed by top management and suggested for further implementation planning:

- 1) solar panels shall be placed on the roof areas of airport buildings and premises.
- 2) big solar plant shall be placed at the wide ground areas on the both sides of airport runways (investment approx. 10 MWh, implementing plans proceeding together with commercial companies)
- 3) charging points for electric vehicles at parking area
- 4) green electricity in use at all airport premises
- 5) energy audits shall be conducted at all premises and based on the audit results further activities shall be planned to implement energy efficiency measures

- 6) all airport ground vehicles in professional use shall be electric or use biobased fuel
- 7) all sub-contractors and partners operating at airport area shall be committed to same environmental goals as airport itself
- 8) environmental policy, code of conduct and social responsibility reports shall be drafted and published
- 9) environment point for all passengers shall be opened to provide information about reaching environmental and energy efficiency targets at airport.



# TECHNOLOGICAL SOLUTIONS

Companies who produce innovative technological solutions based on latest knowledge need more information on the needs of the public building owners. Public building managers need better knowledge on existing solutions, their profitability and how to order them to benefit the highest possible value.

The tool consists of following elements that aim to enhance the dialogue between building managers and technology solution providers:

- an excel-list of mapped innovative technological solutions that are available in the Baltic Sea Region;
- building managers' experiences on different technological solutions;
- evaluation of certain technological solutions such as centralized vs. decentralized ventilation, healthy and circadian lighting, thermal heating systems;
- guidelines and templates for procuring solar energy PV plants, indoor climate; light, thermal, air quality and acoustics, EPC and energy monitoring systems.

With technical solutions, the best effect is achieved when domains are implemented together, integrated or synchronized with each other. Categories we consider important here are building envelope, ventilation, heating and cooling, water usage, lighting, electricity usage and building management systems.

## ENERGY USE AND MONITORING – WILL IT HELP KEEP ENERGY COSTS UNDER CONTROL?

Author: Mikk Maivel, State Real Estate Ltd, Estonia

State Real Estate company will carry out 1.5-year energy monitoring test from hourly based energy use data from five test buildings. Energy monitoring main aim is to answer the question: can detailed energy monitoring decrease buildings energy cost or not and does the systems own cost exceed the revenue achieved?

Although we live in the information age, we still find real estate managers who store their monthly energy data to handwritten books. It is not rare that accountants have the best overview of the energy performance and consumption of the building through making energy related payments. It was not long ago when property managers, owners and tenants of the building had no overview of the energy use and large energy fluctuations were visible by reference to consumption costs only.

Today's situation has fortunately been greatly improved and building managers have better tools to do energy consumption analysis. Most of the experienced facility owners use specific facility management IT-systems to store monthly readings where overconsumption is discovered by property managers while inserting previous months data.

State Real Estate also use an information system for maintenance departments to store monthly based energy usage data. The monthly energy data allows us to compare buildings with similar usage (e.g. school buildings, kindergartens etc.) and detecting possible anomalies and abnormal consumption fluctuations. If there are not enough buildings to compare, a simple spreadsheet program will also help. But there is one flaw – energy usage data is collected with monthly delay, small differences can go unnoticed and readings are not often collected at the same times, which in turn increases the risk of not being detected in time.

Depending on the size of the building, a small cost of overconsumption could mean thousands or even tens of thousands of euros increase in the cost of maintenance of the building and the undue use of the environmental resources surrounding us. In this case the effects must be dealt by our children and grandchildren.

Increasingly more sophisticated building automation systems allow better data monitoring and recordings. New remotely operated energy meters do not require any more local readings and thus help save time and money. Alas, processing huge amounts of data in simple spreadsheet programs is time-consuming and complex. To simplify this issue, there are several specific energy monitoring solutions which contribute to a high volume of energy data. In addition to the analysis the information systems generate automatic reports and display in real time building related necessary information. In addition, the applications also have the so-called "built-in artificial intelligence" which allows you to set up different algorithms to inform the building's technical personnel about excess energy usage. Internal algorithms allow also to measure the profitability of an energy-performance investment and contribute to the increasing uptake of energy performance contracts (EPC). An energy performance contract is a type of contract that enables the owner of a building the guarantee of savings and investment from the contractor.

# THE ENERGY EFFICIENCY MANAGEMENT PLAN

Author: Barbara Wos, Association of Communities and Cities of Malopolska Region, Poland

The Energy Efficiency Management Plan is a program which can improve the energy efficiency of the commune. It is a help for decision-makers and managers, because it diagnoses problems, defines priority tasks, shows the possibilities of implementation, financing, management and monitoring.

The most important conclusion that comes from the study is that the energy efficiency management plan must be multi-stage, well-thought-out and meticulously planned. Basically, the whole process can be divided into 4 stages:

## 1. PREPARATION

An analysis of the state of the environment, an analysis of the situation of the commune and the structure of residents, entrepreneurs, etc.) It is important that the data is reliable from independent sources:

- from a local government unit managing municipal property
- directly from the marketing authorisation holder/users of individual municipal buildings
- from the energy performance certificate
- from energy audit

## 2. PLANNING

In this case, it is important to have a team of specialists who must be selected according to their qualifications. The second stage should end with the identification of tasks to perform, along with a cost estimate and financing ideas.

