Experiences and procurement of technological solutions

EFFECT4buildings Toolbox:

Technological solutions; Annex 2

The project “Effective Financing Tools for implementing Energy Efficiency in Buildings” (EFFECT4buildings) develops in collaboration with public building managers a comprehensive decision-making support toolbox with a set of financial instruments: **Financial calculation tools**; **Bundling**; **Funding**; **Convincing decision makers**; **Energy Performance Contract**; **Multi Service Contract**; **Green Lease Contract**; **Prosumerism**. The tools and instruments chosen by the project has the biggest potential to help building managers to overcome financial barriers, based on nearly 40 interviews with the target group. The project improves these tools through different real cases.

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. EFFECT4buildings mapped **technological solutions** for energy efficiency in buildings with the aim to share knowledge and experiences of energy efficiency solutions among building managers in the Baltic Sea Region.

The purpose of this document is to support building managers in making investment decisions in energy efficiency solutions. To get a better overview of available solutions, more knowledge about the technics as well as their profitability, together with experience from others who have implemented the solutions.

Thank you for your interest in how energy efficient solutions have been implemented in practical life.

Partners

EFFECT4buildings project is implemented with the support from the EU funding Program 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. More information: http://www.effect4buildings.se/

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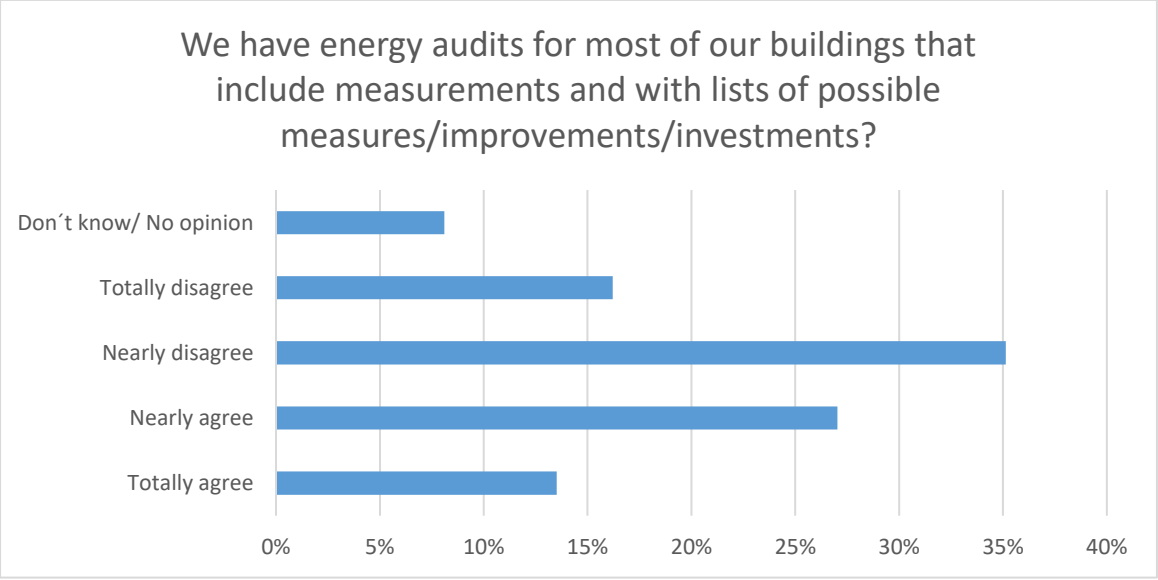
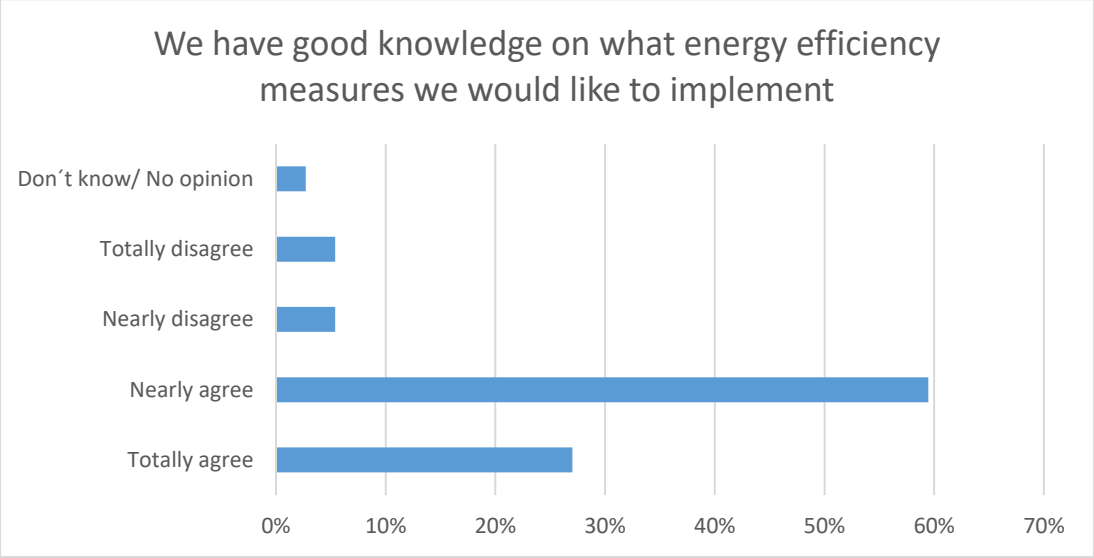
Knowledge about energy efficiency solutions among building managers

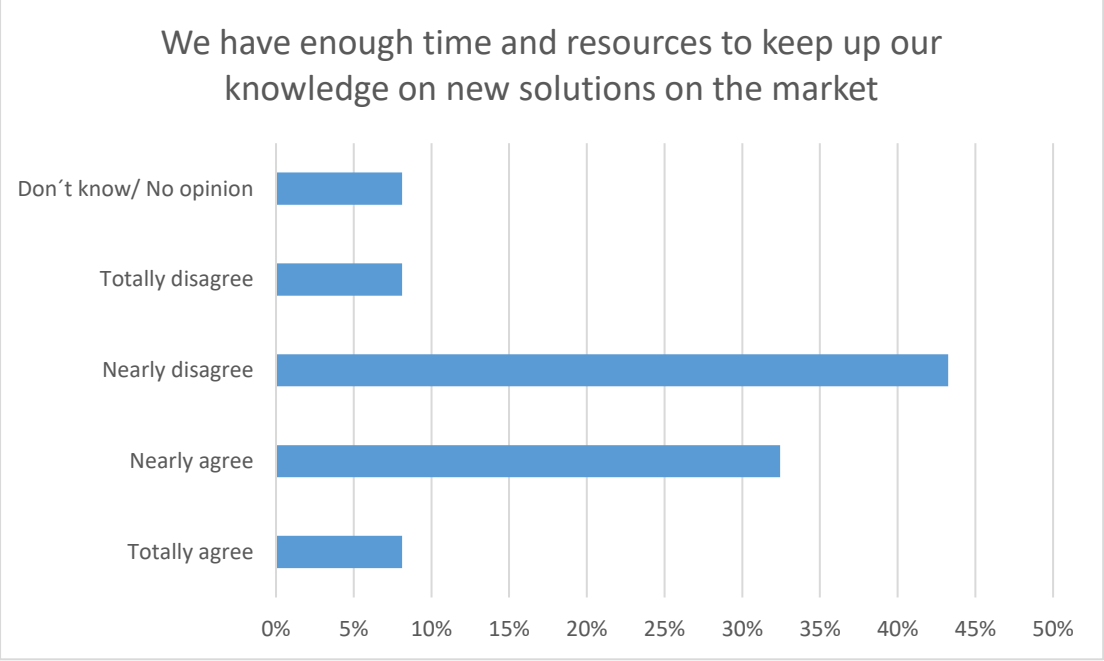
Interviews with building managers

To get a solid view of the state of art among the target group 37 interviews with building managers was done by project partners in seven countries. Public building owners represented by building managers or operation and maintenance managers were the main target group.

Questions were asked about experiences on technological solutions. The answers show that about half of the building managers have energy audits with a list of possible measures for most of the building stock.







Initial answers also show that building managers express that they have good knowledge on what energy efficient measures they would like to implement, but that most of them lack time and resources to be updated on new solutions.

Many regional meetings with stakeholders have confirmed limited knowledge about the large amount of possible measures and the need to inform about additional possibilities.

Statistics from energy audits

In a case by Swedish partner statistics of proposed energy efficiency measures in energy audits was collected. Statistics are based on more than 500 energy measures presented in energy audits for buildings.

Measures was collected for the three categories heating/cooling, ventilation and lighting, since these are the most common measures. Tables show how common/often different types of measures has been proposed.

In addition, data on financial calculations for proposed measures is presented, showing how profitable they are. By calculating saved MWh per invested 100€ (MWh/100€) the most cost-effective measures have been identified. Since Sweden has the highest energy prices in the Baltic Sea Region, the general conclusions on profitability can most likely be applied for all member states.

Heating & Cooling

Category: Heating	**Number of listed measures**	**Annually average saved MWh/ invested 100 €**
Insulation of building envelope	20	0,18
Reduced temperature for spaces	29	7,55*
Changing of windows	6	0,05
Reduced infiltration (sealing of building envelope)	9	0,61
Heat recovery from processes	8	0,59
Control strategy measures (regarding heat system)	8	0,61
Adjustment of heating system	7	0,31
Changing of heat/cooling system	16	0,32
Installation of ceiling fans (reduce temperature differences)	1	0,29
Other	23	0,63
Category: Cooling	**Number of listed measures**	**Annually average saved MWh/ invested 100 €**
Comfort cooling	1	1,84
Adjustment of cooling system	2	1,55
Insulation of building envelope	1	0,12
Adjustment of temperature for spaces	2	N/A*
Changing of cooling system	6	0,63
Other	1	0,29

* Adjusted temperatures does not, in most cases, have an investment cost (or very low).

Conclusions

For heating the most common measures are to improve insulation of the building and to reduce the indoor temperature, but also investments in new heating systems. The most cost-effective measures, that makes sense to start with, is to make sure indoor temperature is set correctly and to seal the building from leakage.

For cooling the most common measure is to invest in new/other cooling systems, while the most cost-effective measure is to maintain/adjust the cooling system correctly.

Ventilation

Category: Ventilation	Number of listed measures	Annually average saved MWh/ invested 100 €
Time- control of ventilation	50	7,81
Demand- control of ventilation	29	3,09
New ventilation units	38	0,45
Heat recovery (e.g. on exhaust air)	10	1,02
Other	38	5,12

Conclusions

For ventilation the most common measures are to invest in time control of ventilation or to invest in whole new units. The most cost-effective measure is to invest in time control or demand control.

Lighting

Category: Lighting	Number of listed measures	Annually average saved MWh/ invested 100 €
Install more efficient luminaries	47	0,46
Presence control and/or sectioning of luminaries	29	0,84
Other	13	1,66

Conclusions

For lighting the most common measures are to invest in more efficient luminaries, but the most cost-effective measure is to invest in presence control.

Tool for collecting and benchmarking data about energy measures

Many energy audits are being done, but not in a standardized way and data is not collected in a way that makes it possible to benchmark results. This means that we miss the opportunity to gain general new knowledge on energy use in different type of buildings/operations/companies. To find out if energy use is at the same level as other similar operations, benchmarking data is valuable to indicate abnormally high energy use for some particular energy user.

Data from energy audits can be collected in a database to make it possible to extract statistics and benchmarking data. Such database has been developed by the company Nordic Energy Audit, started at Linköping University. Data has been collected from all energy audits financed with grants from the National Energy Agency in Sweden, during the last years. The database consists of more than 5000 energy measures.

The data in the database can also be used to reduce the time for making energy audits and for finding more possible measures. Experience shows that the time for making the audit can be reduced by half at the same time as the expert will find double amount of measures.

The EFFECT4buildings project identified a big need for this tool and to make it more user friendly for building managers to insert data and to use it for benchmarking as well as using it as a monitoring system. For that a cooperation with Nordic Energy Audit started.

The project has in cooperation with Nordic Energy Audit further developed the web tool to make it possible for building managers to use in an easy way. Project partner and building managers has tested the tools and given feedback for further improvements. Partners also discussed the benefits from using a common standard for energy audits and how countries in the Baltic Sea Region could cooperate to increase the pace and quality of energy auditing.

