GUIDE

Financial tools and instruments for energy efficiency in buildings

Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
EU STRATEGY FOR THE BALTIC SEA REGION FLAGSHIP
EFFECT4buildings

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THE NEED FOR MORE ACTION!

The EU's climate goal is to be fossil-free by 2050, which requires a big reduction in energy use. Investment in energy-efficient technologies and renewable sources of energy is treated as the way to reach the EU objectives at the same time as supporting economic growth through investments.

40 % of the energy use in the EU is related to buildings for either private or public use and for many different purposes, e g: housing, offices, schools, sports, shops, religious activity, industry etc. Less than 3 % of the building stock in the EU qualifies for the A-label, meaning 97 % of the buildings are wasting money and need to be upgraded. All newly erected buildings must have almost zero energy consumption by the end of 2020.

The dilemma for building managers

Although many guidelines and documents on energy efficiency in buildings already exist, for example Sustainable Energy Action Plans and energy audits of the buildings, building managers are hindered to start moving towards implementation of the energy efficiency measures.

Lack of knowledge and the absence of track records of accomplishment and experience from different energy efficiency solutions increase the perceived risks and contribute to high transaction costs. Lack of financial and personnel resources increase the challenges. Energy efficiency projects ensure their return on investment through energy savings (non-expenses) and not through an increase in revenues. Financiers are instead culturally trained to support the growth of the project developer, more rarely to take into consideration cost optimisation projects.

Consequently, the implementation of energy efficiency measures is hindered and transformation towards energy efficient buildings is slow and often unnecessarily expensive.

EFFECT4buildings

The project provide a decision support toolbox that includes means to calculate and plan the renovation projects most feasible and profitable way, as well as being able to convince financial decision makers so that the scope and return of investments would be clearly and convincingly presented. The main target group is building managers in charge of public or privately owned building portfolio.

EFFECT4buildings was implemented from 2017 to 2020 with the support from the Interreg Baltic Sea Region Programme 2014-2020. There were seven partner countries – Denmark, Estonia, Finland, Latvia, Norway, Poland, Sweden.

The project was also a part of the implementation of the EU Strategy for the Baltic Sea Region (EUSBSR), being a flagship project under policy area Energy and the horizonal action Sustainable development. Flagship projects demonstrate the progress of the EUSBSR and serve as pilot examples for desired change.

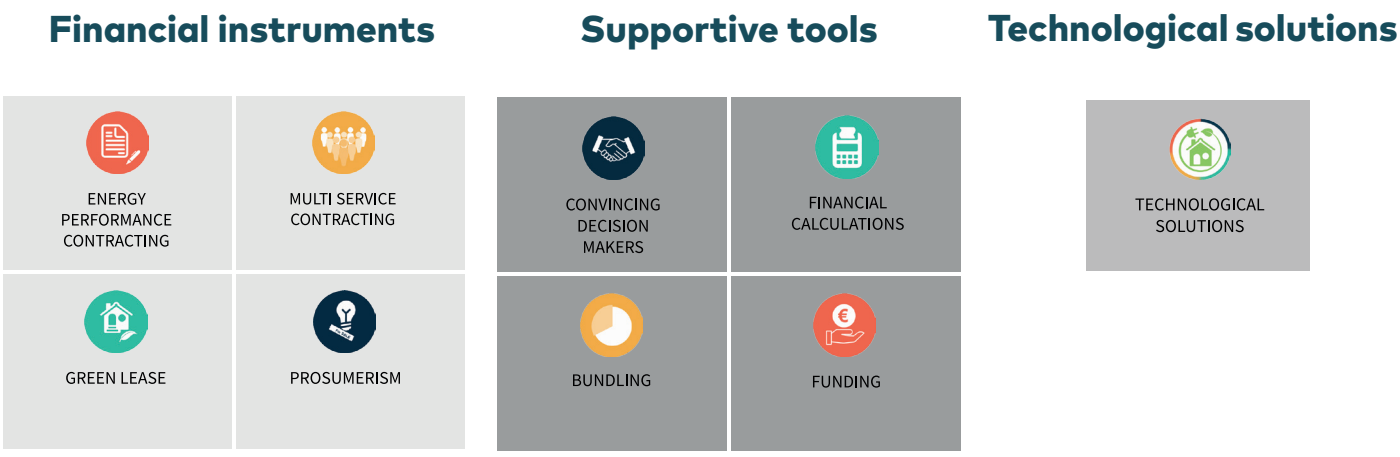
The full toolbox can be found on project webpage: www.effect4buildings.se

A TOOLBOX FOR IMPROVED ENERGY EFFIENCENCY IN PUBLIC & PRIVATE BUILDINGS

Investments in energy efficiency are not currently happening at the rate needed, hindered by barriers such as high upfront costs, lack of access to finance, high perceived risk, lack of trust in new technologies, competing investment priorities, lack of knowledge, awareness and personal resources, and split incentives. Many of these barriers can be overcome, at least significant part, with well-designed financial tools and instruments. Together with complementary measures like policies, regulations, awareness-raising activities, and behaviour changing initiatives and business models for energy efficiency solutions a sustainable long-term impact will be reached.

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

Tools can be divided into two categories: financial instruments and supportive tools. Financial instruments are more complex tools which help to finance or optimize investments in energy efficiency projects. Supportive tools help to achieve the goal of the energy efficiency projects. They can be used as a part of financial instrument or seperately. For all tools and instruments, actual technical solutions are central parts of the toolbox.



Toolbox for financial calculations: 92 % of all interviewed building managers stated that financial calculation methods are extremely important when justifying energy investments, but only half of them found it easy to do or even to understand them. Most common way for calculations of energy measures is pay-back-method, but it does not take aspects of technical lifetime and profitability demand in consideration. Conclusions from recalculations of measures has shown that using Net present value method or Internal rate of return, investments with longer lifetime will benefit and many more measures will be profitable.

Another particularly useful tool is the Total Concept method. When bundling several measures into a larger investment package, the profitability of the whole package can be calculated. Less profitable measures will then be covered by the more profitability ones, making it possible to implement more energy efficiency measures in total. The toolbox also contain calculation tools for Prosumerism, helping building managers to find out the optimal size of a solar energy power plant as, both from financial and energy production perspective.