State Real Estate will test smart energy monitoring systems in five buildings models (three schoolhouses and two office buildings). Responses are sought particularly to following questions:

- Will hourly data monitoring allow to detect early energy over consumption?
- Is the investment on the data less than the financial savings achieved?
- What are the options for implementing the monitoring system and the main barriers in existing public buildings?
- How will real estate managers, users and technical staff of the building take in a new solution?
- In the case of successful results, we will consider how to ensure more optimal management of central government buildings in order to reduce our ecological footprint and save
- taxpayers money and without any concessions for the environment.

Analysis is carried out and test solution setup is performed with the help of engineers from DeltaE. Activities are funded by State Real Estate and Interreg Baltic Sea programme EFFECT4Buildings project budget.

### The possibilities of financing investments

- from the city or commune budget
- from external funds, including: subsidies (grants), loans and credits, other means - municipal bonds, public-private partnership and leasing.

### The goals should be very clearly and reliably defined by:

- coefficients
- ecological effect
- savings

## 3. IMPLEMENTATION

It is important to properly coordinate activities, divide people into appropriate teams, act on schedule, skillful communication and quick response to any delays or problems. The key to success are communicative, resourceful leaders of individual teams.

## 4. MONITORING

Monitoring of work effects, activities focused on maintaining the achieved effect and coordinating subsequent investments or projects in accordance with the energy efficiency canon.

In summary, all stages directly affect each other. This means that problems at one stage will cause problems at the next one. In order for the energy-efficient commune's goal to be achieved, parallel actions and diligence are necessary. The key to success is good communication, and above all competent people.

# NEW TECHNOLOGY WILL GIVE BETTER AIR AND HEALTHIER CHILDREN

Author: Hans Ahlin, County Board of Dalarna, Sweden

The County Administrative Board of Dalarna has participated in several projects aiming to improve indoor environment in schools and pre-schools. Measurements were conducted during 2019 in some of the county's schools and pre-schools. The results show that air, acoustics and light are not always optimal for children's well-being and performance.

"Poor indoor air affects not only health, but also the ability to concentrate and perform in the classroom. Particularly in pre-schools, it is necessary to reduce the number of particles in the air, as there is a tendency for viruses and bacilli to spread," says Marit Ragnarsson, project manager at the County Administrative Board.

Stefan Lysén, Luvian AB, expert on particles in indoor environment and the person who carried out the measurements: "Looking at the air quality, I have found examples of classrooms that on certain days have too high particle levels. The particles can, for example, come from pollen or emissions from clothing and building materials."

Rättviks Fastigheter AB has tackled the problem and is now first in Dalarna with the installation of an air cleaning system for particles and better indoor air at Daljerks pre-school. An investment implemented with funding from Region Dalarna.

"With this pilot we hope to drastically reduce the number of particles in the indoor air, which is especially important for children with asthma or allergy. At the same time, we hope to reduce energy consumption, improve humidity during dry winters and balance the carbon dioxide content," says Ebbe Evbjer, CEO of Rättviks Fastigheter AB.

The installation will be continuously monitored with measurements so that you can compare the air quality in the rebuilt part with the non-rebuilt part and compared to the outdoor air.

"We hope that staff and children will experience increased well-being at the same time as sick level decrease," says Ebbe Evbjer.



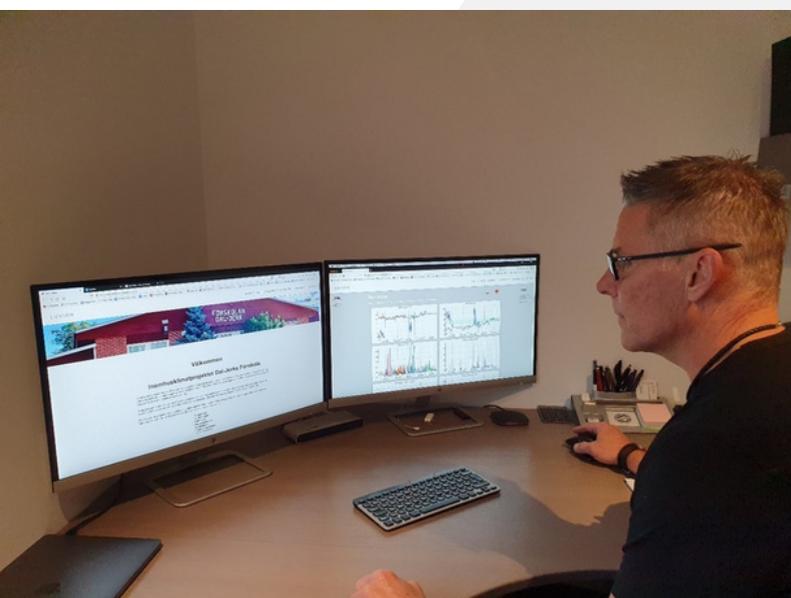
## Facts about the system

The Luvian system is continuously cleaning the air from emissions and particles through a re-circulating system integrated with the existing ventilation system. It also reduces the number of viruses and bacilli. **The system is a combined solution for ventilation, air conditioning and air cleaning.**

The values displayed are temperature, humidity, CO<sub>2</sub>, particles in different sizes PM<sub>1</sub>, PM<sub>2,5</sub>, PM<sub>10</sub> µg/m<sup>3</sup>, total VOC and Formaldehyde.