Information about the web tool and database with energy measures can be found on Nordic Energy Audit web site; www.nordicenergyaudit.se and in this short presentation; https://drive.google.com/open?id=0B6PQBPinqbwpWmYyek1CelpTUkE

Conclusions

Discussions about the potential for the tool lead to the conclusion that Baltic Sea Region would benefit from developing the tool further together and to implement a new more effective way of doing energy audits.

Experiences on energy efficiency solutions among building managers

Stakeholders interviewed in the project also presented their view on what solutions that are already in use in their building(s) are they most satisfied with.

Building envelope (walls, floors, roof, doors, fenestrations):
Understandably, this sector offers the best energy efficiency results when it comes to renovation. It is also one of the most effective measure. What also emerges from our study is that little attention is paid to indoor climate parameters. Key parameters such as CO2 levels, volatile organic compounds (VOC) and humidity are rarely measured. Knowledge and interest among building managers is low for the latter.

49 % of respondents are most satisfied with various forms of insulation, such as insulation of roofs, walls, floors, sealings and attics. Roofs and walls alone were mentioned by 27 % of the respondents, but often combined with one or several other insulation measurements.

32% of the respondent's state that they have changed windows, doors and among these 5 % have also replaced entrances.

8% of respondents report that the building envelope is presently according to prevailing building regulations and hence in sufficient condition at the present, although nothing "extra" or especially energy efficient measures are implemented.

5% of the respondents provide information that they have done a total retrofitting of buildings. One of them could report that they started the heating season one month later after finishing retrofitting of a school and a kindergarten. Another 5 % have installed sunscreens, shading devices and general fenestration.

Ventilation
Ventilation moves outdoor air into a building or a room and distributes the air within the building or room. The general purpose of ventilation in buildings is to provide healthy air for breathing by both diluting the pollutants originating in the building and removing the

pollutants from it. There are three methods that may be used to ventilate a building: natural, mechanical and hybrid (mixed mode) ventilation. Ventilation exerts heat, resulting in a loss of energy. Technologies must be applied to obtain it. Generally, ventilation will be renewed at renovation.

49% of the respondents were satisfied with ventilation systems with heat recovery, often also demand-controlled or balanced ventilation systems providing high air quality in addition to energy savings. Of these 5 % mentioning FTX air handling units as one of the best ventilation measurements, although one point out that they did not save as much energy as the theoretical calculation promised.

14% of the respondents confirm they are satisfied with the ventilation system, but do not specify what kind or why.

5% are in fact stating they are not satisfied with the existing ventilation system of lack of such.

Heating and cooling

Heating and cooling is a relatively complex sector to change. District heating is common in buildings. However, geothermal systems provide the most efficient type of heating. They can cut heating bills by up to 70 percent. These systems are usually difficult to modify during a renovation.

30 % of the stakeholders say they are satisfied with a regulated/adjustable heating system - often including cooling based on user demands and outdoor temperatures.

14 % of the respondents mentions air-air or air-water heat pumps as functioning very well in their buildings.

Another 11 % mention that they are satisfied with geothermal heat pumps providing both heating and cooling.

Building management systems and automation are mentioned by 8 % of the respondents as satisfactory.

Natural or passive cooling was mentioned by 8 % of the respondents where one also mentioned natural heating (e.g. passive heating) as a positive EE measure in the building.

8 % says they are satisfied with district heating in their buildings. Another 8 % confirm they are satisfied with some kind of heating and cooling system, but do not specify any further.

5 % says solar shielding or shading devices are functioning well and finally 5 % say there is no cooling system in their buildings.

Water

Monitoring or measuring water consumptions are presented as a good EE measure implemented in buildings by 16 % of the respondents.

Simple measures like installation of low flow faucets or insulation of water pipes are mentioned by 14 %. Solar or ventilation heated water is mentioned by 14 % of the respondents as satisfactory.

11 % say that they were satisfied with heat recovery from grey water/wastewater using sun collectors or other devices to heat water.

Monitoring of water consumption is also mentioned by 11 % as the most successful EE measure concerning water treatment.

8 % mentioned water treatment or purification as an effective EE measure implemented in their buildings.

Some respondents did not answer this question and about 16 % said there was no special energy efficiency measures targeting the use of water in their buildings.

Lighting

73 % of the respondents pointed out LED lighting as the one thing they were most satisfied with. The majority of the respondents stated this – often in combination with control systems and sensors.

Light control system and sensors are pointed out by 46 % of the respondents. This was often mentioned in combination with LED lighting.

Electricity

Whether a building is able to generate electricity itself depends mainly on the decision and financial capacity. At the same time, solar power generation is becoming increasingly popular. As can be seen from the building's energy efficiency pyramid, this method is complex and expensive. However, it is difficult to apply for A energy class without such measures. All in all, this method is still gaining momentum. It is understood that public building managers do not have much knowledge in this regard.

22 % of the interviewed building owners say they are satisfied electricity is produced by renewable energy sources, most stating solar panels, but other are saying renewable or green energy sources.

19 % state that they are reducing the use of electricity in their buildings by energy monitoring and regulating temperatures.

The rest say they are satisfied with the way this is handled in their building or has not commented.

Building management systems/ICT solutions

The existence of such systems usually provides a better knowledge of the operation of buildings. At the same time, newer systems provide better opportunities for ongoing monitoring and understanding what it takes. All in all, this is a great opportunity for the future, where energy costs are determined instantaneously. Not from behind, as it is today.

65 % of the respondents list the kind of system they have today and confirm they are satisfied with an existing BMS or ICT solution in their buildings.

The existence of any existing solution seems to be more important than what kind of solution they have. Or - another way of interpreting this is that the building managers do not have experiences with or knowledge about different kind of solutions and is hence satisfied with what they have.

24 % say there is no such solutions in use in their buildings.

Other

Other complex or less complete systems are not used. Building managers do not dare to experiment very much. However, we did find some feedback.

16 % - constituting 6 respondents had additional comments to satisfactory EE measures or equipment in their buildings, listing each individually below:

We are implementing quite big renovations and our aim to take care of all possible energy efficiency etc details.

Booking system for sauna department and follow-up of usage.

Has also tested the acoustics in a school within another project.

Training of personnel

Sensor technology (smart control systems)

Radiator fan for better distribution of room heating

Monitoring of media consumption in buildings

Needs

The stakeholders were asked to identify what are the energy efficiency solutions that their buildings still need.

22 % of respondents say that buildings need new or upgraded BMS or ICT solutions.

11 % of respondents point out the need for user involvement and training to reach additional energy savings in the buildings.

Another 11 % of the interviewed building owners point out the need for energy audits identifying EE measures.

The need for better regulation and adjustment of heating systems – demand-based heating systems are mentioned by 8 % of respondents.

Around 50 % of the respondents list various kinds of needed EE measures – the most common being the need for additional insulation, upgrading of ventilation systems, replacement of windows, installation of LED lighting, solar heating or replacement of heating system and more specifically heat pumps. These measures are mentioned in an almost equal amount of times.

Many respondents (16 %) also say that all kind of EE measures are needed and would be welcomed as the saving potential is still large.

Charging of electrical car should be taken care of / solved (enough power available etc.)

Missing solutions

Often the energy efficiency solutions in use do not correspond to the actual needs of the building/building manager. The stakeholders were asked what kind of improvements of the solutions currently in use they would like to see.

Heating systems

Building heating (and cooling) systems needs to be rather complex to actually meet the needs of every space of the buildings at all time of the year. Nonadjustable heating systems often lead to overheating of the building resulting in high energy use. Outdated heating systems needs to be replaced with modern ones and there is a need to turn in to renewable energy sources.

Ventilation systems

Ventilation systems are also rather complex technology and needs to work integrated with the heating system. Often in reality, ventilation systems do not perform as planned and finding the right solutions can be challenging. Ventilation systems not running optimal can result in very high energy losses. Demand controlled ventilation has an extremely large energy saving potential.

Also maintaining of ventilation systems calls for high knowledge. There is a demand for technology for cleaning and washing ventilation systems.

Monitoring, control and ICT solutions

In the field of digitalization, there is growing demand as well as growing market for available solutions. There is a need to work systematically with each and every building, especially when having a lot of old installations.

Building managers inquire data and better adjustability of systems. Sensors that measure temperatures in different parts of the buildings are needed as well as dataloggers that provide online-information. Weather sensors are often a good solution. The better, but more expensive solution, is using temperature sensors in all rooms. Analysis of data help to improve energy efficiency.

Based on collected data, buildings should be able to easily remote control through Building management system /building automation system (BMS). Such systems are on top of the agenda for many building managers. For many buildings with centralized municipality heating systems, the control systems for adjusting heat according to needs has not been developed.

Digital tools for steering individual applications, for example managing the sauna from the mobile phone, is other ways of using digitalization opportunities.

Visualization

To rase awareness and increase the focus on energy savings, different kind of visualization tool are needed. Energy is invisible and by presenting instantaneous energy use on monitors, users in the building can react and change behaviour. Also achieved energy savings should be visualized in a good way. Feedback from users can be from ”smiling faces”.

Building envelope

There is a lot of available technical solutions for better isolation and other parts of building envelope. At the same time there is a need for more cost and energy efficient facade renovation methods. A large part of the building stock in BSR are poorly insulated and has old windows.

Requirements

Stakeholders demands improved and emphasize requirement specifications for energy-efficient solutions in procurement and construction contracts. Also in official regulations, the requirements for energy performance can be higher.

Evaluation of technological solutions

Evaluation of technological solutions by energy monitoring systems

Activity leader:
State Real Estate Ltd.

Overview of activities

State Real Estate Ltd. implemented demo project with two softwares with the aim to test energy monitoring software as a technology solution and to get feedback how effectively existing most popular building service solutions (or technology solutions) work in a real practice in existing building.

There are plenty of such softwares in market and each of them have pros and cons. In the first step we procured simple software which is suitable for all existing buildings with or even without BMS (building management system). We implemented a long dynamic audit for five buildings. All submeters (electrical, heat and water) were connected to the cloud-based EMS (energy monitoring software) to evaluate and monitor building service system work in terms of energy efficiency. In the demo we used software Ecoscada. During the one-year demo period we integrated all submeters to the Ecoscada software; analyzed building work and afterwards launched the alarming system into practice (the software Ecoscada was set to send out alarm e-mail when the building or some specific system consumed more energy than expected). This solution makes it possible to monitor each system which has energy meter.

Analyzed building are shown below:

Jaama 207, Tartu

Võru State School

Lasnamäe 2, Tallinn

Tartu State School

Põlva State School

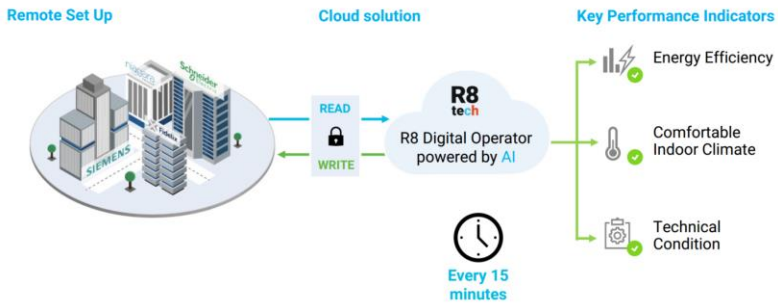
Investigated buildings have plenty of most used technological solutions. The following table lists the most important or somewhat more specific solutions that affect the consumption of buildings and the indoor climate. Table gives answers of each technological solution with its pros and cons.

Technological solution	Impact of the solution on the resource and indoor climate	Result	Implementation within the project
Demand based ventilation with VAV valves	Great	Significantly reduces air flow rates – it causes the reduction of electrical and space heating. Less working hours means less electrical energy for fans and less electrical energy for cooling in summertime and heating energy during the colder period of year. Tricky is automation but it works and gives a good energy reduction. (be aware and use smartly of preventing the spread of viruses!)	Põlva State Gymnasium: The Hall; Lasnamäe 2: Conference rooms on 2nd floor
LED-lights	Great	Significantly reduces the electricity consumption of lighting, especially when needs-based management (occupancy sensor, dimmer based light management etc.) is built in some form. In addition, the cooling energy decreases in these rooms.	All buildings had LED lightening
Cooling beams	Average	Causes fewer cold drafts and noise problems compared to fan-coil solution.	Lasnamäe 2, Tallinn
Automated Roller blinds to block excessive solar radiation to prevent overheating.	Medium/Large	Reduces cooling energy consumption/overheating of rooms, significantly reduces the light hash.	Põlva State Gymnasium: for Eastern, southern and western windows
Passive solutions to block excessive solar radiation	Medium/Large	Reduces cooling energy consumption/overheating of rooms, reduces light-flux.	Põlva State Gymnasium: Balconies/platforms on the southern façade; Southern Alarm Center: screens above the eastern, southern and western windows; Lasnamäe 2: Sirs above the eastern and south-facing windows.