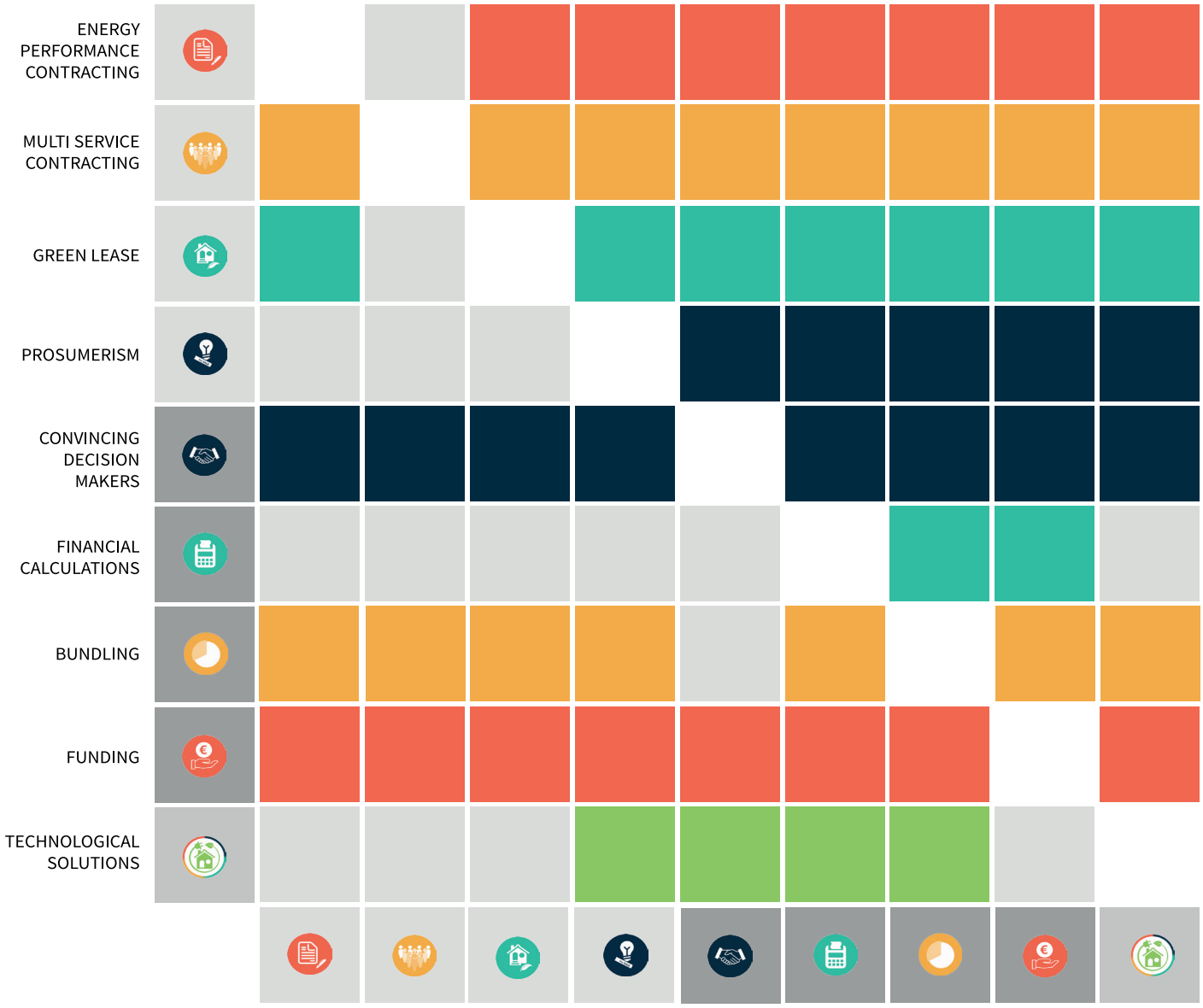
The project introduces an improved EPC model with contract-based partnership for the analyses phase. The Multi Service Contracting (MSC) model, based on some of the same ideas as EPC, includes several benefits except for energy savings, making investments more effective, lowering the risk of sub-optimization, and giving more value for money spent. Also, with models for implementing Green Lease Contracts, users of buildings and tenants can be involved in increased sustainability.

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

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

Possible combinations of tools

This graph shows possible combinations of tools. The horizontal lines represent the tools with possible combinations. Colored crossing point with vertical lines illustrates the tools with its instruments that can be combined to achieve even greater effect. For example: prosumerism tool can be combined with financial calculations, funding, convincing descision makers, technology solutions and bundling. Gray boxes show there are no natural ways to combine the tools.



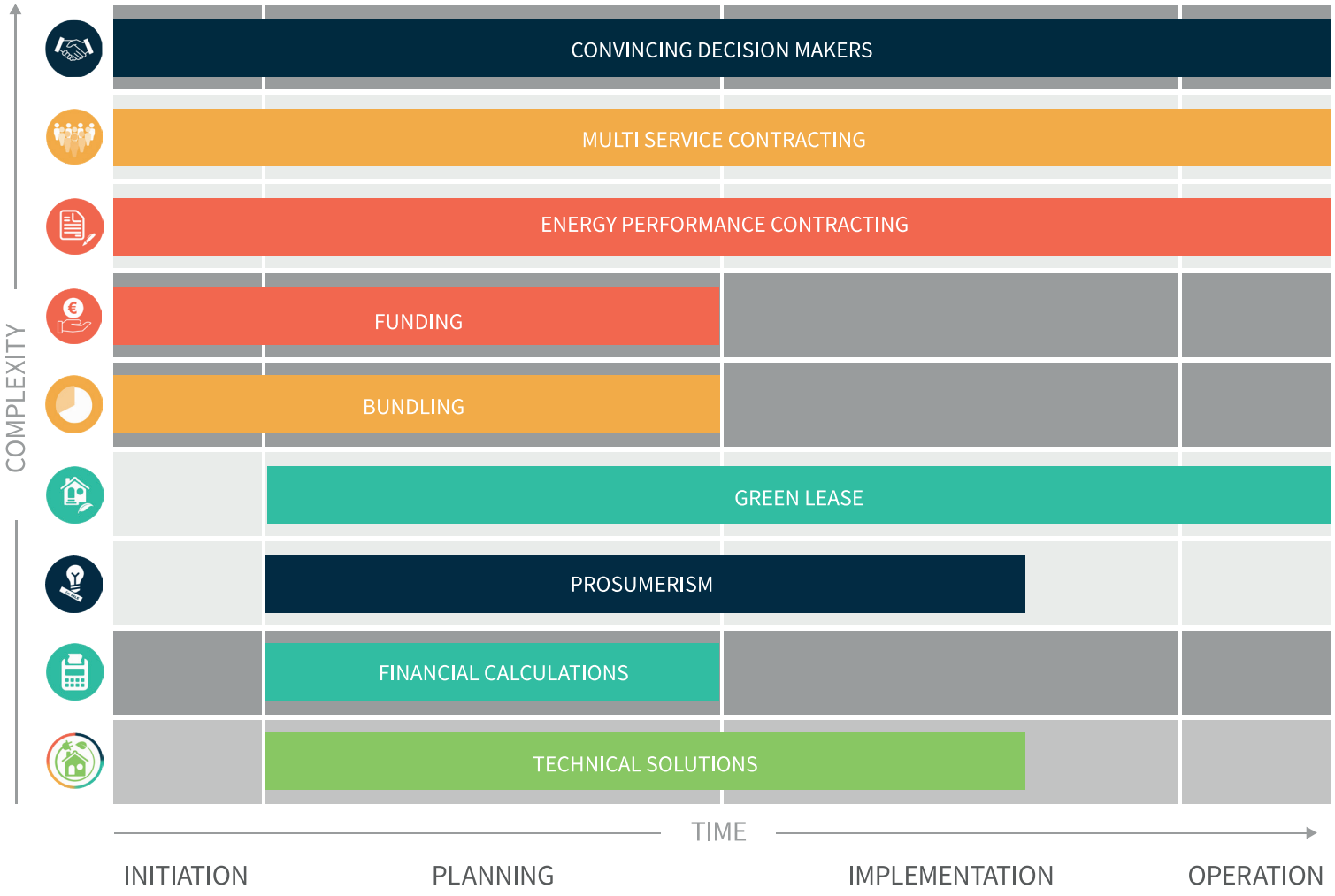
Use of tools at different stages of project

All tools are used during different stages of projects.

The vertical axis shows the complexity of the tool, getting gradually more complex towards the top.

The horizontal axis shows four different stages of project. Light grey background is used for financial instruments and dark grey background for supportive tools. Colours show in which stages the tools are used.

Tools can be used for one or more stages of project, illustrated in the following graph.



CONVINCING DECISION MAKERS

This part of project aimed to create a tool for convincing decision makers to invest in energy efficiency projects. It informs about various topics that can be discussed during a decision making process, arguments to be used to convince decision makers, and instruments for sharing experiences.

Focusing on various issues, like energy saving potential, good and bad practices, local and national policies, the project addressed dilemmas of the three target groups: authorities, investors and users.

Let's understand the problem

Both the survey conducted among public building managers and the discussions held during regional and transnational project meetings showed that public building managers are interested in broadening their knowledge about how to convince decision makers to accept energy investments.