Installation is done in one pre-school department and the measurements are going to be compared with another department. The measurements will be shown in real time on the new homepage. In the picture below Stefan Lysén is analyzing data from the system.

In August the system will be up and running and information can be seen at [www.daladagis.se](http://www.daladagis.se). Mail address to Luvian AB: [info@luvian.se](mailto:info@luvian.se)



# PROPER LIGHTING MAKES A DIFFERENCE AT ERIKSLUNDSGYMNASIET

Author: Hans Ahlin, County Board of Dalarna, Sweden

During the summer of 2020, Erikslund's high school in Borlänge will replace the lighting in all classrooms with Human Centric Lighting (HCL).

Old lighting in all class-rooms will be replaced to adjustable white light with the possibility to change the color temperature from hot to cold light and to control the intensity manually via scenario panels and via an automated sequence. In short, you recreate the natural daily rhythm that daylight gives us, with artificial light.

Lennart Carlsson from Fastighets AB Hushagen:

*"Today we have as little as 250 Lux in some premises. Now we will get 600-800 Lux. The new lighting will help students stay alert and concentrated. The possibility of adapting the light to the educational environment will hopefully contribute to better performance and increased well-being."*



Photo: Lennart Carlsson (left) and Pär Brorsson from the contractor Midroc show how the display looks.

## It's about providing the right light at the right time

Four scenarios can be set on the display in each classroom:

- Focus
- Relaxation
- Presentation
- HCL

Absence control will also be turned on.

Pär Brorsson explains how the system is supposed to work:

*"In the morning, the classroom automatically gets more intense light to wake the students up, then the light is controlled via an automated sequence.*

*However, the teacher can choose to manually activate focus light when it is time for short-term concentration-demanding tasks and relaxation lighting for reading."*

A DALI control system (Helvar router) is installed in all classrooms and adjoining rooms allowing to regulate all lighting and to program different lighting scenarios.

When asked what inspired him to start the project, Lennart says:

*"Last fall, I received an invitation from ByggDialog Dalarna to an afternoon seminar (Energy Café) at Dalarna University where they talked about a successful project at a school in Malmö. It gave me inspiration to set new requirements for this procurement. It is important with good lighting for all students, and in particular for the students with special needs at our school."*

Has the choice of HCL control led to higher costs? Lennart answers:

*"Installation costs are the same, while the luminaires are about 30% more expensive."*

In addition to changing lighting, parts of the ventilation and fire safety system will also be changed.

The project at Erikslund Gymnasium is the first HCL system at a school in Dalarna. However, Pär Brorsson says that Midroc made other installations in Borlänge, for example at the company Svenska Krämfabriken AB.

In the autumn, there will be an evaluation of the system with staff and students and follow-up of the energy consumption.

## About Erikslundsgymnasiet

The school offers electricity and energy programs as well as vehicles and transport programs. About 150 students study at the school, several of whom have special needs.



# POWER LOADS

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

Energy efficiency is not just about reducing the total amount of energy used, but also to optimize the time when the energy is used.

A large part of the solutions to combat climate change, is to switch from fossil fuels to renewables and electricity produced from renewables. The demand for electricity is predicted to increase largely, due to more electrical vehicles, electrification of industries, new buildings and economic growth. Electricity, from for example wind and solar, are depending on weather conditions and don't come in a steady flow. At the same time, the demand for electricity is higher in some times of the year and day. Another trend is that energy production is getting more local with building owners producing their own energy and connecting it to the grid.

To sustain a reliable electricity supply, there is of great importance that the supply can meet the demand at all time and all days of the year. For building owners (and other energy users) there is a need to lower the power peaks, both during days and during years.

In residential buildings, most power is often needed when people come home from work, starting to use electrical equipment and charging their electrical vehicles. This creates a power peak that needs to be handled by the grid company. During the year, buildings with heat pumps need a lot more power during the coldest weeks of the winter. Also this has to be handled by the grid company to avoid electricity being shut down. One way to do this is by flexible price for energy.

*"We can clearly see an increased interest from building owners to work on power demand optimization to lower their energy costs," says Marit Ragnarsson project manager in Sweden. "Both suppliers of district heating and electricity are turning their tariffs more in to being based on peaks instead of the total amount of energy used. So, building managers need tools also for working on this."*

The solutions to balance the power peaks can be sorted in three categories:

- Energy production and grid companies solutions
- Energy users solutions
- Flexible market by third party players, including electrical storage.