Local PV plant	Great	Significantly reduces the amount of electricity purchased online.	Põlva State Gymnasium: PV-panels on the roof
Use of rainwater for rinsing of TOILETS	Great	Water quality of drinking water is significantly reduced.	Põlva State Gymnasium
Building automation	Great	Gives an opportunity to get a quick overview of what is happening with the building service system even outside the building.	All buildings have BMS system with integrated ventilation, cooling, heating, room control, PV-production etc. building service systems.
HVAC Automation	Great	Provides an opportunity to get an overview of the technical systems.	
Monitoring and configuration of building automation	Great	There is a constant overview of what is happening in the building, helps you find energy saving and optimization opportunities, identify problems, etc.	All buildings
Energy Monitoring	Average	Helps to identify overconsumption and analyze consumption data.	All buildings
Monitoring and setting up of building automation and full service of energy monitoring	Great	There is a constant overview of what is happening in the building, helps you find energy saving and optimization opportunities, identify problems, etc. Allows you to identify overconsumption, analyze consumption data and assess the impact of the implemented settings and changes on the energy consumption of the building or system.	All buildings Effect4Buildings A limited volume of projects within the

In overall the demo showed that it is possible to monitor designed and built technological solutions effectively if the building has enough meters. Ecoscada has its own alarm system and it gives alerts when the energy consumption is higher than expected.

Lubja 4, Tallinn



Schematic overview of R8 software

During the demo RKAS realized that in the market there are more advanced solutions which could even control existing solutions and direct them how to consider other systems more accurately (e.g. cooling and heating shouldn`t work in the same time etc). Therefore RKAS decided to do additional tests in Lubja 4, Tallinn in a new office building (a courthouse with detailed BIM model and A-class BMS system with more than 23 000 data points) to get more comprehensive overview of EMS possibilities. The winner in new procurement was the software developer R8Tech (https://r8tech.io/). Their EMS software:

- Software could elaborate BMS and BIM input data (e.g. in Lubja 4 more than 23 000 points were integrated);
- It has internal fault detection (software itself predicting and auto-detecting root causes and calculating operational cost for irregularities. This reduces systems downtime and the number of complaints from tenants);
- Easy accessibility - it has a web based tailored analytical and visual views of energy consumption, whole HVAC condition, weather prediction, real-time energy market data);
- Indoor climate management and possibility to overwrite BMS parameters. 27/7/365 the optimal indoor climate considering ongoing changes in tenant needs, visitor statistics, current weather, and the forecast with smart algorithms. The smarter control system avoids overheating, overcooling and overventilation).

Demo II showed that used technological solutions will work if the automation system works. In a modern building the building service system is complex and to get expected result it needs a competent operator, otherwise building couldn`t perform so energy efficiently and real energy consumption is higher than expected. R8 is one solution on how to help building operator – AI (artificial intelligence) works 24/7.

Most complex systems were:

- Free cooling system.
- Controlling demand-based ventilation.
- Demand based lightening.
- End user behavioral change (temperature levels are always higher than designed).

Long detailed overview of each system mistakes and overall solution overview can be found in the detailed report as an annex.

Evaluation of technologies

Many energy efficiency measures call for more costly investments and influence technical building systems in general. The need to make sure the right solutions are chosen, that actually performs well, means building managers are in need to discuss and share experience with other building managers before taking investment decisions. For that reason, regional and local technology forums and seminars was arranged.

Some technology solutions currently frequently discussed were tested and evaluated in some pilot studies.

- Centralized vs. decentralized ventilation
- Energy efficient light – learning environments and health issues
- Circadian lighting
- Monitoring, steering and control for thermal heating
- Water cleaning in thermal heating systems

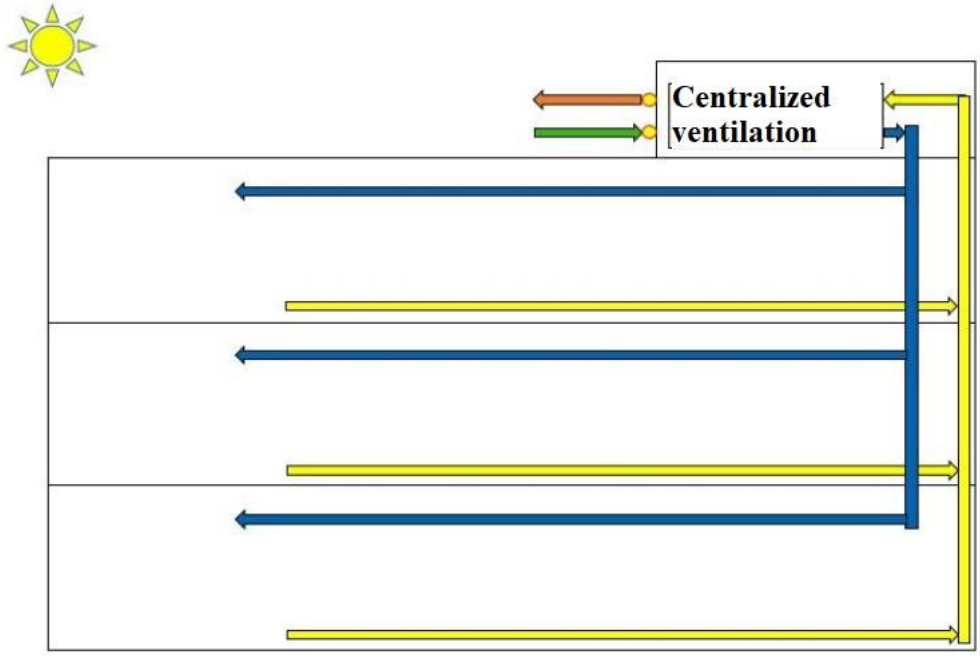
Centralized vs. decentralized ventilation

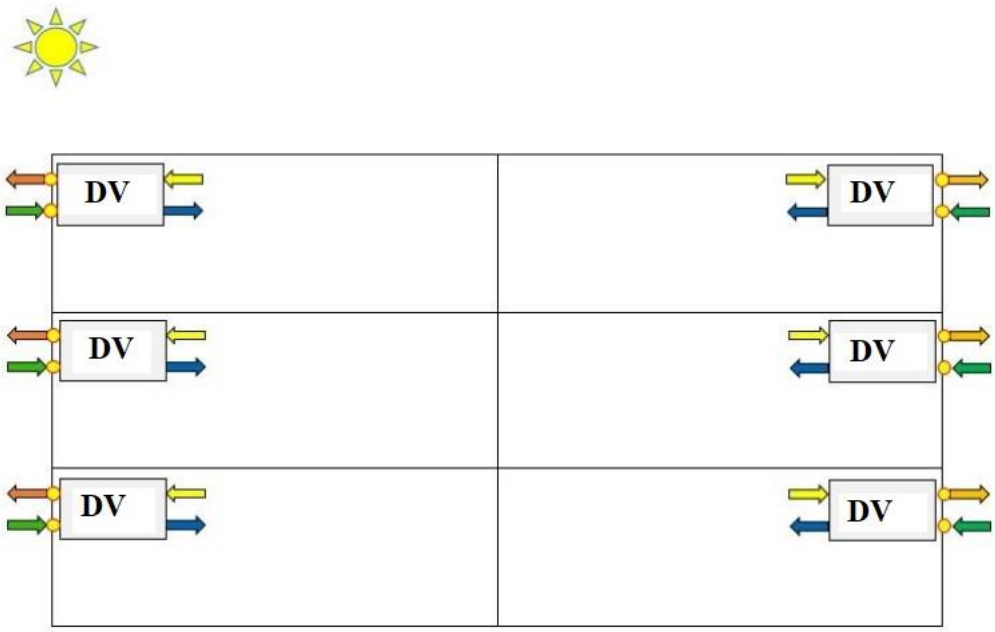
Activity leader
Gate 21, Denmark

Background and motives
Give an overview of the pros and cons in relation to installing centralized and decentralized ventilation.

Method
Conduct information on centralized and decentralized ventilation, including installation, maintenance, and costs. The two systems are explained in separate schemes.

Result
The different schemes outline opportunities and barriers in relation to installation, operation and maintenance of centralized and decentralized ventilation. Centralized ventilation systems use a ductwork to transport the supply and extract air, while decentralized systems, each device equipped with a heat exchanger and fans, are usually placed directly in the facade of the building.





In the following tables the pros and cons of centralized and decentralized ventilation systems are summarized respectively.

Centralized ventilation

PROS

1	It requires few penetrations for air intake and removal (i).
2	They are easy to control from one central thermostat (i).
3	Comfortable, consistent temperature from room to room (v).
4	Noise pollution is often lower with centralized systems, because with a centralized fan it is possible to buffer the sound so that noise from the fan will not be heard in living areas (vi).
5	Maintenance cost are usually lower than in decentralized solutions because of the fewer units to service (i).

CONS

1	Usually takes up more space than the decentralized ventilation systems, because it requires the installation of a ductwork to transport the supply and extract of air. It also requires space for a large mechanical room (i).
2	It normally requires the installation of new fire and smoke dampers (i).
3	It isn't possible to make a stepwise replacement of the old ventilation system. Therefore, there will probably be more costs for rehousing the users, while the renovations take place (i).
4	Higher energy consumption compared to decentralized ventilation (ii, iii).

Decentralized ventilation

PROS

1	Usually takes up less space than the central ventilation systems. It has multiple, small mechanical rooms (i).
2	It normally won't require additional fire protection costs(i).
3	It is possible to make a stepwise replacement of the old ventilation systems, and by that the remaining rooms continue to be available for the users. This can reduce the cost of rehousing (i).
4	Despite of the lower efficiencies of smaller fans compared to bigger ones, the missing ductwork leads to lower pressure losses for decentralized devices and thus, to a lower power consumption (ii, iii).
5	Allows for easier individual control of separate spaces (v).

CONS

1	It requires many penetrations for air intake and removal (i).
2	Maintenance can be more expensive because of the many units, although there are examples of cloud solutions, where it is possible to control all the decentralized units online from one location (i).
3	Decentralized systems produce higher noise levels (ii).

Installation costs

Regarding the installation cost, there is no clear answer to whether centralized or decentralized systems are to prefer. Some authors (iv) have found that initial cost could be 27% higher for decentralized systems, while others have come to the opposite conclusion, and consider decentralized ventilation to have lower installation costs than centralized solutions, as it is possible to avoid running new ductwork throughout the building (vii). However, the installation costs depend to a large degree on whether the ventilation systems are installed in older buildings or as part of a newbuilding. In the former case, it can generally be less expensive to use a decentralized approach to ventilation (vi).

References

i. Tranholm, Gitte and Sall, Lars
2018 "Vælg en ventilationsløsning som passer til din skole", Projekt *Skolerenovering i en helhed*

ii. Merzkirch, Alexander; Maas, Stefan; Scholzen, Frank and Waldmann, Daniele
2016 "Field tests of centralized and decentralized ventilation units inresidential buildings – Specific fan power, heat recovery efficiency,shortcuts and volume flow unbalances", *Journal of Energy and Buildings* 116, pp. 376-383

iii. Kim, Moon Keun and Baldini, Luca
2016 "Energy analysis of a decentralized ventilation system compared with centralized ventilation systems in European climates: Based on review of analyses", *Journal of Energy and Buildings* 111, pp. 424-433

iv. Lindvall, Sara
2018 *"Comparison of centralized and decentralized ventilation in a multifamily building in Stockholm – an LCA study",* Degree project in the field of technology energy and environment, Stockholm, KTH Royal Institute of Technology, School of Industrial Engineering and Management

v. Presidential Heating and Air Conditioning
2017 *"Understanding Centralized and Decentralized Heating Systems",* https://www.presidentialheatandair.com/understanding-heating-systems/ (accessed November 12, 2018)

vi. De Torres, Dustin
2015 *"Centralized Whole House Ventilation Systems versus Decentralized Spot Balanced Ventilation",* Zehnder, http://info.zehnderamerica.com/blog/centralized-whole-house-ventilation-systems-versus-decentralized-spot-balanced-ventilation (accessed November 30, 2018)

vii. Kristiansen, Kirsten Vernon
2015 "Bedre indeklima på skoler i Faxe", *Magasinet Skolen* 2, pp. 60-61

Energy efficient light – learning environments and health issues

Activity leader
Gate 21, Denmark

Background and motives
Give examples of how innovative light solutions can give other positive effects than just being energy efficient.