Most of the public building managers have some sort of experience in this, but due to the lack of practice and space for sharing them, these experiences are not shared. Being unable to use a relevant global wisdom, building managers are left on their own on figuring how to convince decision makers to invest in energy efficiency solutions. This is accompanied by the lack of identified dedicated policies and legislation focused on supporting the energy investments.

The developed tool would help the building managers to seek for new possibilities on how to convince the decision makers to invest in energy efficiency.

Solution

In each project country, it should be possible to identify front-runners in terms of various ideas on how to convince decision makers in energy efficient investment processes.

Most of them could be found among organisers of workshops, trainings, and conferences related to presenting best practices in energy efficient issues, or among authors of related publications and guidelines. This knowledge is very diffuse, however, making the task difficult.

EFFECT4buildings has produced a support tool for convincing decision makers. It consist of the following elements:

- Three reference films on good practices and energy-saving technologies in public buildings.
- Templates for brochures and leaflets, to be used by building managers to prepare their own brochures and leaflets, in a simple and legible way presenting the motives and legitimacy of investments in energy-efficient technologies in public buildings.
- A list of golden rules, containing ten golden rules for the proper operation of energy-efficient buildings. Showing examples of how to apply good practices, each of them should be used by managers to ensure that their projects are carried out well.
- A training scenario, consisting of training courses on the effective use of good practices, directed to public property managers. The courses deal with topics related to recommendations for local, regional and social policies.
- The tool can accelerate energy efficient investments, by helping building managers to better analyse and understand the investments' profitability as well as to easier convince decision makers to invest in such solutions.

A successful implementation of the tool requires all the project partners – along with representatives of building managers from all the project countries – to get actively involved, so that they can share their experiences and ideas.

Combination with other tools

The aim of the tool is to convince decision makers to invest in energy efficiency projects. This tool can be used independently in everyday life, also with projects not related to energy. But it can be a good addition to every other tool in this toolbox – almost every project involves different stakeholders who need to be convinced in the outcome. Financial calculation tool, EPC, MSC, Prosumerism or even the funding available may help in convincing the decision makers.

Conclusions

The main result of this part of the project is the tool devoted to convincing decision makers to invest in energy efficiency projects. Thus, it addresses the problems and dilemmas of authorities, investors and users.

The tool helps assess factors behind success and failure in convincing decision makers to fund energy investments, and to provide good practices. The tool will be accompanied by a series of regional conferences, workshops and study visits, and policy recommendations will be prepared.

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TOOLS

1. Guide for Convincing decision makers
2. Guideline how to convince decision makers
3. Guideline how to convince decision makers (Polish)
4. Golden rules
5. Golden rules (Polish)
6. Brochure template
7. Brochure template (Polish)
8. Reference films of good practice in a school
9. Reference films of good practice in a transport company
10. Reference films of good practice European Solidarity Center

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/convincing-decision-makers

FINANCIAL CALCULATIONS

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

Let's understand the problem

Interviews with building managers proved that most of them (92%) consider financial calculations critical for justifying energy efficiency measures before making decisions. At the same time, only about half of them find it easy to do—or can even understand financial calculations. Around 40 interviewed building managers – representing building stock of about 11 million square meters, with over a thousand separate buildings – stated that understandable calculation tools are key to implementing more energy efficiency measures.

The profitability of an energy efficiency investment is crucial, and investment decisions have long-term consequences in the future. Implementing energy efficiency measures requires comprehensive justification and clear calculations with easy understandable visual charts presented mainly by building managers.

Decision makers and other stakeholders need clear visual information to easily estimate the profitability of various suggested investments. Planning strongly depends on budget restrictions and the availability of convenient funding sources. All these details are key for decision makers, who have to weigh them to make final decisions.

The most common method for financial calculations of energy measures, also in energy audits, is the pay-back method. This method does not take aspects of technical lifetime and profitability demand in consideration. Therefore, complementary calculation methods are needed and building managers need knowledge in how to use them.

Solution

Building managers need financial calculation tools that are both useful and understandable. If both these requirements are satisfied, a building manager can use them to study the profitability of energy efficiency investments. EFFECT4buildings have developed two financial calculation tools to evaluate diverse options in a decision-making process in energy efficiency investments. It has also developed relevant training material exists for educational purposes.

Calculation methods

Planning a new energy efficiency investment benefits from estimating its life cycle costs. It can be done using cash flow analysis, by predicting all costs and benefits during the investment's life cycle. For the investments with long life cycle, it is beneficial to use discounted cash flows, which called Net present value (NPV).

Alternative economic method is Internal rate of return (IRR). Internal rate of return is the discount rate, which makes investments net present value to 0. IRR is the very useful method for decision makers to estimate profitability of investment.

These methods are particularly suitable for choosing different kind of technical solutions for energy efficiency in buildings that may have different initial investment costs, different operating, maintenance and repair costs, and possibly different technical lifetime. Complementary calculation methods should also be implemented as a standard for energy serving companies, for example, in energy audits.

The Pay back time method

This method works out how long it takes to recover the amount invested (reimbursement period). The advantage of this method is that it is easy to use and understand.

The disadvantage is that it encourages short-term investments because it does not take technical lifetime and interest into account. The method is not suitable to use for long lifetime investments in the building sector with long life time, for example thermal insulation, window replacements etc.

The net present value method

The method converts all costs and savings to their present value. If the present value of all future savings is greater than the investment, it is considered to be cost-effective.

The net present value method can also be used in comparisons of different options when there are no actual savings to be made. The present value of the total costs of the different options then shows which is the most cost-effective over a period of time.

The internal rate of return method

The internal rate of return method determines that the present value of the annual savings should be equal to the investment, i.e. the net present value is zero, and calculates what interest rate fulfils that condition. This interest rate is called the internal rate of return.

The internal rate of return method produces a calculated internal rate of return that is equivalent to the annual return on the capital invested. Whether this return is acceptable can be seen immediately by comparing it with the investor's required rate of return, the cost of capital.

Excel calculation tool

The comprehensive Excel calculation tool proposed in the project is handy, simple and straightforward to use for building managers to study the profitability and other aspects of energy investments.

The tool is accompanied by a comprehensive training material; it describes, among others, all optional methods behind calculations. The training material can be used as an additional supporting material for studying and sharing information about calculation methods for stakeholders, or as educational material for all possible interested parties.

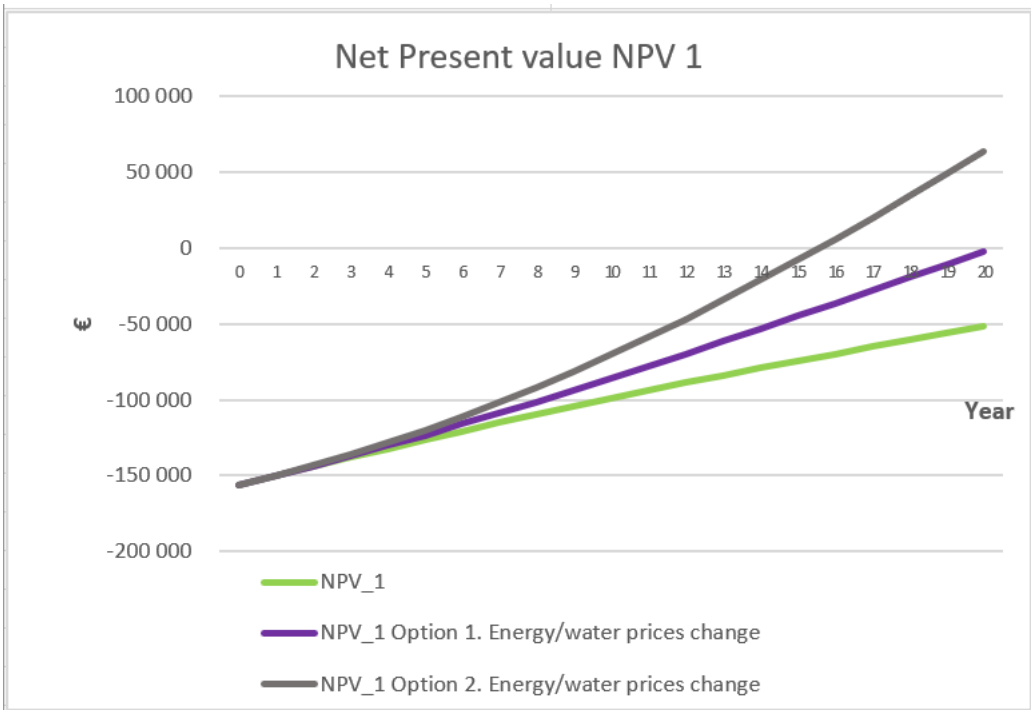

FIGURE 2. GRAPHS FROM EXCEL CALCULATION TOOL

The financial calculation tool mainly aims to facilitate decision making when implementing energy efficiency investments. Its charts are easy to use and understand, and so can be employed when presenting financial data to decision makers and other stakeholders.