EFFECT4buildings has arranged seminars with building owners and grid companies to discuss possible solutions and cooperation. The response has been very positive with a big interest shown. A network of all ten grid companies in the region of Dalarna has been gathered in to one network to work on the challenge together.

*"All grid companies are facing the same challenge, so cooperation makes very much sense," says Marit Ragnarsson who has been appointed by the group to manage the network and to apply for external funding for a pre study to identify action needed.*

Power demand optimization technology need to be promoted for building managers. For example, with ITC solutions electrical devices can be set to run and charge at night when the demand for electricity is lower.

Another interesting and most relevant solution is to develop cooperation between grid companies and building owners. The grid owners can adjust the heat in the building according to power demand to avoid peaks, by using the energy heat storage in the building.

*"We can clearly see that this is an area we all have to focus more on in the future and it is an area that makes a lot of sense for cooperation in the Baltic Sea Region," Marit Ragnarsson says and hoping it will be possible for the coming Interreg Baltic Sea Program.*

## PILOT WITH DEMAND CONTROLLED ZONE VENTILATION IN APARTMENT BUILDING

Author: Marit Ragnarsson, County Board of Dalarna, Sweden

In Sweden, there are high demands on ventilation systems in buildings. A good air environment prevents headaches, fatigue, irritation and bad odors. The Swedish National Board of Housing, Building and Planning's requirement for air flow is 0.35 liter per second, per square meter. When no one is staying in the home, the flow may be reduced to 0.1 liter per second. However, the rules are general for a building and do not take into account how the rooms are used. In practice, this means that, for example, a bedroom may have too little ventilation when more people than expected sleep there or that rooms where no person is currently staying are over-ventilated.

As ventilation systems use a large amount of energy, it is important that the systems are designed in such a way that they are used optimally. Room heating and air conditioning account for 27% of energy use in commercial properties and 43% in residential buildings.



Photo: Jonn Are Myhren, Healthy Homes

*"The problem is often that the ventilation system operates with overcapacity and at the wrong times. One third of the 24 hours a home is often empty and the family is away at school or work. If ventilation goes to full effect during this time, energy is wasted completely unnecessarily," says Jonn Are Myhren at Healthy Homes that has developed a solution to meet this challenge.*

Healthy Homes has developed a ventilation system that can control ventilation based on the needs that exist in each room during different parts of the day. A Healthbox is installed that controls the ventilation with timing or sensors that detect carbon dioxide, moisture and odour from each room. The flow goes down when there is no presence and energy is saved. For example, in the morning when using the bathroom, shower and kitchen the ventilation is increased. In daytime, if no one are at home, the ventilation is reduced and increased in bedrooms at night."

The system can run on automatic or user surveyed.

With an app the actual levels of temperature, moisture, CO2 and ventilation activity can be monitored. The active user can adjust and personalize/maximize the benefits via the app. For the more passive user an easy filter exchange once a year is all maintenance that is needed.

The solution has been installed in family homes with good results. The EFFECT4buildings project wanted to test the solution in an apartment building since energy saving potential seems very high. The purpose of the pilot was to investigate whether a new ventilation system for apartment buildings could make energy consumption more efficient while at the same time a high indoor comfort could be obtained.

One building owner in the stakeholder network in Dalarna, Nordhemstigen, provided the project with a suitable building that anyhow was renovated. The County Board of Dalarna granted finance for the investment and the pilot was monitored and evaluated in a degree thesis in construction for Bachelor of Science in Engineering.

The method was to install a demand-controlled zone ventilation system in the apartment and measure air quality, air temperature and air flow rate with the help of sensors.



The Healthbox unit is connected to each room by air channels and sensors.

The new ventilation system was compared with two common ventilation strategies; extract air and natural ventilation. Carbon dioxide levels, air humidity and temperature was monitored and evaluated.

The measurement data shows that the demand-controlled ventilation system in most cases reaches the recommendations while the energy demand is lower. The demand controlled zone ventilation system resulted in 28 liter per second, compared to 35 liter per second for ordinary systems.

CO2 levels in bedrooms was exceeded with standardized ventilation systems when bedroom door was closed, since exhausted valves are placed in bathrooms and kitchens. Natural ventilation is a good system to reduce energy use, but the pilot shows that the CO2 recommendations could not be met all time of the day.

An important conclusion from the degree thesis was that ordinary ventilation strategies such as natural draft and exhaust air give a worse indoor climate compared to the demand-controlled system.