Method
Share four good examples of installation of energy efficient light and their effect on other areas, including:

- Canteen lighting for reduced food waste
- Good light enhances the children's learning outcome in schools
- Dynamic lighting in classrooms
- Circadian Lighting

Result
Knowledge of the positive effect of light in relation to health, learning situations and waste.

Introduction
Investment in energy efficient light in public buildings help municipalities, as well as regional and national entities, fulfilling their climate goals and obligations. However, light should not just be energy efficient, but comply with the need of good working and learning environments for the users of those buildings, and the health of patients and residents in nursing homes.
This document gives examples of how innovative light solutions can give other positive effects than just being energy efficient.

Good examples

Canteen lighting for reduced food waste
In the public school in Dalby in southern Sweden, in the municipality of Lund, a rebuilding of the canteen turned out to be more than just a project about saving energy. Part of the project was about the new lighting solution, which has the aim of creating a more pleasant environment with less noise and reduced food waste as a result (Lighting Metropolis, 2017a). This is an example of a project that thinks wider than just about assuring lower installed effect.

As illustrated by several studies, food waste is an immense problem. It is suggested that in England, over a school year, in the primary and secondary schools there is a total food waste of 80.382 tons. And another study shows that in a Welsh hospital food waste range between 19% and 66% per meal (Falasconi et al, 2015). Obviously, innovative light alone can't put an end to food waste, but if it could be part of the solution, then it is certainly worth make use of the lessons learned from this project, and scale it up to other cafeterias in public buildings. Furthermore, it is expected that the new light solution will increase the number of children wanting to eat in the cafeteria. This should also be acknowledged, considering that making sure the children are well fed is paramount to their ability to succeed academically (Brody, 2017).

Good light enhances the children's learning outcome in schools

In the Danish municipality Ballerup, it was tested how different lighting solutions can support the learning environment in schools. In the public school Skovlunde Skole Nord, two classrooms were selected for the project. In one of the classrooms, the luminaires had a directional optic, which makes the light less diffuse and more directional (Figure 1).

Figure 1: classroom with more directional light

In the second room, the luminaires had a micro prismatic optic that diffuses the light in the room with a very even spread and thus a low glare (figure 2).

Figure 2: Classroom with a very even spread

Students and teachers had a good perception of both light solutions. However, the evaluations varied a bit from one classroom to another. In the first classroom (figure 1), the students and the teachers described the light as 'cozy' and 'comfortable', while students and teachers from the other classroom (figure 2) described their light as a 'good working light', and that 'it was easier to watch' in this room. In some learning situations, it might be that a more directional lighting is the best choice, while in other learning situations the best choice would be a more diffuse lighting. The important thing is that the lighting must be adapted to the function and use of the classroom. This project stresses that it isn't just a matter of assuring that a light solution meets some specific energy saving standards, but also to make sure that the selected light solution is the best for stimulating a good working and learning environment (Larsen, Lybeck and Makvart, 2018).

Dynamic lighting in classrooms

In the Danish Municipality Albertslund it is tested whether new lighting designs can improve concentration and the ability to learn. On the public school Herstedlund four class room were renovated, and the new lighting design involves three predefined lighting settings: 1) a smartboard mode, for teaching at smartboards, 2) a fresh/focus mode, for focus on the teacher, and 3) a calm/relaxed mode, for focus on the pupils and a cosy atmosphere. The results show that the different settings enable the teacher to structure activities, and through this decrease the noise levels and improve the learning outcome (Lighting Metropolis, 2017b). However, an important factor is that the light should be easy to operate for the teacher (Larsen, Lybeck and Makvart, 2018).

The implicit effects of lighting on learning and classroom achievement cannot be dismissed. As Mott et al. (2012) mention, *"visual impairments alone can induce behavioral problems in students, and the level of concentration and motivation in the classroom".* In the study of Mott et al (2012) they reported that focus lighting led to an increase in oral reading fluency performance of the students.

Circadian Lighting

In 2017 the Nobel Prize was awarded to three scientists *"for their discoveries of molecular mechanisms controlling the circadian rhythm"* (The Nobel Assembly at Karolinska Institutet, 2017). When there is a mismatch between our internal biological clock and the external environment, our wellbeing is affected. Among the critical functions that can be affected are such things as behavior, hormone levels, sleep, body temperature and metabolism. Furthermore, it is also found that it can lead to an increase risk for various diseases (The Nobel Assembly at Karolinska Institutet, 2017). For those reasons it is very interesting to take a look at some of the experiences from Circadian Rhythm Lighting.

Circadian Lighting changes during the day and night, with the strongest light in the middle of the day, and at night there is a special night light, without the blue tones.

Circadian Lighting on hospitals

In most hospitals there is the same light intensity around the clock. However, this has negative effect on the health of the nurses working at night. In a recent study carried out on two Danish Hospitals, it was found that installing circadian lighting had a positive influence on the working environment and the behavior of staff (Aarhus University Hospital, Rigshospitalet, and Chromaviso, 2018).

A recent hospital-based study has proven that circadian lighting has a positive effect on stroke habilitation. Stroke is frequently accompanied by depression, but the study showed that patients lying on the section with circadian lighting had significantly reduced depressive mood, compared to patients in sections with normal lighting (West et al., 2017).

Circadian lighting also plays a central part in a new project that Psychiatric Center Copenhagen is in charge of (Psychiatric Center Copenhagen, 2018). The first results indicate that the working environment has improved for the staff and it is reported that the patients sleep better (Bispebjerg Hospital, 2017). If the wellbeing of the patients improves, it is expected to lead to a reduction in the use of medication. Furthermore, it is also demonstrated that circadian lighting is linked with the duration of patients' inpatient stay (Chromaviso, 2018c).

Figure 3: As the day progresses, the natural light emitted by the sun changes in color, angle, and intensity. A circadian lighting system can be designed to mimic that progression. Image taken from Chromaviso (2018a).

Circadian Lighting: a great success for residents and staff in a dementia center

In the Danish municipality of Lemvig, they installed circadian lighting in a dementia center. The results were overwhelmingly good. The residents gained more energy, slept better, and the staff reported that they got less exhausted by working here, compared to other places with normal lighting (Kamstrup, 2018). Similar experiments are currently carried out in the Danish municipality Albertslund, where it will be tested whether circadian lighting has an effect on the

aging process and risk of disease as well as quality of life, appetite, depression, delirium, sleep, symptoms of dementia and mobility (Chromaviso, 2018b).

References

Aarhus University Hospital; Rigshospitalet, and Chromaviso
2018 *"Døgnrytmelys kan hjælpe sygeplejersker i skiftende vagter",* http://www.auh.dk/presse/information-om-auh/nyheder/2018/dognrytmelys-kan-hjalpe-sygeplejersker-i-skiftende-vagter/ (accessed December 14, 2018)

Bispebjerg Hospital
2017 *" Lyset er med til at helbrede i Ny Psykiatri Bispebjerg",* https://www.bispebjerghospital.dk/nythospital/nyt-og-presse/nyheder/2017/Sider/Lyset-er-med-til-at-helbrede-i-Ny-Psykiatri-Bispebjerg.aspx (accessed December 14, 2018).

Brody, Jane E.
2017 *"Feeding Young Minds: The Importance of School Lunches",* The New York Times, https://www.nytimes.com/2017/06/05/well/feeding-young-minds-the-importance-of-school-lunches.html (accessed December 7, 2018)

Chromaviso
2018a *"Pilotstudie: Effekten af døgnrytmelys på sygeplejersker som arbejder i skiftende vagter",* https://chromaviso.com/doegnrytmelys/forskning-i-ergonomisk-doegnrytmelys/pilotstudie-effekten-af-doegnrytmelys-paa-sygeplejersker-som-arbejder-i-skiftende-vagter/ (accessed December 14, 2018)
2018b *" Klinisk forskning: Døgnrytmelys som velfærdsteknologi på plejecenter",* https://chromaviso.com/doegnrytmelys/forskning-i-ergonomisk-doegnrytmelys/klinisk-forskning-doegnrytmelys-som-velfaerdsteknologi-paa-plejecenter/ (accessed December 14, 2018)
2018c *"Clinical research: Therapeutic lighting for swifter recovery",* https://chromaviso.com/en/circadian-lighting/research-in-circadian-lighting/clinical-research-therapeutic-lighting-for-swifter-recovery/ (accessed December 14, 2018)

Falasconi, Luca; Vittuari, Matteo; Politano, Alessandro and Segrè, Andrea
2015 "Food Waste in School Catering: An Italian Case Study", *Sustainability* 7, pp. 14745-14760

Kamstrup, Lars
2018 "*Døgnrytmelys en stor succes*", Folkebladet Lemvig, March 31

Larsen, Malene Bugge; Lybeck, Casper; Makvart, Jakob
2018 *"Det rigtige lys letter læringen",* Energiforum Danmark, https://www.energiforumdanmark.dk/app-magasiner/2018/april-tema-energiomstilling/det-rigtige-lys-letter-laringen/

Lighting Metropolis

2017a *"Reducing food waste in school canteens by creating a welcome and attractive eating environment",* https://lightingmetropolis.com/blog/projects_post/canteen-lighting-for-reduced-foodwaste/ (accessed December 7, 2018)
2017b *"Light & learning at schools",* https://lightingmetropolis.com/blog/projects_post/light-learning-at-schools/ (accessed December 14, 2018)

Mott, Michael S.; Daniel H. Robinson; Ashley Walden; Jodie Burnette and Angela S. Rutherford
2012 "Illuminating the Effects of Dynamic Lighting on Student Learning", Sage Open, https://journals.sagepub.com/doi/abs/10.1177/2158244012445585 (accessed December 14, 2018)

Psychiatric Center Copenhagen
2018 *"Fremtidens sengestue blev indviet på toppen af Bispebjerg Hospital",* https://www.psykiatri-regionh.dk/presse-og-nyt/pressemeddelelser-og-nyheder/Nyheder-og-pressemeddelelser/Sider/Fremtidens-sengestue-blev-indviet-p%C3%A5-toppen-af-Bispebjerg-Hospital.aspx (accessed December 14, 2018)

The Nobel Assembly at Karolinska Institutet
2017 *"The Nobel Assembly at Karolinska Institutet has today decided to award the 2017 Nobel Prize in Physiology or Medicine jointly to Jeffrey C. Hall, Michael Rosbash and Michael W. Young for their discoveries of molecular mechanisms controlling the circadian rhythm",* https://www.nobelprize.org/uploads/2018/06/press-39.pdf (accessed December 14, 2018)

West, Anders; Poul Jennum; Sofie Amalie Simonsen; Birgit Sander; Milena Pavlova and Helle K. Iversen
2017 "Impact of naturalistic lighting on hospitalized stroke patients in a rehabilitation unit: Design and measurement", *Chronobiology International*, 34 (6), pp 687-697

Circadian lighting

Activity leader

Gate 21, Denmark

Background and motives

Circadian lighting is a new technical solution, the case partner in Denmark knew a project (Lightel) that has tested the effect and followed up on results to collect experiences for future projects testing or implementing circadian lighting.

Method

Data was based on the final report of the anthropological results that was send to case partner in Denmark by the Lightel project owner. Data was from reading the final report from the project.

Result

The ELFORSK project Lightel investigated the effect of circadian lighting in elderly homes in the municipality of Albertslund. The project was carried out from October 2017 to March 2018 and entailed a trial group of 22 inhabitants and a control group of 16 inhabitants. The lighting was set-up in the 22 individual homes at the elderly home and at one common area.

The project entailed three methodologies; anthropological, clinical and sensor based research. The anthropological study has been finished, but the two others are still awaiting to be peer reviewed. The findings in the anthropological study was that both the inhabitant and employees experienced that the circadian lighting had a beneficial effect on the circardian rhythm, better sleep and reduced the *delir* (unrest) of the inhabitants.