REDUCTION OF CO_2-EMISSIONS	Ventilation system with heat recovery	Geothermal heat pump system
Reduction of CO_2-emissions ($kgCO_2$/year)	20.400	46.000
Reduction of CO_2-emissions/ CO_2-emissions before measures (%)	16 %	35 %
Reduction of CO_2-emissions during the life cycle ($kgCO_2$)	408.000	920.000
NON-ENERGY BENEFITS	**Ventilation system with heat recovery**	**Geothermal heat pump system**
Decrease cost due the non-energy benefit (euro/year)	8.200	0
Pay back time 2 (year), includes the efforts of non-energy benefit (for example decrease health cost)	7,96	8,64
FINANCIAL RESULTS	**Ventilation system with heat recovery**	**Geothermal heat pump system**
Pay back time (year)	13,65	8,64
Internal rate of return, IRR (%)	2,06 %	8,28 %
Internal rate of return, IRR (%), option 1. Energy/water prices change	5,24 %	11,39 %
Internal rate of return, IRR (%), option 2. Energy/water prices change	8,29 %	14,43 %

TABLE 1. TWO MEASURES CAN BE COMPARED WITH THE TOOL

To help estimate and understand the profitability of an energy efficiency investment, the tool uses the following methods to compare alternative energy efficiency measures:

- Cash flow
- Net present value
- Internal rate of return
- Pay-back time
- Carbon dioxide emissions

The tool also includes sensitivity analysis, with options to estimate energy and water price changes. In doing so, the tool helps analyse and compare possible future development paths. The calculations can also take into account non-energy benefits.

Simplified web calculation tool

The EFFECT4buildings website presents a web tool for the financial calculations of profitability. Straightforward and simple to use. It helps estimate the rough profitability of individual investments using different calculation methods. The tool It also visualizes the different calculation methods it includes in pedagogic graphs. Simplified financial calculation tool can be found here: https://energi.jahopp.com/energy.html

Results from testing and recommendations

Based on testing of the tool among planned end users, the tool was further adjustments and improved. Conclusions from recalculations of proposed energy efficiency measures showing the need to use complementary financial calculation methods than simple pay-back-time.

The table below simplifies results of the analysis, showing that pay-back-time disregards the technical lifetime of the investment. Investments with longer lifetime will benefit from using the net present value method. In many cases using internal rate of return will make more measures profitable than using only pay-back-time would make.

The proposed tool should create a new standard for presenting measures in energy audit reports, requiring to present alternative financial calculations for each measure. All countries should implement at least net present value and internal rate of return.

Investment	Cost	Pay-back time		Technical lifetime	Net present value		Internal rate of return	
Solution A	10,000	5 years	Most profitable!	10 years	7,000		7 %	Profitable!
Solution B	10,000	8 years		20 years	8,600	Most proftable!	8 %	Profitable!

TABLE 2. COMPARISON OF SOLUTIONS A AND B

Combination with other tools

Financial calculation tools can be combined smoothly with other tools provided in the project toolbox. By utilizing diverse combination of tools, it is possible to get more comprehensive and clearer picture of profitability of the planned investment, thus these tools complement each other in a holistic way. To get positive implementation decisions, different calculation methods for comparing alternative energy efficiency measures should be used and presented. The output of financial calculation tools can be used with every other tool as careful calculations help to achieve the main goal.

Conclusions

By using different financial calculation methods, results will be different on what solution is most profitable. Without efficient training, building managers, energy auditors, and other investors will have problems with using these methods, translating to the insufficient implementation of new energy efficiency measures.

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

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TOOLS

1a Guideline for excel based financial calculation tool.
1b Financial calculation tool in excel format
1c Financial calculation tool in excel format. Example.
2 Guideline for Financial calculation methods
3 Presentation of measures in energy audits. Example.
4 Financial calculations training material (PP)
5 Financial calculation tool in web format, online https://energi.jahopp.com/energy.html

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/financial-calculations/

BUNDLING

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

Let's understand the problem

Energy efficiency measures often consist of many small investments. They can be so technical that decision makers can have problems understanding them. An energy audit may result in a long list of possible measures in many fields. The risk of "cherry picking" (choosing individually most profitable solutions) is high, and many building managers have confirmed expieriencing it when facing decision makers. Picking low-hanging fruits often results in sub-optimal solutions, since it is cheaper to use several measures at the same time in a building. Furthermore, measures are often interlinked, one measure depending on another – and vice versa.

Creating a set of several energy efficiency measures is one solution. Another one is grouping less profitable measures into a larger package and not justifying them individually. Such an "energy efficiency package" would prevent the risk of cherry picking, since decision makers do not have to learn all the details about these measures. Not only is such an approach easier to communicate, but also it can give a better overview, thereby helping focus the discussion on a strategy rather than on details. Such an energy efficiency package can be presented along with other investment needs.

Thus, building managers need methods for bundling investments, but also training to learn how to use them. Some bundling tools were developed by previous projects, and then adopted and implemented in EFFECT-4buildings.

Basically three different kind of bundling types can be identified:

1. Bundling energy efficiency measures in one building/project
2. Bundling several energy efficiency measures of the same type in several building/locations, to reach a critical size of investment, e.g., street lighting or HVAC
3. Bundling multiple energy efficiency measures of different types in several buildings/locations

Solution

Bundling is a way to merge many small investments into a large investment package. Thus, instead of choosing a single energy efficiency solution, bundling makes it possible to make large-scale investments or deep renovations, thus creating possibilities for larger scale renovations and retrofitting. This makes bundling a perfect option for, when considering different ways how to accelerate and encourage the implementation of energy efficiency measures.

Bundling can be carried out with the Total Concept Method (TCM), which aims to improve energy performance in buildings in terms of assuring the maximum profitable energy savings. TCM and feasibility calculations are based on increasing the implementation of energy efficiency investments. TCM helps building owners understand the financial benefits and opportunities of energy retrofitting, making it possible to go much further with energy improvements.

Implementing all measures separately increases design and construction work and other overhead costs, compared to a bundled investment package. By forming an action package, both single cost-efficient measures ("low hanging fruits") and more costly ones are considered. The most economically profitable measures will assist less profitable ones, making the complete action package fulfil profitability frames.

Bundling as a tool is based on deep understanding of Total Concept Method and Total Tool. TCM has been proven a handy and workable in several implementation cases in diverse public buildings and other premises. It facilitates local building managers to provide a realistic feasibility assessment on how to implement an extended energy efficiency measures package and how to convince decision makers to make the final implementation decision. For these purposes a comprehensive and convenient training material presentation of TCM and Total Tool has been gathered to increase the awareness of main target group and other stakeholders.