*"I find this technology fantastic," says building owner Stig Hjalmarsson from Nordhemstigen real estate company in Hedemora, Dalarna. "It is not often that you can increase indoor climate quality at the same time as reducing energy use, but with demand controlled zone ventilation it is possible.*

*A good thing is also that it is possible to force the ventilation to increase when more people are in the room. Ordinary ventilation systems are less flexible and most often there is only exhaust air diffuser in kitchen and bathrooms. I would like all ventilation systems to have ventilation in all rooms.*

*I have not yet evaluated the profitability of investing in the system, but I am sure that I will go ahead and try to get the technology installed in more of our buildings."*

## RENOVATIONS OF OLD MULTIFAMILY HOUSES

Author: Benny Magnusson, Sustainable Building Cluster in Dalarna, Sweden

Many real estates in Sweden are in great need of renovations and this requires a lot of resources, so it is important to choose the right measures. Krylbohus buy old apartment buildings and renovate them.

Krylbohus real estate bought 40 multifamily houses in Krylbo, Sweden. Not really knowing what they were getting into, water damage, mold, leaking roofs, chimneys that blows down and very poor documentation about the real estates. It is difficult to choose the right measures and do the right priorities when the condition of the buildings is so bad. It is often easier to fix the problems when they arise.

There is a great need to get a total methodology early in this process to be able to do more measures simultaneously. If more measures can be done in the same time you save both money and resources. Krylbohus have together with ByggDialog Dalarna started to do an energy- and resource auditing to find combined measures that can be done to save energy, resources, and money.

An energy and resource audit gives a good overview of the condition and functions of the properties and the organization's work methods. Analyzing energy and resources use in an early stage increases the chances, getting the most effect from their investments.

It is a challenge to start the work with an energy and resources audit as it takes a lot of time and requires great knowledge. There is a stress to fix the problems that are here and now, but once you

have past that and started the audit, you quickly see that it gives dividends and in the long run facilitates the work and is favorable for profitability.

Krylbohus has already started to change its heating system where the shortcomings were great with large losses. Uninsulated attic has begun to be insulated in connection with roof repairs. Water leaks have been identified thanks to the examination of water consumption in the various real estates.

It is of utmost importance to take the time and do a proper mapping in the initial stages, even if it feels resource intensive. It can be better to let an external company work with the energy and resource audit. This way the real estate company only need to provide the information and focus on their commitments.



# A SUCCESSFUL, CAREFUL RENOVATION

Author: Benny Magnusson, Sustainable Building Cluster in Dalarna, Sweden

Tunabyggen took the help of researchers to find a model for the renovation of the “million program” houses in Tjärna Ängar. The model focuses on energy- and cost efficiency, climate impact, housing comfort, and collaboration for participation and decisions.

How do you renovate buildings in million program areas according to today's requirements for energy efficiency without being forced to large rent increases which may, among other effects, result in increased segregation? In Tjärna Ängar in Borlänge, where about 90 percent of the residents are immigrants, the real estate company Tunabyggen has renovated a test building where researchers from Dalarna University have been involved in the process and influenced the choice of measures. The goal is to create a model for the remaining renovation work in the area (a total of 36 residential buildings), but also for similar projects in Sweden. The renovation period lasted from 2015 to 2017 when the building was put into operation.

The five goals of the project were ambitious – to halve the building's energy use, to renovate carefully and cost-effectively, to carry out the jobs without the tenants being evacuated and to create better living comfort. During the project, comparisons were made with two, initially identical reference houses, at Tjärna Ängar, which were renovated with different heating solutions.

## Halved energy use

The use of an exhaust air heat pump in the basement and supply air radiators created an energy-efficient renovation where energy use was reduced by 55 percent.

# CLEAN AIR AT HOME

Author: Benny Magnusson, Sustainable Building Cluster in Dalarna, Sweden

In Dalarnas Villa, three different varieties of modern energy-efficient ventilation systems which ensure that the air is healthy to breathe are being tested.

Dalarnas Villa in Hinsnoret near Falun, is a 150 cubic metre villa in which several different modern technologies are being tested.

The first test of ventilation, which started in August 2019, was demand-driven ventilation that is otherwise mostly found in office buildings. The technology comes from the company, Healthy Homes, and means that sensors indoors and outdoors measure temperature, carbon dioxide content and humidity. The system delivers exactly the ventilation needed for the moment, which improves air quality whilst saving energy. Humans thrive best in a relative humidity (RH) between 40-60% and in the villa the habits and lifestyles which are best to maintain the healthiest air quality will also be studied. Is it better to hang up the washing in the living room or the bedroom? Then is releases moisture into the room instead of it being ventilated away into an airing cupboard.