So far, the overall recommendations from the project are:

- It is a difficult trial group, since their health is inevitably going downwards
- The lighting from the inhabitants earlier home have a significant effect on their way of "feeling at home", therefore the circadian lighting must be integrated with the inhabitants lighting
- IoT-control can reduce the energy consumption. In the trial case the energy consumption was greater than at the control group, yet the overall energy consumption was still below the average in Denmark since the elderly home has new LED lighting

The sensor based and clinical study focused on sleep quality, physical and psychological function by carrying out questionnaires, functional and cognitive tests, collecting blood samples and collecting sensor-based data from wrists and legs. The results from the study are expected to be published in 2020, when the peer-reviewing is done.

Monitoring, steering and control for thermal heating

Activity leader

Inland County Council, Norway

Background and motives

EE+ Hands on regulation learns the thermodynamics of the building and ensures the correct supply of thermal energy, thus maintaining stable temperature at the desired level. Over the year, the purchase of energy is reduced by 10 to 25%.

Several wireless sensors are placed in selected zones / apartments in the building. These have a practical display showing temperature and relative humidity. At the same time, the sensors report to smart software on the Internet, which calculates the correct flow temperature for controlling each heat section.

How is traditional regulation?
Traditional regulation takes place based on the temperature outside the building, usually on the north side. A configuration curve ensures that the operating temperature is determined at a given outdoor temperature.

Frequently this regulation is supplemented by thermostat control of zones and / or each radiator and loop with underfloor heating. It is easy to understand that there are fluctuations in temperature inside the building and low efficiency utilization of energy, when the regulation does not take into account changing temperature outside, does not immediately change the indoor temperature. Thermostat control ensures that additional heat supply in each room (from sun, humans and electrical equipment), to some extent is taken into account. However, thermostats in zones and radiators do not react until a change of 1-2 degrees has occurred.

Method

EE+ Hands on regulation uses artificial intelligence and learn how stable heat balances are achieved and maintained in the particular building. Thereafter, the supply of heat energy is regulated to maintain the desired and stable internal temperature, while saving from 10 to 25% of purchased energy. *EE+ Hands on regulation* uses a wireless mesh network tailored for simultaneous use of the most common communication protocols. The network can communicate data for a large number of different sensors and actuators - a convenient digital platform to make existing buildings smarter.

The heating system at Storhamar School, Hamar, was used as a pilot in the development of EE+ Hands on regulation.

Result

Storhamar School is the oldest school in Hamar. With its buildings from different periods - oldest from 1914 and newest from 1997 – the piloting involved some challenges with how the system could be regulated. After overcoming these challenges, the statistics is showing savings of over 20% from autumn 2016 up to 2020. More than that, the potential of even more savings is very likely once the heating coils for ventilation could be connected to the control of the heating system.

In this graphic, the temperature-adjusted consumption of energy for Storhamar School is presented. As can be seen, the curve changes for 2016 from April, and the change is significant from August to September. The stakes showing January, February and March 2017 have the same trend as the results from 2016 fall.

The next task for Hamar municipality is to install *EE+ Hands on* in another three of their properties. These are Hamar Town Hall, a school, and a kindergarten.

v2 of *Hands on regulation* links the heating system and ventilation and maintains the correct CO2 level and high energy efficiency, as well as alerting for abnormal energy consumption under various weather conditions, using a local weather station and artificial intelligence. v2 was being developed in 2018.

Water cleaning in thermal heating systems

Activity leader

Inland County Council, Norway

Background and motives

Øvrebyen upper secondary school is a situated in Kongsvinger, a small town with approximately 12 000 inhabitants in Hedmark county, Norway. The school has a heated area of 7 602 m^2.

The school is built in several construction stages, but mainly in the 1990s. The technical facilities are largely from the construction years. The school has a water-based heating system connected to district heating plants in Kongsvinger.

A water treatment construction, of the brand Enwamatic, were installed on the heating system's 3 water circuits in May 2018. The purpose of the installation was to ensure the correct water quality in the water-borne heating system. The building owner also sought to find out if the correct water quality in the heating system also provided a more energy efficient plant, since experience shows that it reduces inner coating or "plaque" in pipes and heaters.

Method

For several years, many small measures have been implemented at the school to optimize operations and reduce energy consumption for heating.

Result

Comparisons of energy consumption before and after the water treatment measure do not capture any effect of other energy efficient measures taken during the same period. Even so the assumption is that there is a positive trend reducing the energy consumption due to this specific measure.

It is only the recorded energy consumption data on the water-based heating system that is a basis for the reduced consumption. Possible reduced energy consumption of electric power due to lower resistance in the piping system has not been measured or considered in this context. This would anyhow represent such a small percentage of total electrical consumption that we would not be able to see the effect with the available data.

Experiences after first year of operation

When comparing the average temperature-adjusted consumption figures for the period 2014-2017, there is reduced consumption of 6 % in the period May 2018 - April 2019.
Compared to the prior year of lowest consumption during the period, the reduced consumption is 4.3 %.

The plant has had stable operation throughout the period. So far there are also positive experiences with parts of the plant where it uses to be difficult to maintain desired room temperatures. This seem to work better than before implementing the water treatment measure.

There is still a need to monitor the facility for an extended period of time to see if this trend persists. There is also a need to evaluate if there are other measures that may have affected the energy saving results.

Procurement of energy efficient solutions

Even if building managers have concluded what kind of quality they are aiming for with a certain technical solution, it is not always easy to formulate a request for tender that actually in the end deliver that. The project has for some critical areas developed templates and recommendations that can be used by building managers in the Baltic Sea Region when investing in energy efficiency technology, especially public organizations with special requirements for public procurement.

The following guidelines and templates for procurements have been developed:

- Procurement of solar energy PV plants
- Procurement of indoor climate; light, thermal, air quality and acoustics
- Procurement of Energy performance maintaining contracts
- Procurement of energy monitoring systems

Procurement of solar energy PV plants

Tool and templates for procurements of solar energy PV plants are being presented in the toolbox for Prosumerism and consist of:

- Guideline for solar energy (strategic) planning
- Guideline for step-by-step to become a prosumerist
- Guideline for procurement of solar energy
- Prosumerism calculation tool

Procurement of indoor climate; light, thermal, air quality and acoustics

Tool for procurements of a good indoor climate are being presented in the toolbox for Multi Service Contracts.

Energy Performance Maintenance Contracts, EPMC

Basis for purchase of Performance-based services regarding ventilation, heating, cooling and controls in buildings

The document
The purpose of this document is to serve as a basis or foundation for purchasing of services regarding ventilation, heating, cooling and controls in buildings, with the purpose of achieving best possible energy efficiency and system function. 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 which functions shall be maintained and how the service provider can prove success. For results above or below agreed level of performance there will be a bonus or a fine. The contract can thereby be denoted as an "Energy Performance Maintenance Contract, EPMC" (compare EPC for investments).

This appendix to the RFP aims to highlight the need for routines and accompanying documents that will lead to continuous improvements regarding the use of energy and it is intended to be used for every new service contract that is signed.

By establishing this comprehensive document, we ensure that our investments, buildings and systems are regarded in long term and that also the energy costs for these buildings and systems are taken into account over a given period of time. Furthermore, we also put certain demands on our service providers; we make it clear that we valuate energy efficient solutions and systems of good quality (although such solutions initially may be more expensive) and we also encourage them, through these demands, to develop more efficient systems and units, to train their personnel and to take part of the responsibility for our energy costs.

GENERAL PART

This general part can be used as a part of the RFP in the purchasing of services, in addition to specification of other terms and demands.

PURPOSE OF THE PURCHASING, ECONOMY AND ENVIRONMENT

The purpose is to increase the focus on the function and energy efficiency of equipment and systems. Energy is a scarce resource globally. The world´s reserves of fossil fuels are diminishing fast. The costs related to the extraction of these energy resources are rising as it is harder and harder to reach them. For the users of energy this means increasing prices. The price increase on energy is faster than general cost escalation.

The Customer AA purchases large volumes of energy every year for ventilation, heating and cooling of buildings.

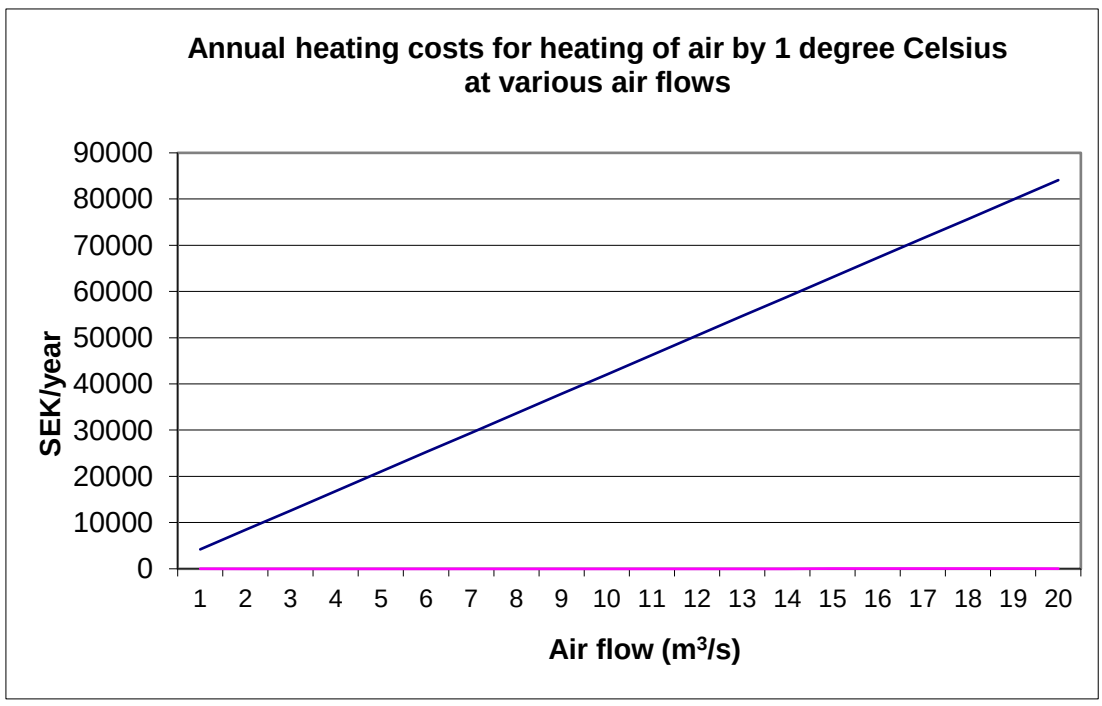
Common for all purchased energy, purchased for the benefit of our personnel, alternatively our tenants, and our business, is that there are always commodities like coal, oil, uranium, or renewable fuels etc. as the sources of this energy. Every used unit of energy thereby leads to the use of fuels somewhere in the global or local energy supply system so that our needs of energy can be satisfied. Therefore, all use of energy also affects the local and the global environment. The connection between energy and environment is a reality that always must be considered.