The work process of the total concept is divided into three steps:
Step 1: Creating the action package
Step 2: Carrying out the measures
Step 3: Following up

TCM provides an action plan comprising a package of energy efficiency improvement measures that as a whole fulfils the property owner's profitability requirements. The profitability assessment in TCM is based on the internal rate of return (IRR) method, which assesses each investment by the actual profit it creates, expressed as an internal rate of return.

These IRR values vary between single measures, which in practice means that the most economical and the most profitable measures, as shown in figure 1, will assist the funding and implementation of less profitable measures. Operating this way, the complete action package will fulfil the profitability frames set by the building owner.

Basic principles of TCM and Total Tool should be clearly explained—preferably, using data visualization—to the decision makers and all other essential stakeholders involved in the energy efficiency implementing process.

In some cases, however, charts like Figure 2 can be particularly useful. For example, this chart can be used to clarify the profitability and IRR values of each single measure included in the package, thereby helping the target group to analyze and understand the material and all the calculations provided by Total Tool.

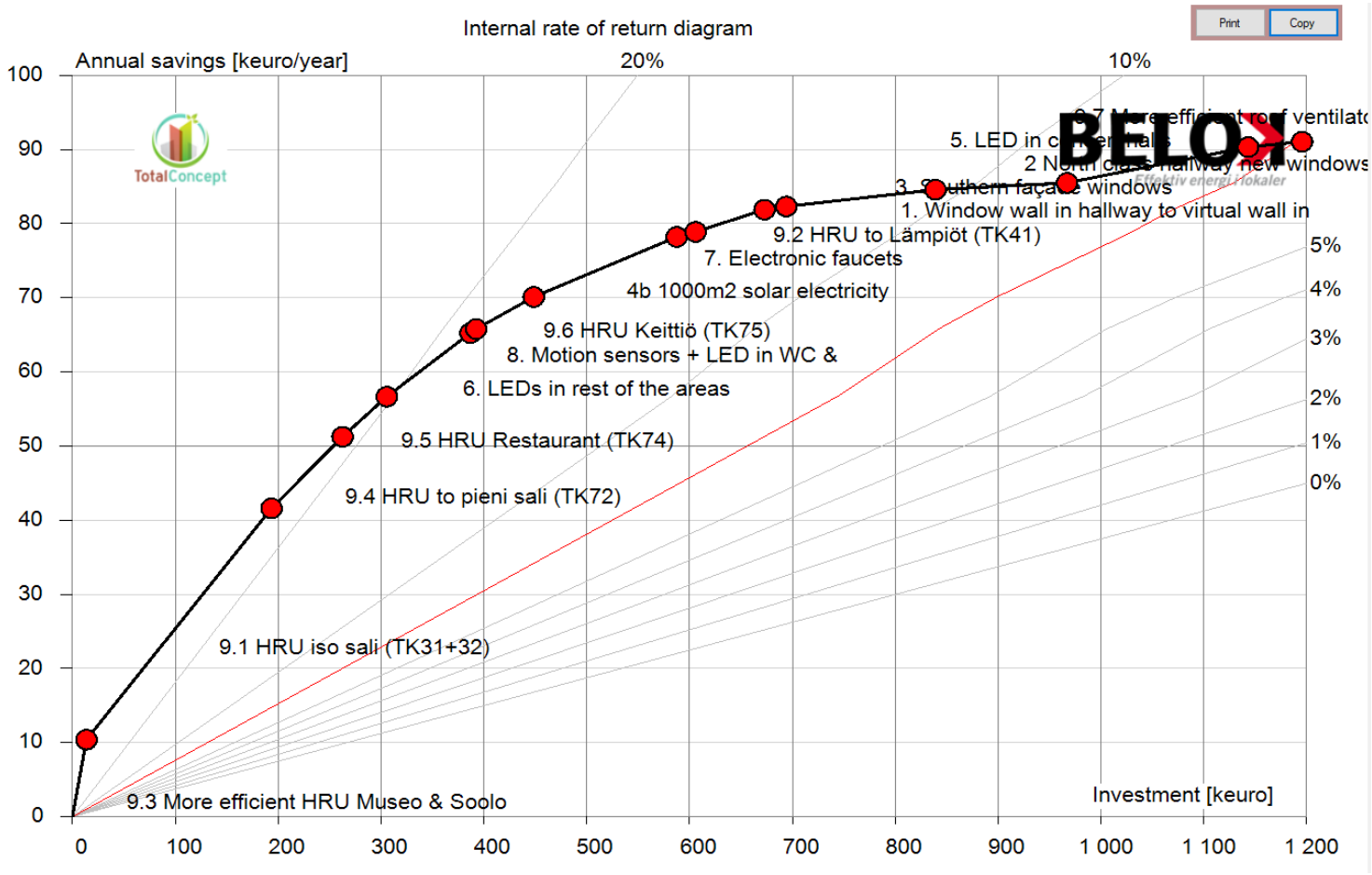

FIGURE 1. ALL BUNDLED MEASURES COMBINED IN ONE CHART

E..	N..	Name	Economic calculation period [year]	Investment [keuro]	Internal rate of return [%]	Heat energy saving [MWh/year]	Heat energy cost saving [keuro/year]	Electricity saving [MWh/year]	Electricity cost saving [keuro/year]	District cooling energy saving [MWh/year]	District cooling cost saving [keuro/year]	Other cost savings [keuro/year]	Total cost saving [keuro/year]	Profit [-]	Sum of internal rate [%]	LCC [keuro]
☑	1	9.3 More efficient HRU ...	20	13,6	79,14	169	10,14	3	0,27	0	0	0	10,41	8,11	79,16	-160,21
☑	2	9.1 HRU iso sali (TK31+...	20	180	19,12	520	31,2	0	0	0	0	0	31,2	1,84	23,62	-340,34
☑	3	9.4 HRU to pieni sali (TK...	20	69	15,33	161	9,66	0	0	0	0	0	9,66	1,48	21,52	-92,04
☑	4	9.5 HRU Restaurant (TK...	20	43	13,60	90	5,4	0	0	0	0	0	5,4	1,33	20,45	-47,00
☑	5	6. LEDs in rest of the are...	15	81,3	8,98	-142	-8,52	174	15,66	48	1,44	0	8,58	0,96	18,44	-103,15
☑	6	8. Motion sensors + LED...	15	5,6	8,10	-7,1	-0,42	10,5	0,94	1,3	0,03	0	0,55	0,91	18,32	-6,55
☑	7	9.6 HRU Keittiö (TK75)	20	56	7,14	72	4,32	0	0	0	0	0	4,32	0,82	17,05	-15,91
☑	8	4b 1000m2 solar electricity	25	139	5,73	0	0	90	8,1	0	0	0	8,1	0,68	14,43	-49,96
☑	9	7. Electronic faucets	25	18,4	2,04	4,9	0,29	0	0	0	0	0	0,68	0,43	14,07	-0,12
☑	10	9.2 HRU to Lämpiöt (TK...	20	67	1,56	50	3	0	0	0	0	0	3	0,47	13,05	17,25
☑	11	1. Window wall in hallwa...	30	21,2	-0,26	7,3	0,43	0	0	0	0	0	0,43	0,26	12,67	13,89
☑	12	3. Southern façade wind...	30	145	-1,75	37,7	2,26	0	0	0	0	0	2,26	0,19	10,46	107,27
☑	13	2 North class hallway ne...	30	128	-5,37	15,4	0,92	0	0	0	0	0	0,92	0,09	8,81	112,58
☑	14	5. LED in concert halls	15	176	-6,89	-91	-5,46	105	9,45	28	0,84	0	4,83	0,25	7,37	6,34
☑	15	9.7 More efficient roof ve...	20	52,5	-7,47	0	0	8	0,72	0	0	0	0,72	0,15	6,94	40,71

FIGURE 2. IRR-VALUES OF EACH MEASURES PRESENTED SEPARATELY

Results from testing and recommendations

Main challenge is that bundling, TCM and Total Tool are currently not yet so widely used by the target group. To change that, inspiring education is needed, including visual presentations and valuable examples of successful implementation of using the method and tool itself.