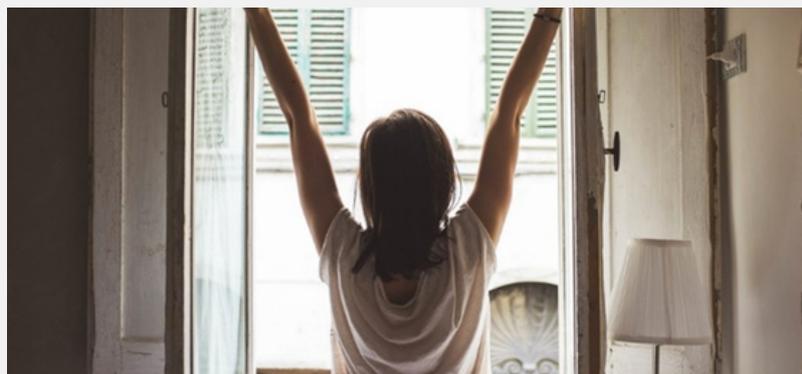
The disturbance was also significantly less than with other complete renovations – instead of building large new ducts, existing ventilation ducts and unused rubbish dumps were used. However, the residents needed to be evacuated to modules while certain measures were implemented in the apartments, an insight that has led to the decision to evacuate the other houses during future main-pipes replacements.

The previously existing problem with cold drafts disappeared with the improved ventilation and the chosen technology solution with supply air radiators. The heat is now transferred via a two-pipe system, which reduces energy consumption but also distributes the heat more evenly than the previous single-pipe system.

Other measures included a new roof and new facade, new bathrooms and windows. In addition, new entrances, balconies and laundry rooms were built.

To compensate for increased electricity needs, solar cells have been installed.

Now, three buildings have been completely renovated and measurements have been going on in parallel in the houses for a year.



## The air we breathe

The second ventilation system being tested in Dalarnas Villa is a so-called Luvian system. The Luvian system, which is installed after the FTX unit, mixes air from inside and outside the house and simultaneously purifies the air of small particles. Distributing airborne heat via ducts in the ventilation system provides an even distribution to all rooms. It also has advantages such as rapid adjustment to both external and internal temperature changes.

Cooling functions exactly the same but in reverse. Instead of warming the air before distribution, the same heat pump is used to create cooling. The system mixes the air and maintains a comfortable temperature on warm days.

The Luvian system has a large air purifier inbuilt as part of the ventilation system. It not only cleans the air that comes in via the ventilation but also the air recirculating inside the house. The system purifies 98% of the air through a combination of different filters.

### Testing a new ventilation unit

In a third type of ventilation system, a ventilation unit with controllable moisture recovery will be tested. The hope is to find a good way to control moisture recovery between the different air streams in a way that gives both optimal heat recovery and indoor humidity. Both with regard to damp proofing in the building and human health and well-being.

An ordinary rotary heat exchanger has metal surfaces where moisture recovery takes place, but now a rotary heat exchanger is being tested in which the surfaces that come into contact with the air currents have a coating that selectively binds a limited amount of water molecules. Ventilation units will be delivered to Dalarnas Villa next summer and in the meantime the company is working on tests and testing of the concept.

# DALARNA'S VILLA OFFERS USEFUL LESSONS

Author: Benny Magnusson, Sustainable Building Cluster in Dalarna, Sweden



How can we build houses as sustainably as possible and as far as possible prevent damage due, for example, fire and water leaks?

The Dalarna's Villa research project, which was set up to improve competency in the construction industry when it comes to long-term sustainable buildings with healthy indoor environments for residents, will hopefully provide some of the answers. Various modern technologies for ventilation, heating, climate control, control and drainage are tested in the house.

### Start from scratch

For Fiskarhedenvillan, which supplied the materials for the house, the project meant the start of new sustainable development for the company. How can a building's carbon footprint be reduced during its lifecycle? The company is now investigating different solutions for foundations (the concrete foundations of a house account for the greatest environmental impact) as well as using better insulation and fewer thermal bridges to mean no heat pump is needed. Instead, for example, solar panels could supply the negligible amount of energy required for heating.

The average renovation of a water damaged bathroom involves 300 kilos of carbon emissions. For Fiskarhedenvillan, protecting the house from water damage means that a new product, the water fault switch, has now become standard in their houses.

A water fault switch detects, alerts and shuts off the water supply in the event of a leak but also has other functions such as automatically shutting off the water when nobody is home or when there is a risk of freezing damage.

### Nordic Ecolabel

The work of building the house was carried out by Magnus Byggare who also supervised construction students from the high school who were on site to learn about sustainable house building. Since the building should meet the requirements of the Nordic Ecolabel, much of the material used was new to the company.

For example, Dalarnas villa is insulated with cellulose insulation made from recycled newspapers in the outer walls and wood fibre in the inner walls. It produces around seven times lower carbon dioxide emissions compared to glass wool and 10-100 times lower than rock wool insulation.

Many useful lessons have already been learning from this exciting research project and more will follow in the coming years as the project continues to collect data on energy use and indoor climate.

# NATURAL FILTRATION - ENVIRONMENTAL BENEFITS OUTWEIGH ENERGY SAVINGS

Author: Liv Randi Lindseth, Contracted by Inland County Council, Norway

Water treatment is an important factor in all water-borne heating systems. Experience has shown that purification of water will reduce the accumulation of internal coatings in the form of particles, bacteria and corrosion in pipes and heating systems. Purification will thus provide better flow of water which leads to a more efficient heat distribution in the plant. The goal of water treatment is therefore to reduce energy consumption, reduce service and maintenance costs and extend the life of the plant.