The primary purpose of the purchased services that this document describes is to form a basis for a structured way of working by the chosen supplier of services that leads to:

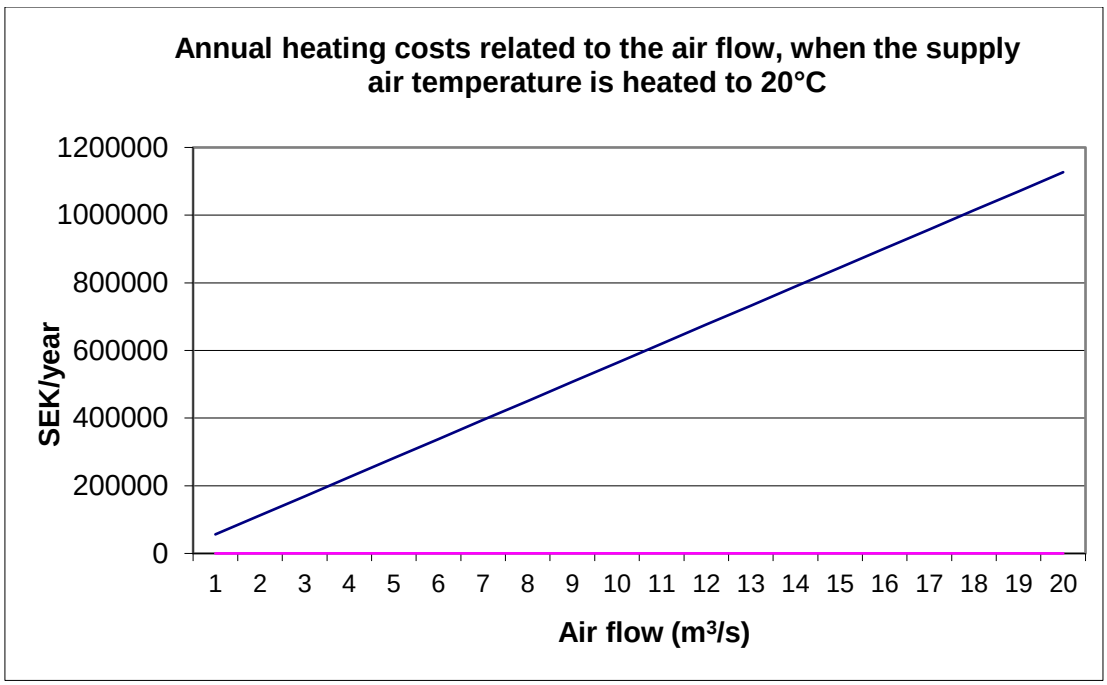
- More efficient equipment and buildings.
- Lower operational costs regarding energy, thereby also better profitability.
- Reduced environmental impact from our buildings and businesses.
- Minimised need for future investments since equipment and systems are serviced, maintained and operated is such a way that their span of life is prolonged.
- The maintaining of functions in existing equipment.

By showing that we take our responsibility towards an efficient use of energy with as little environmental impact as possible, we also can gain valuable goodwill.

The following charts show the importance in working actively to reduce the use of energy for ventilation. The numbers are based on the climate conditions in the center of Sweden and a cost of heating energy of 1 SEK/kWh.



This means that e.g. in one of our buildings, where we have a total ventilation air flow of 5 m^3/s, it costs us 21 000 SEK extra per year if we heat the supply air 1 degree Celsius too much, for nothing.



Heating 5 m^3/s of air all year round to 20 °C costs 282 000 SEK. With a functioning heat recovery, the cost is half of that or less. So, that the service provider keep systems operating and operating well has a large economic value.

DEMANDS FOR QUALIFICATION

The suppliers of the requested services shall have the following competences and experiences:

- Certificate for mandatory ventilation control (OVK in Sweden) regarding services of ventilation systems.
- Certificate for cooling according to Swedac or similar international certification body if the purchased services are related to cooling systems.

DESCRIPTION OF THE TASK

The customer AA operates as follows:

- Renting commercial spaces and/or apartments
- Office work in office spaces in own building
- Industrial manufacturing in own building
  (Cross over non-relevant or type in something else)

Buildings that are included in this purchasing

(Type data relevant for the buildings that are included in this purchasing of services…)

Priority order for facility management and maintenance

The service of the building´s systems shall be done with the use of a minimum of scarce and environmentally bad resources as possible. This can, however, not be overdone so that other demands and valuations are jeopardised. Therefore it is important to establish the following priority order, that shall not be overlooked:

1. The demands by Authorities on the business of *the customer AA*

2. The health, the safety and the working conditions for personnel

3. Norms for various activities and technical systems

4. External environmental impact, locally and globally

The demands by the authorities on building owners do include control over energy use and that implemented measures to reduce energy use and if possible, to use only renewable energy.

Focus

We want the suppliers of services addressed and asked for proposals to focus on the following important factors:

- Trimming of equipment for best possible performance
- Continuously maintain good operation of equipment and systems
- Control of the energy efficiency of systems
- Identification of potential for improvement of performance
- The education, training and development of the personnel of the service provider that can be of good use for *The customer AA*

Performance of service

How we expect that the service provider performs services agreed upon in the final contract are describes in an appendix that accompanies the RFP.

EVALUATION OF OFFERS

Received proposals/offers will be evaluated based on price, competence and experience and the following criteria:

(Specify which evaluation criteria that will be used.)

TERMS FOR CONTRACT

The customer AA intends to sign the following contract with the service provider:

Parties

Xxx

Contract period

Xxx

Contract documents

The contract documents complement each other. If the contractual documents in some aspect are contradictory it will be specified that they are valid according to the following order:

1. The description in the RFP with the headlines; ”Purpose of the purchasing, Economy and Environment” and ”Description of the task”.
2. Potential changes and amendments to the contract.
3. The contract and the description of buildings and systems.
4. Other parts of the RFP.
5. ABFF15 (Swedish regulations, choose what is applicable for building related services and maintenance in your respective country)
6. The proposal from the Provider of services

How to perform the task

This general description of the task in the RFP will be used for all applicable equipment and systems in the participating buildings. In the appendices 1 – 4 we have included detailed check lists for services related to operation and maintenance of systems for ventilation, heating, cooling and controls. Controls are naturally also part of the other 3 systems and do not always have to be treated separately.

These check lists are suggested for the selected service provider to use at every service visit within the framework of the signed service contract. If the service provider has equal check list that will give the same good result as the once provided here it is possible that *The customer AA* can agree to use the check lists of the service provider.

At every visit by personnel from the service provider for service or other work according to the contract within a building or system it is of outmost importance that the visit is acknowledged by authorised personnel within the organisation of *The customer AA*. During the

acknowledgment a verbal report will be given, later on followed by a written report, such as updated check lists.

Suggestions regarding potential performance improvement is supported and shall be reported to the customer after every visit, if such improvements have been identified. See also respective appendixes.

In the case of faults or mistakes that lead to emergency visits it is essential that the cause of the fault is established and that measures are taken to avoid future similar faults.

Follow-up

The purchasers want confirmation that all planned service visits have been performed and that systems are operated as efficiently as possible. This means including the following parameters in the contract. The service provider will be given the opportunity to verify the parameters before the contract period starts, with the purpose of reaching a mutual agreement on what levels that are to be reached.

Temperature

Indoor temperature shall be _____^{o}C, plus/minus 1 degree C.

Supply air

Total supply air flow within the building/buildings shall be _____m^3/s and is not allowed to diminish by more than 20 % before an exchange of filters is done.

Heat recovery:

The temperature efficiency regarding heat recovery in Air handling unit _____shall be at least _____%.

The temperature efficiency regarding heat recovery in Air handling unit _____shall be at least _____%.

The temperature efficiency regarding heat recovery in Air handling unit _____shall be at least _____%.

and so on.....

Further parameters that are agreed upon

Xxx

Energy use

By keeping the levels agreed above we conclude that the energy use of the building(s) during a normal year should be kept at _____ kWh/m^2/år (start value). Specify individually for every building.

Compensation, bonus and penalty

Compensation for the provided services are paid as a fixed annual amount in accordance with the accepted offer.

If the agreed upon energy efficiency is not maintained there will be a penalty of 0,5 SEK/kWh * building area * specific energy use based on the buildings area of _____m^2 unless the service provider can prove that the increased energy use is a result of circumstances that are beyond what the service provider can control.
The penalty is paid as a lump sum for the actual year and is based on an energy cost for heating that is *1 SEK per kWh.*
If the energy use is lower than the start value there will be a bonus paid to the service provider, likewise based on an energy cost for heating that is *1 SEK per kWh.*
After the end of every year of the contract the annual energy use for heat is calculated. The calculated energy use is adjusted according to the degree days of the year in question. Compare with the start value.
Example for a building, 1 000 m^2 with a specific energy use of 140 kWh/m^2/år (heating)
Normal energy use: 140 000 kWh/year (start value)
If the measured and adjusted energy use is 145 000 kWh/year or above there will be a penalty of *2 500 SEK.*

If the measured and adjusted energy use is 135 000 kWh/year or below there will be a bonus of *2 500 SEK.*

Invoicing and terms of payment

Specify how invoices are handled, terms of payment etc.

Responsibility

Demands regarding insurances for liability

Termination and transfer of the contract

Specify terms on how the contract can be terminated or transferred to another party.

ANNEXES

Control report of demands according to the contract
Check list heating
Check list cooling
Check list ventilation
Check list controls

For customer AA *Service provider*

_____ _____

Date Date

_____

Name Name

Control report for" Contract for purchase of Performance-based services regarding ventilation, heating, cooling and controls in buildings"

This control report will be presented to the customer at every service visit.

Today a control has been performed showing the following demands and parameters are within the boundaries of the service contract:

Temperature
Indoor temperature is _____ ^{o}C (demand _____ ^{o}C plus/minus 1 degree C)

Supply air
Total supply air flow within the building/buildings is measured to be _____m^3/s (demand _____m^3/s +/- 20 %)

Heat recovery:
The temperature efficiency regarding heat recovery in Air handling unit _____is _____% (demand_____%)

The temperature efficiency regarding heat recovery in Air handling unit _____is _____% (demand_____%)

The temperature efficiency regarding heat recovery in Air handling unit _____is _____% (demand_____%)

and so on.....

Further parameters that are agreed upon

Xxx

Energy use
By maintaining the parameters above we conclude that the enery use of the building(s) during a normal year can remain at _____ kWh/m^2/år (start value).

City and date:_____

Signature: _____ Typed name:_____

ANNEX

Checklist for services regarding heating systems in buildings

Facility: _____ Date: _____

Address/premises/building: _____

Meter number for district heating: _____

BASIC DATA

Agreed temperature levels	
Potential reduction of temperatures during night and weekend	
Pump stop, based on 3 day average outdoor temperature, at oC	
Set point for temperature difference ΔT in district heating oC (e.g. > 45 oC)	

CONTROL REPORT

Control set points for temperatures, off-sets, curves and break points of curves. Is the supply temperature control correct and efficient?	
If there is night or weekend temperature reductions, is this done correctly?	
Control that pump stop works as intended and at the right outdoor temperature	
Control that the weekly motioning of pumps works (summer time)	

Meter readings and follow-up of energy use

Month	Energy (MWh)	Flow (m^3)	Degree days	m^3/MWh	MWh/degreeday
1					
2					

3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Meter readings and follow-up of temperatures

Month	Outdoor temp.	Temp room 1	Temp room 2	Temp room 3	Temp room 4	Domestic hot water	Complaints
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Control and follow-up of temperature differences in district heating

ΔT		Deviation/ notes	

GENERAL

Is the supply water temperature controlled with respect to the outdoor temperature?

Proposed measures: _____

_____

Leaking heat exchangers, valves, pumps

Proposed measures: _____

_____

Noise from valves and pumps

Proposed measures: _____

_____

Pump stop function exists and is in use? At which outdoor temperature is the circulation pumps stopped?

Proposed measures: _____

_____

“Pump motioning” (are pumps run for short periods regularly also when there is no need for heat?)

Proposed measures: _____

_____

City and date:_____

Signature: _____ Typed name:_____

ANNEX
Checklist for services regarding
cooling systems in buildings

Facility: _____ Date: _____

Address/building: _____

Refrigerant: _____Quantity: _____

Cooling objects (rooms, air handling units, cooling baffles):

_____

BASIC DATA

Temperature set point for cooling	
If increased temperatures during night and weekend, to which temperature?	
Pump stop, based on 3-day average outdoor temperature, at oC	
Set point for temperature difference ΔT, cooling oC (e.g. > 8 oC)	

CONTROL REPORT

Control set points	
Control pump stop operation and at the correct temperature	
Control pump motioning operation	
Control that dew point regulation works (cooling baffles)	
Control that cooling is blocked if nighttime cooling is done by air handling units	

CONTROL REPORT FOR FACILITIES OVER 3 KG OF REFRIGERANT

For facilities with more than 3 kg of refrigerant an annual control must be done and the observations denoted in the appropriate journal according to the recommendations by e.g. The Swedish Cooling and Heat pump Association.

Last previous control, date:_____

Report number:_____

Notes in the report: (Inspection passed, leakages, dirt etc.) _____

_____

CONTROL REPORT FOR FACILITIES UNDER 3 KG OF REFRIGERANT

For facilities with less than 3 kg of refrigerant an annual control must be done, and the observations denoted in the appropriate journal according to the recommendations by e.g. The Swedish Cooling and Heat pump Association.