The project has proven that the bundling method can be used not only by building managers, but also as a standard for the presentation of proposed measures in energy audits. The project shows an example of how this can be done.

Another best practice in using the bundling method is to make a Public Private Partnership agreement when approving state aid grants for investments in SMEs. Aid can, according to EU regulations, be granted to investments in increased competitiveness and for energy efficiency measures.

As a pre-condition for such aid, an energy audit can be set. It should provide a list with all possible energy efficiency measures, from simple and least costly to costlier and less profitable ones. Then the decision needs to be made on who is responsible for what, ending in an agreement, for example, that the applicants handle simpler measures at their own expense while the costlier measures can be granted aid. In this manner the goal to carry out all measures can be achieved, instead of "cherry-picking".

The project proved that the method is so successful that it should be tested on a larger scale within the EU.

Combination with other tools

Bundling is a good tool which helps to find funding and makes a project more attractive to the decision makers or investors. On the other hand, it provides energy efficiency measures for smaller projects which are less attractive. Bundling can be mainly used together with EPC, MSC, Green leasing and Prosumerism tools to get higher savings and to look more attractive to the decision makers and politicians.

Conclusions

Bundling offers a holistic and comprehensive way of combining small measures into one package. Its basic idea is to make a planned investment more profitable and more interesting from an economical point of view, especially for potential investors. It can also be used as a standard in energy audits, but also it can facilitate finding an optimal funding source and receiving state aid. Bundling can also be used for agreements with companies receiving state aid. Total Concept Method and TotalTool offers an interesting solution for implementing energy efficiency investments in buildings.

TCM gives an easy and valuable method to illustrate the economic profitability of individual measures. As a whole, TCM is a brilliant way to implement a successful energy efficiency project. Bundling methods can also be used as a standard for energy audits and for agreements with companies receiving state aid.

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TOOLS

1. Guideline for Bundling
2. Bundling training material (PP)
3. Excelsheet for bundling in an energy audit (Swedish)

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/bundling


RAMLOSA
RAMLOSA
RAMLOSA

FUNDING

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

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

Let's understand the problem

Limited financing possibilities from own funds often hinder energy efficiency investments in municipal buildings. The survey conducted among public building managers has shown that their knowledge is limited mostly to existing public funding schemes, but also that they are interested in broadening it. Each project country has front runners that improve funding schemes for energy efficiency invest-ments, and they can inspire others.

The implementation of energy efficiency investments in the public sector may be based on:
- a traditional formula for financing public investments, i.e., budget funds; and
- financing from external funds: subsidies and grants, loans and credits, and other means (e.g., bonds, public-private partnership, and leasing).

Local governments usually plan investments for which funding is easiest to obtain and which are most desirable from a social point of view (e.g., improving the welfare of inhabitants), like thermo-modernization of buildings and renewable energy.

Local governments in Poland and the Baltic countries wanting to follow sustainable development will have to face important challenges, such as a reduced availability of non-returnable grants after 2020. This will require not only their active involvement but also support from other institutions, which can help them participate in the dialogue and the exchange of know-how, proven technologies, and good practices with other municipalities.

Solution

We have prepared a guide presenting all funding possibilities for public building managers in a systematic way. It gives the target group a good overview of funding sources, facilitating them to find one.
The presented broad catalogue of funding possibilities in energy investments will help convince decision makers during the phase of energy efficiency project management. Together with experiences from those that have already used new funding sources, it can inspire organizations to try new funding strategies.

Buildings can be either public or private, and can be used for public or private purposes. The analysis and mapping of funding possibilities in this project has focused on funding for publicly owned buildings, regardless of how they are used; thus, it included administrative buildings, other non-private institutions, and some residential buildings.

The below table summarises the types of funding sources:

Type of funding sources:	Description	Examples
Public	Analysis of the available public funding sources and mechanisms for financing investment projects in the field of energy efficiency in publicly owned buildings.	EU funding, state funding, financing by banks owned by the Treasury of State, other public financing.
Non-public	Analysis of the available non-public sources and mechanisms for financing investment projects in the field of energy efficiency in publicly used buildings in individual project countries.	Private resources of business entities, including those taking part in ESCO projects; commercial bank offers dedicated exclusively to such enterprises.
Mixed	Analysis of the available mixed (public and non-public) sources and mechanisms for financing investment projects in the field of energy efficiency in publicly owned buildings.	

Public funding sources

National funding papers for the project partners show mapped funding possibilities from public funding sources. The mapping shows that the most common funding source is loans from municipal financial institutions, in the form of either ordinary investment loans or special environmental/energy loans (e.g., Kommunekredit in Denmark, Kommuninvest in Sweden, and Kommunalbanken in Norway).

Non-refundable grants and aid for investments in energy efficiency in municipalities are much more common in Poland, Estonia and Latvia. For the Nordic countries, such funding is rarer; if available, it focuses on planning investments. It is expected that municipalities in all the countries in the Baltic Sea Region will have less possibilities to obtain grants for investments in the forthcoming EU program period, making it even more important for all member states to find alternative funding sources.

Private funding sources

Private funding is still rare for public organizations, and it is very difficult for the public service sector to apply for preferential financing of investments from international non-public financing sources. Such an offer is almost absent on the market. The potential for innovative forms of private-public partnerships in terms of energy efficiency investments is large, however.

Budgetary units face frequent financial constraints, a constant compulsion among self-government authorities to seek savings, an unquestionable need to improve energy efficiency, and the lack of sufficiently qualified and experienced technical staff enabling the efficient and effective preparation and subsequent implementation of energy investments. One possibility for them is to try to finance investments under public-private partnerships, like with ESCO companies, in a formula that will allow financing a given modernization investment from future savings in energy costs.

Funding possibilities for managing authorities

Public organizations can act as managing authorities for EU funding and other national funding. Regardless of whether the program is targeting public or private organizations, funding possibilities can be destinated for energy efficiency investments. Aid for SME to invest in energy-efficient solutions can be granted according to the EU Commission Regulation No 651/2014 and 1407/2013, but there is a need to better define eligible types of measures. For that reason, we have produced related guidelines, together with implementation of a framework program for energy efficiency in SME in Sweden.

Results from testing and recommendations

As part of the project, we supported building managers applying from new sources they had never used before. This experiment succeeded: clearly, they both needed and appreciated support in filling out applications. We also helped them share experiences with other building managers. It resulted in several new investments that otherwise would not have been implemented, because of a lack of both capital and skills in writing applications.

From our experience, it clearly follows that the target group needs both training in funding sources and guidance in how to apply for funding. To this end, workshops during which building managers present their experience and best practices as well as exchange ideas can help.

Combination with other tools

External funding and subsidies play a major role in energy efficiency related projects due to relatively high costs. This tool is broadening the knowledge of various funding sources at EU and national level. This is a supportive tool and can be used together with all other tools. In some cases, external funding helps to continue with energy efficiency projects e.g. EPC, MSC and sometimes it is necessary to use EPC, MSC, Prosumerism etc. models to get funding.

Conclusions

Thanks to producing energy and returning the surplus to the grid or other energy consumers, prosumerism helps reduce electricity bills and become more environmentally friendly. Before deciding whether to become a prosumer, one needs to analyse the current situation in terms of legislation, laws, and support mechanisms in one's country. Existing tools, including the EFFECT4buildings tool for prosumers, can help calculate the project's profitability. Deciding to become a prosumer, one should follow existing guidelines and instructions to implement the chosen PV system.