Traditionally, water treatment has taken place by chemical additives. As part of Inland County's goal to optimize operation and reduce energy consumption, they have wanted to test the effect of greener alternatives in their water-borne heating systems.

## Natural filtration

Inland county has tested a new system for water treatment to purify the water in its own heating systems. EnwaMatic water treatment was installed at Øvrebyen upper secondary school in May 2018 and at Skarnes upper secondary school in May 2020.

Marcus Hermansson is an FDV operator in Inland county and is well acquainted with the installation in the two buildings and how they work.

*"This is a purification mechanism that is connected to the tap water in the plant and directs the water through a purification and filtration process. The water is passed through several layers with a purifying filter consisting of different layers of sand and gravel that retain particles in the water. Purified water is then returned to the plant," Marcus explains. "This will in theory lead to lower energy consumption, he adds, but the biggest benefit is without a doubt the environmental one," Marcus states.*

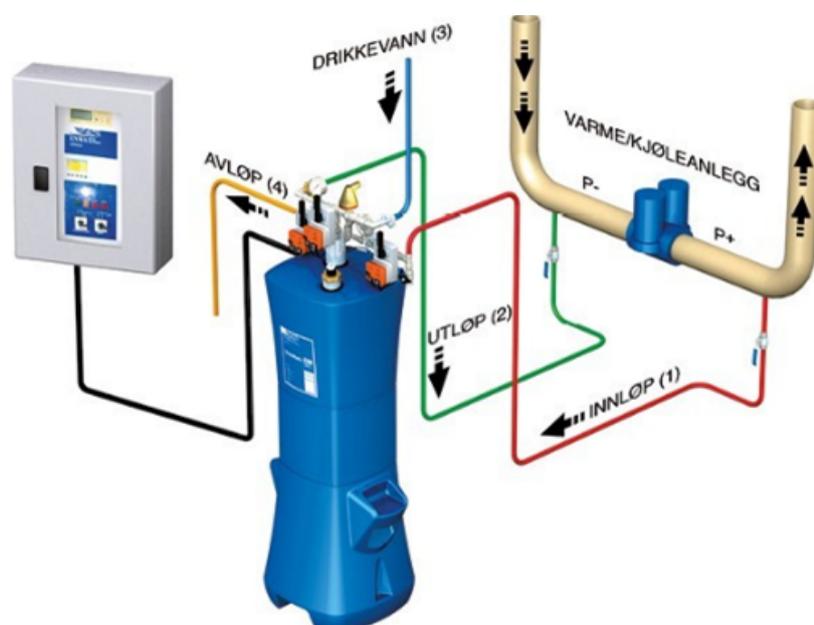
The new purification mechanism only uses natural filtration of the water and no chemicals are added. Chemical purification of the water has previously been most common to avoid the collection of dirt and particles with the environmental disadvantages this entails.

*"Having said that, it seems to lead to a certain reduction in energy consumption as well," Markus continues.*

After the first year of operation, Øvrebyen upper secondary school was able to demonstrate a temperature-corrected reduction in energy consumption of 6% compared with the three previous years. Even when comparing for the lowest consumption in the period, the reduction was 4.3%.

At Øvrebyen school, they also experienced that the heat distribution in parts of the plant worked better, and that they could maintain the desired room temperature in previous problem areas.

*"We have now installed EnwaMatic also at Skarnes upper secondary school, and hope to see the same results there," Marcus Hermansson concludes.*





# ENERGY EFFICIENCY PLATFORM CAMS ESTABLISHED IN BALTIC SEA REGION

Author: Marit Ragnarsson, County Board of Dalarna, Sweden



EUROPEAN  
REGIONAL  
DEVELOPMENT  
FUND

As lead partner for EFFECT4building, Dalarna County Board participates in a new platform collaboration with other energy projects in the Baltic Sea region. The platform is funded by the Baltic Sea Program and is called Climate Adaptation & Mitigation Synergies Energy Efficiency Platform, CAMS.

## Methods for energy auditing in the Baltic Sea region

Within the collaboration, methods for large-scale implementation of cost-effective energy auditing of high quality will be tested. The method is based on using comparable data in a database and is a continuation of the EFFECT4buildings project that has worked to develop the method.

*"EFFECT4building focuses on what happens after an energy audit is made, by developing and providing financial tools to get more measures implemented. However, we can state that many thousands more energy audits need to be made in each BSR state, and this quickly to cope with the climate challenge. For this, methods are needed that enable us to carry out energy audits more rationally, while at the same time the quality needs to be increased without a price increase,"* says project partner Marit Ragnarsson from the County Board of Dalarna in Sweden.

There is also a great untapped potential in not collecting data in a standardized way that enables comparisons and generation of new knowledge. The EFFECT4building project has tested and participated in the development of the NEAD platform, which has been developed by Nordic Energy Audit and has come to the conclusion that there is great transnational added value in developing this together in the Baltic Sea Region. The method that is developed can at the same time serve as a platform for disseminating results from other ongoing / completed energy projects.