Last previous control, date:_____

Report number:_____

Notes in the report: (Inspection passed, leakages, dirt etc.) _____

_____

GENERAL

What signal controls the chiller? (External control, e.g. ventilation unit, room thermostat or internal controls)

Proposed measures: _____

Other Proposed measures: _____

City and date:_____

Signature: _____ Typed name:_____

ANNEX
Checklist for services regarding
ventilation systems in buildings

Facility: _____ Date: _____

Address/building: _____

Location in buildning:_____

Serves (room, building, department):_____

Heat recovery (type): _____

BASIC DATA

Weekday	Operating hours
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

CONTROL REPORT

Control of temperatures and efficiency of heat recovery

Outdoor air, °C (A)	
Supply air after heat recovery, °C (B)	
Supply air after heating coil, °C	
Exhaust air, °C (C)	
Exhaust air after heat recovery, °C	
Initial efficiency, according to main document	
Controlled efficiency, % * (B-A) / (C-A) x 100	

* The efficiency can only be controlled when there are substantial heating needs.

Follow-up of efficiency

Quarter	Efficiency	Nominal values, efficiency
1		Cross-flow heat exch, 60 %
2		Battery heat exch, 50 %
3		Heat recovery wheel 80 %
4		

Control of pressure drop

Before filter replacement Pa		After filter replacement Pa		Deviations/ notes	

Other controls

Set point for supply air temperature or exhaust air temperature (depending on whether space temperature is controlled with respect to supply or exhaust air temperature). Are temperatures in accordance with contracted temperatures?	
Check that operating hours are set as agreed.	

Dirty coils, fan housing and air intake?	
Check that cooling recovery works.	
Check that programmed night time cooling works.	
Leaking valves and pumps	
Noise from belts and other components	

GENERAL

Are operating hours in accordance with production / office hours? _____

Proposed measures: _____

_____

Is there a timer for over-time work? _____

Proposed measures: _____

_____

Are there different operational modes (full speed, half speed, low speed, frequency control)?_____

Proposed measures: _____

_____

Start-up sequence gives a safe and non-freezing operation?_____

Proposed measures: _____

_____

Cooling recovery possible and/or in operation?_____

Proposed measures: _____

_____

Night time cooling installed? _____

Proposed measures: _____

_____

Other:_____

Proposed measures: _____

_____

City and date:_____

Signature: _____ Typed name:_____

ANNEX
Checklist for energy saving measures regarding control systems in buildings

Facility: _____ Date: _____

This check list is intended to be used to check that the control systems and its components work optimised.

CONTROL REPORT

Check	Deviations and needs for action
Check and adjust regulators, actuators, valves and sensors.	
The calibration of sensors is of importance and should be done at least every third year. Date of last calibration:	
Check that heating is blocked during and after finished nighttime cooling	

GENERAL

The heating and cooling regulation loops include regulators as well as the controlled object. In an optimised unit or facility, the regulation is based on a PI(D) regulator. Stable and non-oscillating regulation is achieved after a maximum of 4 periods, at a change of load corresponding to 25 % of the set point. No self-oscillating circuits are tolerated.

Systems for cooling and heating shall co-exist and not work against each other.

Other: _____

Proposed measures: _____

_____

City and date:_____

Signature: _____ Typed name:_____

Procurement of Energy monitoring systems

Activity leader

State Real Estate Ltd., Estonia

Introduction

In June 2016 State Real Estate Ltd (hereafter: RKAS) made public market research in a wider topic than EMS (energy monitoring system). We wanted to know does it have private market interest or not. Previously we have had PPP-experience and during that time we thought that market could be ready for EPC. To be more precise we wanted to get answers for the following questions:

- How many ESCO companies are in Estonia;
- What are the main boundary conditions for EPC;
- What kind of software are in the market for energy-monitoring;
- How big (heated area, energy consumption) is suitable EPC project/building;
- Etc.

Although the market itself was even non-existent we still got plenty of answers and after that we had several discussions and workshops. We understood that private market was interested to do EPCs and concern the EMS there are plenty of software`s in the market which could help to reduce energy consumption with minimum investment. Research were made before Effect4Building project and on that time Effect4Building project seems the best option to get financial support for making real demo.

Demo I

In May 2018 State Real Estate Ltd. started to prepare procurement documentation. In first phase RKAS choose 5 buildings which fulfill the selection criteria's:

- New or recently renovated building;
- Have existing BMS (building management system);
- Have more than one meter for heat, electricity and water;

RKAS decided to test EMS system for three school buildings (Põlva State School; Võru State School; Tartu State School and two office buildings (Lasnamäe 2, Tallinn and Jaama 207, Tartu). Due to lack of workforce and RKAS internal principle by what RKAS is a qualified customer and project management company not the real performer of the work. RKAS decided to procure energy monitoring solution for test period of one year as a service where contractor do the analyze and everyday tracking of BMS and EMS system.


Jaama 207, Tartu


Võru State School


Lasnamäe 2, Tallinn


Tartu State School


Põlva State School


Lubja 4, Tallinn

In procurement the successful bidder is Estonian local company Hoiame Kokku Grupp OÜ (trademark is Engineering company DeltaE (https://www.deltae.ee/). DeltaE launched EcoScada EMS system and integrate 135 different meters (water, heat, electricity) to EcoScada (https://www.ecoscada.com) platform. After integration in 02.2019 RKAS started one-year test period. During that period DeltaE is analyzing the overall energy consumption through EMS software, if they got indication that consumption is too high, they will figure out the reason of overconsumption in BMS-system. In the end of test period DeltaE will write a report which comply with the open-access principle. This report should give an answer to the following questions:

- How EMS helps building manager? (four different public building managers will share their feedback);
- What are the technical barriers for launching the EMS system for plenty of buildings?
- Technical overview how to use it together and without BMS system and how to get maximum benefit from it?
- Is it profitable to monitor hourly based consumption or not (based on 5 monitored buildings)?
- Test period results for energy consumption in five buildings.

Preliminary results during the period 03.2019 – 11.2019:

Building	Achieved energy cost reduction (EUR)
Lasnamäe 2, Tallinn (office building)	-5040
Jaama 207, Tartu (office building)	-1405
Võru State School	-150
Tartu State School	-8807

Põlva State School	-1096

Although the EMS will give good tool for managers. It makes possible do have a quick overview about real time energy consumption but still their motivation and interest level were too low. Even the maintenance staff and occupant`s interest were not too high. In positive side DeltaE helps to solve lots of indoor climate and other problems in HVAC system. We discovered that the bottleneck is BMS system quality and maintenance. In addition, we made preliminary conclusion that such simplified software doesn't solve our real problem – too high energy consumption in public buildings. We need more advanced smarter software what gives the reason of fault not just the indication that consumption is high.

Demo II

In next step RKAS decided to do additional test in Lubja 4, Tallinn it is a new office building (courthouse with detailed BIM model and A-class BMS system with more than 23 000 data points) to get more comprehensive overview of EMS possibilities. The winner in new procurement is software developer R8Tech (https://r8tech.io/). They had more advanced EMS software:

- Software could elaborate BMS and BIM input data (e.g. in Lubja 4 more than 23 000 points were integrated);
- It has internal fault detection (software itself predicting and auto-detecting root causes and calculating operational cost for irregularities. This reduces systems downtime and the number of complaints from tenants);
- Easy accessibility. It has web based tailored analytical and visual views of energy consumption, whole HVAC condition, weather prediction, real-time energy market data);
- Indoor climate management and possibility to overwrite BMS parameters. 27/7/365 the optimal indoor climate considering ongoing changes in tenant needs, visitor statistics, current weather and the forecast with smart algorithms. The smarter control system avoids overheating, overcooling and overventilation).

Demo nr. 2 procurement technical description was more detailed, and we have better understanding what we want and need to test. We required that the software must have internal AI (artificial intelligence), it must do online (24/7/365) fault detection and it should have possibility to overwrite different values in BMS – so we wanted the software which is capable to even manage the BMS system.

Preliminary results during the period 11.2019 – 12.2019:

Building	Achieved energy cost reduction (EUR)
Lubja 4, office building	-16 600

Conclusion

To sum up our case how to tender EMS is not possible to give very quick answer. It depends the user needs. So firstly, every building manager or local municipality, company etc. should define the goal.

If there are plenty of problems in BMS and complaints from occupants than it is recommended to procure expertise for HVAC and BMS system or dynamic tracking of it (a longer period of analyzing BMS trends and HVAC system work while considering tenants feedback).

If it is necessary to collect metering data into one software, there are plenty of cheap and simple softs in market.

If the aim is energy management of plenty of buildings, it is rather complicated task. And it will be necessary to do exhaustive homework before the procurement. The process itself is described in Figure.

The more accurate is technical requirements or description the better is result. To buy subscription or software we thought that subscription could be more useful.

ANNEX 1 – Market research

INVITATION TO PARTICIPATE IN THE MARKET RESEARCH ON ENERGY SERVICES ORDER

Dear potential partner,

State Real Estate Ltd. (hereinafter the Contracting Authority) is currently conducting a market survey to provide market participants with an overview of their intention to conduct an energy service procurement and feedback from potential interested parties on the main terms and conditions of public procurement, notably market readiness and assessment Your feedback is an input for the procurement of energy service contract by State Real Estate Ltd.

This notice is public and is intended to ensure equal treatment and equal access to information for all interested parties in the contracting authority's proposed procurement of energy services. Participation in this market study will not confer any advantage to any of the participants in any future proposed public procurement.

It is planned to carry out a sample procurement of energy service contract in 2016-2017. After conducting a market survey and analyzing the feedback collected during the course of the market research, the contracting authority takes a position on the terms and type of procurement. Public procurement is conducted through the national electronic public procurement environment (https://riigihanked.riik.ee).

Key terms:
EPC - is an Energy Performance Contracting agreement between a contracting entity and a contractor (usually ESCO) where the contractor's investments in energy saving measures are paid for on the basis of the actual energy savings achieved by the contracting authority.
ESCO refers to the Energy Service Company found for an energy project
source of funding or helping the customer to find it, generates profit from the savings resulting from the energy saving measure and provides a guarantee for the savings, ie. if the expected energy savings do not materialize at the planned level, ESCO will incur losses.
"ENERGY SERVICES" means any physical benefit, service, or good that comes from combining energy with energy efficient technology or activities, which may include contracted operations, maintenance and control required for the provision of the service and which are normally demonstrated to lead to verifiable healing or primary energy savings (2012/27 / EU).

MAIN TERMS AND CONDITIONS OF THE PROPOSED ENERGY SERVICES PROCUREMENT

The contracting authority is seeking a contractor to procure energy services aimed at renovating central government buildings and increasing energy efficiency through financing the cost of energy savings. It is important for the buyer to:
(a) the renovation meets at least the minimum energy performance requirements laid down in the Regulation on the building undergoing major renovation pursuant to Section 65 (3) of the Building Code;
(b) the renovation does not lead to a deterioration of the indoor climate of the building (s) to be renovated;
(c) the contracting authority's monthly expenditure on the management of the building (s) does not increase;

In order to draw up the procurement documents in the best possible way based on today's market situation, please answer the following questions:

1. Have you had any previous experience in providing energy services?
    a. to the private sector
    b. to the public sector
2. What type of energy service contract have you used, and if you are willing to bid for the following types of contract:
    a. a guaranteed energy service contract;
    b. a Shared Savings Energy Service Agreement;
    c. shared savings with co-financing (so-called combined contract).
3. What would be the minimum duration of the energy service contract (for many years) and for which type of contract?
    a. up to 3 years;
    b. 5 years
    c. 10 years
    d. 15 years
    e. sell
4. What would be the minimum annual total cost of energy and the amount of energy (heating + electricity) for the building (s) corresponding to the baseline so that it is realistic and reasonable to apply the energy service to the building?
5. What would be the minimum size of an object / property where to apply the energy service?

6. What would be the investment of € / m2 per contract you are willing to make for the energy service?
7. What kind of work are you prepared to do under the energy service contract (mention sample work)?
8. Who should determine the baseline and when?
9. How do you recommend fixing the indoor climate before and after implementing the energy service?
10. What do you recommend that you ask for a tender in a public procurement and evaluate the contracting authority (whether package of measures, energy savings;….)?
11. What procurement qualification do you recommend to apply?
12. Who should carry out the maintenance of the building's technical systems during the energy service contract? Under what conditions can third party servicing be performed?