TOOLS

1. Funding possibilities
2. Funding possibilities in Poland (Polish)
3. Funding possibilities in Finland (Finish)
4. Funding possibilities in Sweden (Swedish)

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/funding

ENERGY PERFORMANCE CONTRACTING

Energy Performance Contracting (EPC) is a well-tested and successful tool that has been helping building owners reach their energy and climate targets more quickly than with traditional implementation of energy saving measures. Still there is potential for more use of EPC to reach unrealised saving potential in public sector. To promote the use of EPC, this guide introduces an improved implementation model based on the present market situation and experiences in Denmark, Sweden, Finland, Norway, Poland, Estonia, Latvia and Lithuania. The main novelty aspect being contract-based partnership during the analysis phase of EPC projects.

This guide includes a description of adapted tender documents proposing new selection criteria better suited to the goals of public building owners, as well as contract templates, an EPC presentation and a step-by-step guideline for starting up an EPC project – all gathered in a tangible EPC toolbox.

Let's understand the problem

EPC is a model for implementation of Energy Efficiency (EE) measures with guaranteed results in public and private buildings. In EPC projects, energy savings are used to cover investment costs. Both technical and financial risks are hence outsourced to an Energy Service Company (ESCO), also called the EPC supplier. EPC is used to implement a high number of EE measures within a short time period. Its improved implementation will help reach climate and energy targets at a faster rate and speed compared to the use of inhouse public resources.

Implementation in four phases:

Phase 0: Start-up and tender phase
Phase 1: Energy analyses and project development phase
Phase 2: Implementation and construction phase
Phase 3: Energy-saving and guarantee phase

The last one distinguishes EPC projects from other typical turnkey projects, as EPC includes guaranteed savings for an agreed number of years after all the energy efficiency measures have been implemented.

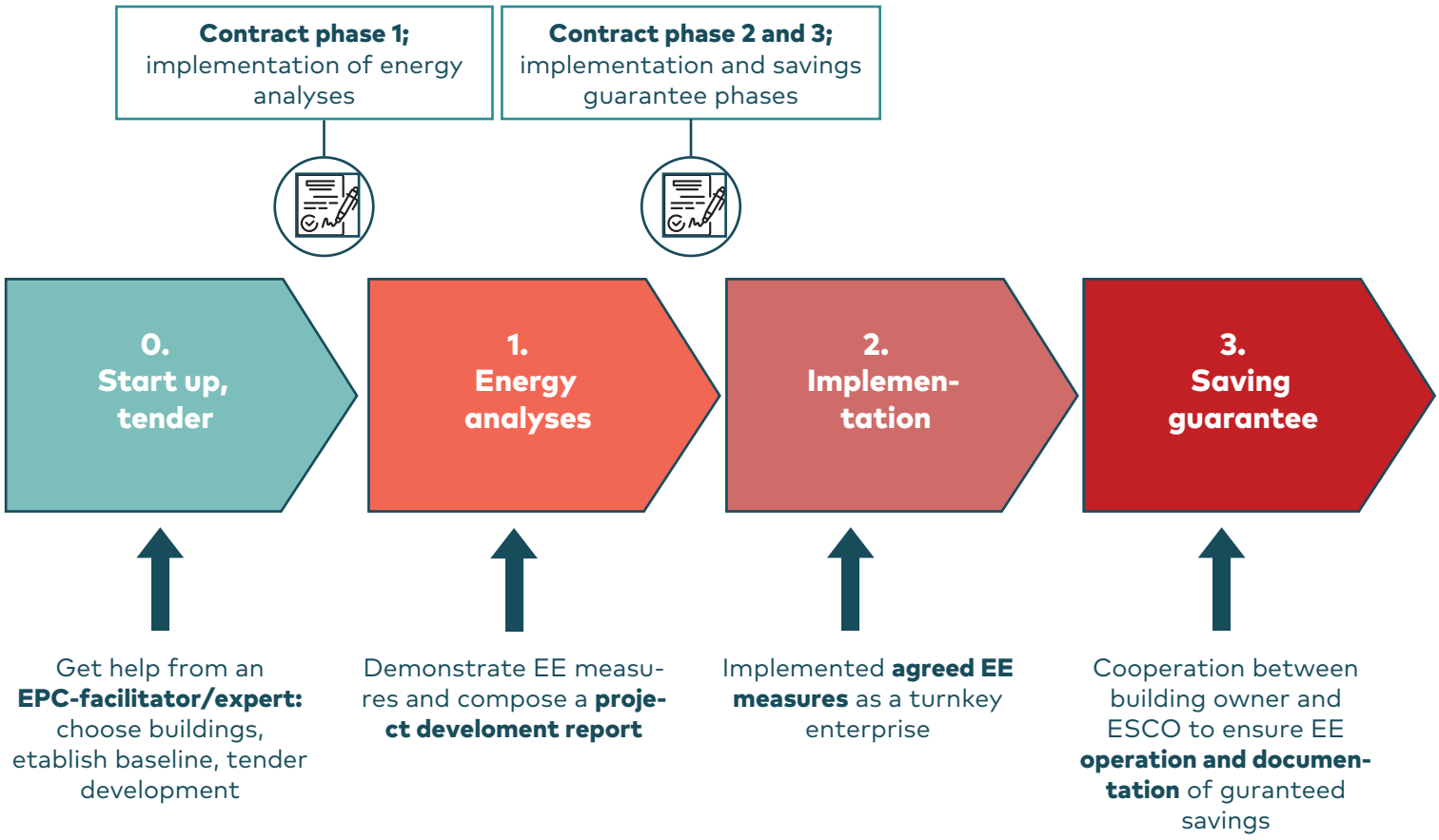

FIGURE 2. THE PHASES OF AN EPC PROJECT

Over the last 10-15 years, then EPC model have been tested in many EU and Nordic countries. The concept has been implemented in many public buildings in the emerging Polish EPC market, but is still little known in Estonia, Latvia and Lithuania.

Several studies, e.g. the EPC market report by the Nordic Council of Ministers concludes that EPC is beneficial for the building owners, but there is still a large saving potential and possibilities for further development. The most common barriers for growth are the complexity of the concept, "heavy" procurement process, lack of knowledge, lack of good practice examples and documented results, lack of trust and active facilitators.

To reach goals on climate and energy, the use of EPC in the building sector needs to increase since the model is designed to reach these targets at a higher rate and speed than many other energy efficiency tools and instruments.

Solution

EFFECT4buildings developed the improved EPC implementation model based on experiences from EPC projects and market reports listed in the references. Although the partner countries implemented the model in somewhat different ways (like in terms of financial structure and contractual basis), the implementations are to a large extent comparable.

The obvious and most common successes include savings in energy use, reductions in CO_2 emissions (on average, 18-50% reduction in public buildings), the modernisations of technical building standards and the allocation of funds based on saved energy to other public areas. EPC projects reduce maintenance budgets and secure investments, and the guarantee is particularly important for actors with limited budgets.

Many EPC projects have had common challenges. There is no designated legal framework for EPC in the partner countries, expectations from the project can hence differ a great deal from country to country. The start-up of new EPC projects is hindered by a lack of knowledge, the complexities of the model and its procurement, a lack of trust in the model as well as a lack of facilitators. Other challenges come from too little emphasis being put in the start-up phase (0) on creating ownership and hence on anchoring the project in the organisation, and from insufficient cooperation in Phases 1 between the building owner and the ESCO. From the ESCO's perspective, defective and incorrect baseline data, including errors in energy data and operating conditions, pose a high risk. Many of these challenges are less common in Denmark.

The solution offers an improved way of implementing the EPC model, which ensures successful implementations of future EPC projects, thanks to the following improvements:

- allocating enough time by the building owner to developing and following up the EPC project;
- improving cooperation agreement and/or partnership contract between the building owner and the EPC supplier, which is particularly important during the analysis phase;
- equalising differences in knowledge between customer and supplier, by bringing in one or more relevant experts, e.g., a skilled EPC facilitator;
- considering options to lower transaction costs;
- improving the calculated guarantees of tenderers;
- improving templates for tender and contract documents; and
- conducting risk assessment analysis.