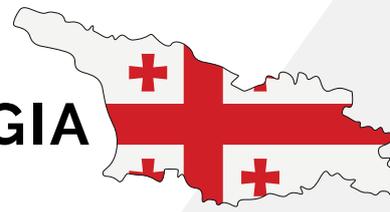
CAMS also develop recommendations on how to combine energy measures with climate adaptation measures in buildings.

In this way, experiences from the EFFECT4buildings project can be disseminated and experiences can be exchanged between the ten other projects involved; LowTEMP, AREA 21, Co2mmunity, Act Now, BEA-APP, RDI2CluB and also HORIZON 2020's HERON, SIM4NEXUS, ENLARGE, and ARCEE funded by EuropeAid.

[Read more about the CAMS platform.](#)

# ENERGY COOPERATION WITH GEORGIA

Author: Marit Ragnarsson, County Board of Dalarna, Sweden



EFFECT4buildings project has established a cooperation with Georgia on energy efficiency in buildings. The focus is mainly on training programs to increase knowledge on potential measures, new technology as well as how to plan and calculate investments.

County Board of Dalarna in Sweden made a peer to peer visit in Georgia to plan the activities together with LTD Laboratory of Construction in Tbilisi. During the visit, several seminars was arranged among other with cluster organization ICCA, Ministry of Economy and sustainable development, Municipal Development Fund and a group of building managers.

*"We found out that most of the tools provided by EFFECT4buildings project are relevant for building owners, building managers and construction companies in Georgia," says project manager Marit Ragnarsson from Sweden.*

Lasha Tchotchua, CEO from Laboratory of Construction, added:

*"We also lack a standard for energy efficient construction. As a construction company, we build what's being ordered, but we would all gain for having a standard to refer to."*

Representatives from Laboratory of Construction participated in partner meeting in Krakow to exchange experience with the partner team.

The plan is to set up a training program for policy makers to strengthen the capacity to implement more energy efficiency measures.

*"We need to involve politicians and other decision makers to a larger extend, says Sergo Buiglishvili from Georgia. I promote and sell green roofs. And I can see that when the knowledge increase, the interest in investment also increase."*

Coming activities is to do a peer to peer visit in Dalarna, Sweden as well as participate in more partner meetings with EFFECT4buildings, but due to Corona virus further activities has been put on hold.

The cooperation with Georgia has been financed by the Swedish Institute.

*"This is a concrete way for our flagship project to disseminate results and also to learn more about the situation for energy efficiency in eastern countries," says Marit Ragnarsson.*

EFFECT4buildings is part of the implementation of the EU Strategy for the Baltic Sea Region (EUSBSR), being a flagship project under policy area Energy and the horizontal action Sustainable development. Flagship projects demonstrate the progress of the EUSBSR especially well and serve as pilot examples for desired change. Cooperation with countries being part of EU Eastern partnership is encouraged in the framework of EUSBSR.

## CLIMATE CLUB

Author: Benny Magnusson, Sustainable Building Cluster in Dalarna, Sweden

There are many smaller real estate companies in Sweden, and they have often limited resources and few employees.

It is not unusual for an employee to have different job descriptions such as energy controller, caretakers, climate controller, etc. This means that he/she needs to have knowledge and time to distribute in the different roles with no body to consult with. This situation can be very stressful, and it is easy to focus on the things he/she is good at.

To help the smaller real estate companies ByggDialog started a Climate Club where real estate companies meets and exchange thoughts and ideas. Sharing experiences and helping each other, everyone will be winners.

The climate club has so far 15 municipality and private real estate companies as members. Six of the companies are members in the Swedish Climate initiative, this means that they have set the goal to be fossil free and reduce energy use by 30% by 2030.

There also three voluntarily areas: power peaks, climate friendly procurement and climate friendly living.



ByggDialog Dalarna use this initiative as a starting point in the work in the climate club. This helped to start working groups in the different areas. The members choose which areas they want to work with, and the only requirement is that they must participate actively.

The club meets four times a year plus working group meetings that are determined by the members and held when needed. In this way, we can capture everyone's problems and needs that arise and try to support them in their everyday work. In addition, there will be study visits, workshops, and seminars. This is done to increase the members knowledge and be more innovative.

It is a challenge to get people to prioritize this because small managers are often stressed. Therefore, it is of the utmost importance that they feel at an early stage that participation helps them in their progress. Together we create a fossil free and climate neutral operation and management in Dalarnas real estates.



# EFFECT4buildings

EFFECT4buildings project is implemented with the support from the EU funding Programme Interreg Baltic Sea Region (European Regional Development Fund) and Norwegian national funding. The aim of the project is to improve the capacity of public building managers in the Baltic Sea Region by providing them a comprehensive decision-making support toolbox with a set of financial instruments to unlock the investments and lower the risks of implementing energy efficiency measures in buildings owned by public stakeholders.

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