We are also looking forward to your suggestions on the energy service contract, the terms of the procurement and the recommended evaluation criteria.
Please send feedback to contact mikk.maivel@rkas.ee no later than 10.08.2016
Mikk Maivel, Energy Efficiency Project Manager at Riigi Kinnisvara AS, phone +372 56 461 251, e-mail mikk.maivel@rkas.ee

ANNEX 2 – Demo I Technical description

Contracting authority: AS Riigi Kinnisvara
Title of the contract: "Testing of the energy monitoring system within the Effect4Buildings project"

TERMS

In the Technical Specification, the Contracting Authority is referred to as the Contracting Authority.
The person to whom the contract is intended to be awarded as a result of this procurement is called the Contractor.

OBJECTIVE OF THE PROCUREMENT

The purpose of public procurement in all parts of the procurement is to test the impact of the energy monitoring system as a novel technological solution and its potential positive effect on optimal property management, measuring the expediency of energy efficiency investments and improving indoor indoor climate. The contracting authority wishes to procure the integration of three school buildings, one office building and one internal security building with an energy monitoring application for the demo period (Procurement divided into lots; energy use deviations from optimal operating modes. The tenderer may submit a tender for only one or two or all of the lots.

The subject of this procurement is the installation of an energy monitoring system and the monitoring of the energy use of buildings after the system has been set up for 12 months, along with regular reporting and improvement of the monitoring system. As part of the activities, the following buildings will be integrated into the monitoring system (Table 1).

Table 1

Part	Building	SCADA	Different meters			
			Heat	Electricity	Water	Total
I	Jaama 207, Tartu (office building)	Niagara AX	4	19	5	28
	Tartu State Gymnasium	Niagara AX	3	4	11	18
	Põlva State Gymnasium	Niagara AX	3	5	7	15
II	Võru State Gymnasium	Siemens Desigo	4	6	6	16
III	Lasnamäe 2, Tallinn (office building)	Metasys, Johnson Controls	3	15	40	58

WORKING DOCUMENTS

The source documents for the works (according to priority) are:

- This Technical Specification;
- Building automation systems implementation documentation (5 buildings)

In the event of a conflict between documents of the same order of priority, the document containing the more stringent requirement shall prevail. In case of discrepancies between the construction documentation and the system built in the building, the contractor must ensure that the purpose of the contracting authority is feasible and therefore a review of the building is required during the procurement procedure. The contractor must ensure that the reliability and performance of the local building automation system are not disrupted and affected by the monitoring and that the performance of the existing system is maintained during and after the monitoring period.

The work must be carried out on the basis of the tender documents as a whole.
All applicable legislation, standards, technical regulations and quality requirements must be observed when carrying out the work.

DEADLINES AND PHASES

The planned commencement of the works shall be carried out immediately after the conclusion of the contract and the execution of works specified in the technical specifications shall be divided into intermediate stages:

Two months from the award of the contract is a preparatory period for the contractor to set up and configure the systems. The Contracting Authority shall provide the Contractor with access to the building automation system and the relevant buildings. Provides the tenderer with all technical and pre-monitoring energy usage information known to the contracting authority.
Thirteen months after the Preparation Period - A test period in which the contractor is required to monitor the monitoring system to make continuous improvements to optimize the performance of the building's technical systems to achieve energy savings, better indoor climate and greater customer satisfaction. If necessary, the contractor shall make the necessary program modifications in building automation in agreement with the Client and the technical staff of the building. The Contractor is required to conduct a written review of the aggregate results of the period and any changes made during the period (first period ending 6 months after the award of the contract; period II ending 9 months after the award of the contract; period III ending 12 months after the award of the contract) .

Two months after the test period - Summaries, finalization of the final report, presentation of the final results both to the client and to the information seminar organized by the client (minimum 2 seminars).

PURPOSE OF THE CONTRACTING AUTHORITY AND DESCRIPTION OF THE WORKS AT VARIOUS STAGES

The Contractor is obliged to collect data from the meters in the building either directly or through the building automation system (traffic must be one-sided) at intervals not exceeding 1 h. The technical solution must be developed by the contractor and it is important to consider that the existing building automation system will not be disturbed;

Observe the indoor climate of the building and consider customer satisfaction in the improvement proposals (if necessary, take random measurements);
Generate user (minimum 3) monitoring system for the vendor and provide training in its use;
The monitoring system must have built-in algorithms for automatic energy use monitoring and analysis, have degree-day conversion, enable the generation of an energy consumption information view that can be displayed to building users for educational purposes (ie, be viewable through an HTML web browser);
In the event of anomalies, inform Riigi Kinnisvara AS immediately and clearly indicate any necessary changes that could be implemented by the technical staff of the building in order to reduce the overhead;
Monitoring customer satisfaction and communication with the maintenance partner, building user and Riigi Kinnisvara AS;
The contractor must generate automated monthly reports that include, among others. the results of the monitoring period. In addition to the monthly reports, the contractor must make a quarterly report containing monthly results, explanations for changes, and suggestions for improvements;
Regular meetings will be held as needed to analyze previous period energy use and possible automated report enhancements, and possible solutions to improve monitoring system usability and service (minimum quarterly);
The Contractor shall consider the volume of the procurement as the cost of minor modifications and corrections to the building automation program (up to 10 hours in total per building during the contract period);
At the end of the test period, the contractor shall submit the final report of the test period, which shall include, inter alia, the following information (both in the view of the test facility and in the procurement section):
An overview of the energy and CO2 saved during the monitoring period; change in customer satisfaction and internal climate;
Expert judgment on the wider use of the energy monitoring system in public buildings, the potential security risks, the cost-benefit of the service and the benefits to the public building manager, a description and overview of interfacing different SCADAs, etc .;
The final report shall also include a summary in English of the description of the solution, the result achieved, any bottlenecks, etc.
The Contractor must appear at the Customer Information Seminar (2 pcs) (NB: one presentation in English).

GENERAL REQUIREMENTS FOR WORKS TO BE ORDERED

- The work must be such as to enable the Client to fulfill its overall objective as set out in clause 5.
- The Contractor shall draw up the execution documentation of the work carried out (final report).
- Works must comply with the General Quality Requirements (RYL).
- Engagement includes all installation activities that are not explicitly described in the Technical Specifications but are usually necessary to achieve the stated purpose.
- Restore the finish after making holes in the construction and installing the equipment. Avoid contact of building dust with utility systems. The Contractor shall be obliged to clean on a daily basis his work site which has been affected by the works carried out. Floors, walls, ceilings and furniture are free of dirt

and household waste, using appropriate and prescribed cleaning products and supplies, and working methods.

- Site Responsibility The Contractor shall be responsible for the performance and safety of the Contractor.
- The installation of equipment shall take place in the premises of the operating building. The work must be coordinated with the building user, the building's technical staff and the representative of the contracting authority. The Contractor shall also have in place measures and procedures to ensure that the premises and equipment are not damaged or maintained.

RESTRICTIONS ON WORKING

The exact schedule of the work must be agreed with RKAS and the building user prior to the execution of the work if physical access to the building is required.

OTHER CONDITIONS TO BE TAKEN INTO ACCOUNT FOR TENDERING AND WORKING

The tender must take into account the execution of all works necessary to achieve the objective described in the procurement documents and its annexes until the completion of the works envisaged in the procurement documents and their delivery to the Contracting Authority. Any work or product required for the smooth operation of the structures and systems, which is not reflected in the tender but without which the final purpose cannot be guaranteed, shall be considered by the Contracting Authority to be no additional cost.

The tender must also take into account the execution of works that are not explicitly described in the procurement documents, but are necessary for the actual condition and condition of the objects. Before submitting a tender, the Contractor must examine the current situation of the sites and take into consideration all the work required in his tender, based on his professionalism and experience in similar work when determining the need for and cost of the works. The proposed relationship to reality is the Contractor's risk.

The tender must take into account the execution of works that are not explicitly described in the procurement documents, but which are in accordance with applicable legislation, technical regulations, standards and requirements of relevant authorities (incl. Rescue Board, Electricity Control Center, The Contractor must be aware that additional requirements may be made by the aforementioned authorities in the course of or upon acceptance of the works.

It is the Contractor's responsibility to determine the amount of work required to fulfill the purpose described in the procurement documents. Where specific volumes of work are given in the basic documents of the procurement or in the annexes thereto, they shall be considered as informative and the tender shall take into account the actual volumes of work required.

In the case of solutions / formulations / works which are subject to different interpretations, unless clarified during the procurement procedure, the Contracting Authority's interpretation shall prevail during the performance of the contract.

ANNEX 3 – Demo II Technical description

Contracting authority: AS Riigi Kinnisvara

Title of procurement: "EFFECT4Building Testing Software for Building Automation Diagnostics, Optimization and Energy Monitoring"

TERMS

In the Technical Specification, the Contracting Authority is referred to as the Contracting Authority.
The person to whom the contract is intended to be awarded as a result of this procurement is called the Contractor.

OBJECTIVE OF THE PROCUREMENT

The purpose of the public procurement is to test a software solution in a building equipped with building automation, which enables the Client to optimize the work of building automation management and to achieve higher energy efficiency with increasing customer satisfaction. The software solution provided must allow:
1. Provide continuous diagnostics and monitoring of the building automation system and associated equipment (eg fans, controllers, valves, etc.) to detect possible malfunctions and low efficiency operation as soon as possible (the system must be capable of transmitting error messages and automated reports to pre-entered email addresses);
2. continuous energy monitoring and monitoring of systems energy efficiency;
3. The software solution must be interfaced with the building automation software and through the software being tested it must be possible to make settings that facilitate operator operation eg. changing usage schedules and settings;
4. If possible, use and test the acquisition of basic information (location of premises and interconnection with different technical systems) from the building information model based on the building documentation.

WORKING DOCUMENTS

- The source documents for the works (according to priority) are:
- This Technical Specification;
- Lubja 4, Tallinn Building automation system implementation documentation

In the event of a conflict between documents of the same order of priority, the document containing the more stringent requirement shall prevail. In the event of any discrepancy between the construction documentation and the system built in the building, the contractor must ensure that the contracting entity's objective is feasible (tenderers will be able to familiarize themselves with the building before bidding). The contractor must ensure that the reliability and performance of the local building automation system are not disrupted and affected by the monitoring and that the performance of the existing system is maintained during and after the monitoring period. The contractor must ensure that the end-user satisfaction of the building is not disturbed.
The work must be carried out on the basis of the tender documents as a whole.
All applicable legislation, standards, technical regulations and quality requirements must be observed when carrying out the work.

DEADLINES AND PHASES

The planned commencement of the works shall be carried out immediately after the conclusion of the contract and the execution of works specified in the technical specifications shall be divided into intermediate stages:
• One month from the award of the contract is the preparatory period for the contractor to set up and configure the software. The contracting authority shall provide the contractor with access to the building automation system and the building. Provides the tenderer with all technical and pre-monitoring energy usage information known to the contracting authority. After configuring the software, the contractor must provide training to the client and provide user accounts for the client and their representatives.
• Five months after the preparation period - A test period in which the contractor, in collaboration with the customer, monitors the software solution and, if necessary, helps set up the application
• One month after the test period - Summaries, finalization of the final report, presentation of the final results to the client as well as at the information seminar organized by the client (minimum 2 seminars). NB! the contractor must note that the information seminar may take place up to 6 months after the end of the test period.

PURPOSE OF THE CONTRACTING AUTHORITY AND DESCRIPTION OF THE WORKS AT THE VARIOUS STEPS

- Reduce administrative and maintenance staff (building automation system monitoring), increase technical staff operational efficiency (faster fault detection), greater energy efficiency and customer satisfaction with the building's indoor climate;
- The Contractor is obliged to carry out data collection from the building automation system (Siemens Desigo CC) in the building at Lubja 4, Tallinn;
- Assess the usability of the existing information model and make suggestions to improve and improve the information contained in the information model;
- Provide the user (minimum 3) with a monitoring system and provide training in its use;
- Access to the software interface must be through a common web browser (Internet Explorer, Mozilla, Google Chrome, etc.);
- Automatic error messages and tasks from automatic diagnostics must be forwarded immediately to the e-mail addresses specified by the Client;
- Regular meetings will be held as needed to analyze previous energy use and possible automated report improvement suggestions and possible solutions to improve the usability of the monitoring system and improve service (minimum 2 pcs);
- At the end of the trial period, the contractor will submit a final report of the trial period (a document that will be publicly distributed to third parties), which will include, inter alia:
- Overview of test results (malfunctions detected, potential impact of software on energy efficiency, indoor climate, customer satisfaction);
- Expert judgment on the wider benefits of a software solution

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