The improved EPC implementation model

Most suggested improvements focus on the first two phases of the EPC process, the start-up and tender phase (0) and the energy analyses and project development phase (1). This is because these two phases are critical for the choices and decisions that form the basis for failure or success in the implementation (2) and guarantee (3) phases.

Phase 0 – start-up and tender phase

As part of an "EPC toolbox" found under Annexes a short step-by step guideline for building owners on how to start an EPC project and a presentation that will help introduce EPC in own organisation has been developed. The toolbox also includes templates for tender documents and associated annexes for the announcement of an EPC tender. Based on our findings, new elements have been included in order to ensure a fair balance between the customer and the EPC supplier.

Summing up it is emphasized that building owners need to gain deep knowledge about the building stock, and to identify goals for the project during Phase 0. The building owner must devote resources to the project, and it is important that there be a sense of ownership to it, from both the administrative and political perspectives. This having been accomplished, the search of the right EPC supplier can begin. At this stage, it is recommended that the building owner ask for assistance from an EPC facilitator, a person with expertise in EPC processes and interaction.

A recommended procurement process starts with a pre-qualification of 3-5 EPC suppliers/ESCOs where implementation skills and relevant experience are among the qualification requirements. The qualified suppliers then compete by delivering a proposal containing energy efficiency analysis of 1-3 representative sample buildings as part of the proposal work. Analyses are prepared using the same energy audit template, where measures, investments and savings are summed up. The total net present value of these measures and the cost of Phase 3 constitute two of several award criteria. Other suggested award criteria besides price are; technical quality of equipment and installations, mark-up percentage, description of project understanding and the cooperation process. The EPC suppliers answers to these criteria will constitute the basis for later full scale analyses and description of measures. Award criteria must be weighed according to the customer's goals and expectations from the project.

If the building owners' overall goals are to fill maintenance gaps and to include deep renovation measures, price should not be assigned the highest weight.

Phase 1 – The analysis phase based on partnership agreement

In the new implementation model, Phase 1 is based on contract-based cooperation in a partnership agreement. In Phase 1, the measures to be implemented

in Phase 2 are based on the "open book" principle, where measures are found in cooperation on both choices of function and economy. In the partnership contract, both parties' services and deliveries are contractually agreed upon, a process meant to create understanding and trust between the parties. Phase 1 results in a unified pre-project plan, including a project development report that summarizes all the agreed measures. Once the pre-project is completed and approved by the customer, the supplier is paid an agreed fee for Phase 1.

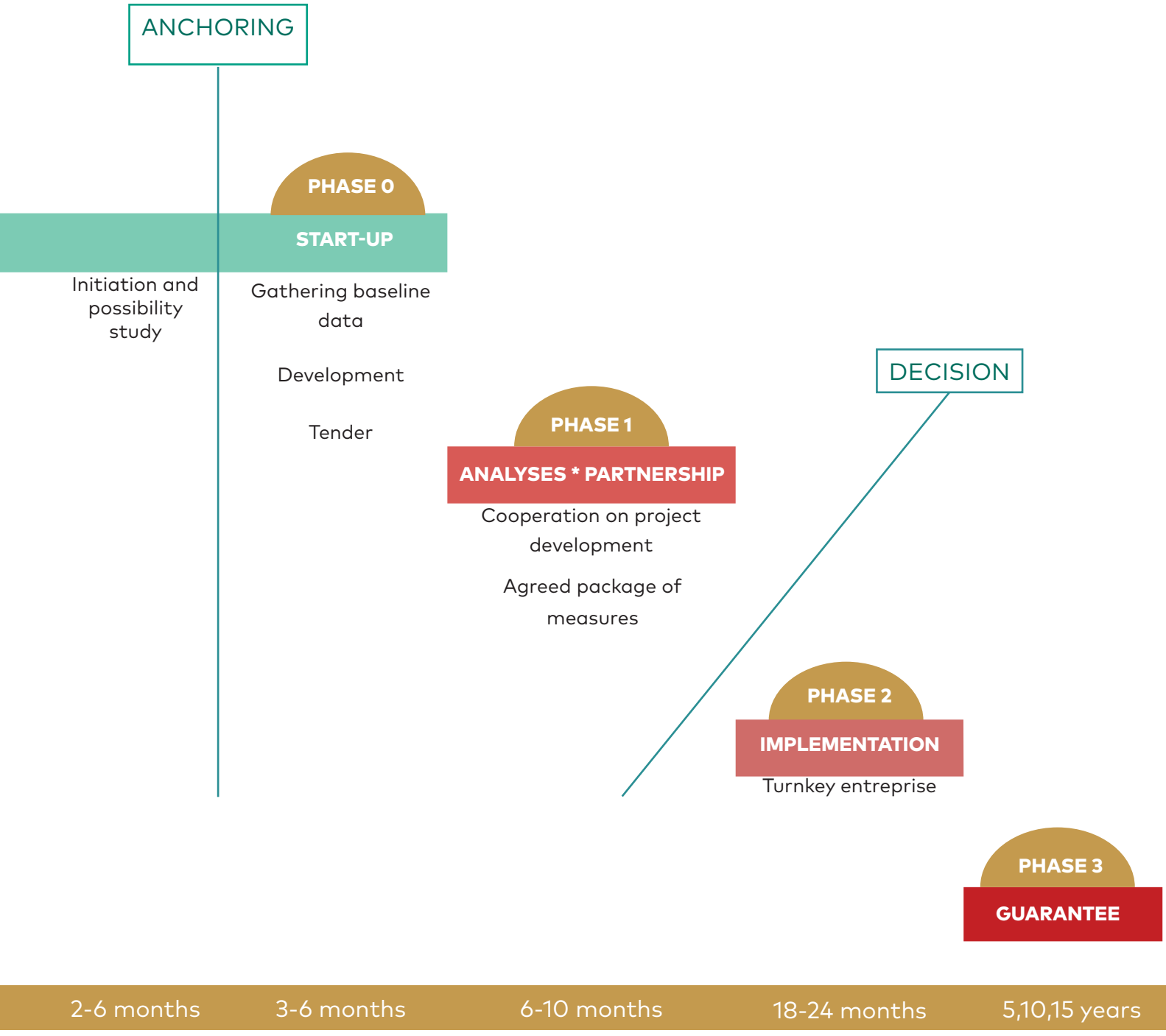

FIGURE 3. AN EPC PROJECT WITH A CONTRACTUAL PARTNERSHIP IN PHASE 1.

A partnership contract includes

A partnership contract includes

- objectives and attitudes for the analysis phase;
- the organization of the project;
- the work, the process, and the delivery and performance; and
- rights to use the project's materials and documentation.

The final result of Phase 1 is a project development plan with measures agreed by the parties. These measures will be implemented as a turnkey enterprise in Phases 2 (implementation) and 3 (guarantee). (A Norwegian official standard for EPC projects, NS6430, exists and might be useful also for other countries – especially for Phases 2 and 3 of EPC projects.)

Experience from testing and recommendations

EPC with a contract-based partnership in Phase 1 is not necessarily the best implementation method for all municipalities and building owners. Sometimes, traditional EPC will be a better alternative, especially if one uses the improved templates and takes into account recent marked experience.

A contract-based partnership might require more time allocated for meetings during Phase 1 than does traditional EPC, but also more expertise, in terms of contract development, energy efficiency, and technical issues. Phase 1 of a partnership project requires the customer to do the very same work as that which is done during Phase 0 of a successful traditional EPC project, so both implementations actually takes a similar amount of time. Adapted for contract-based partnerships, however, the new templates would have to be modified to be used in traditional EPC.

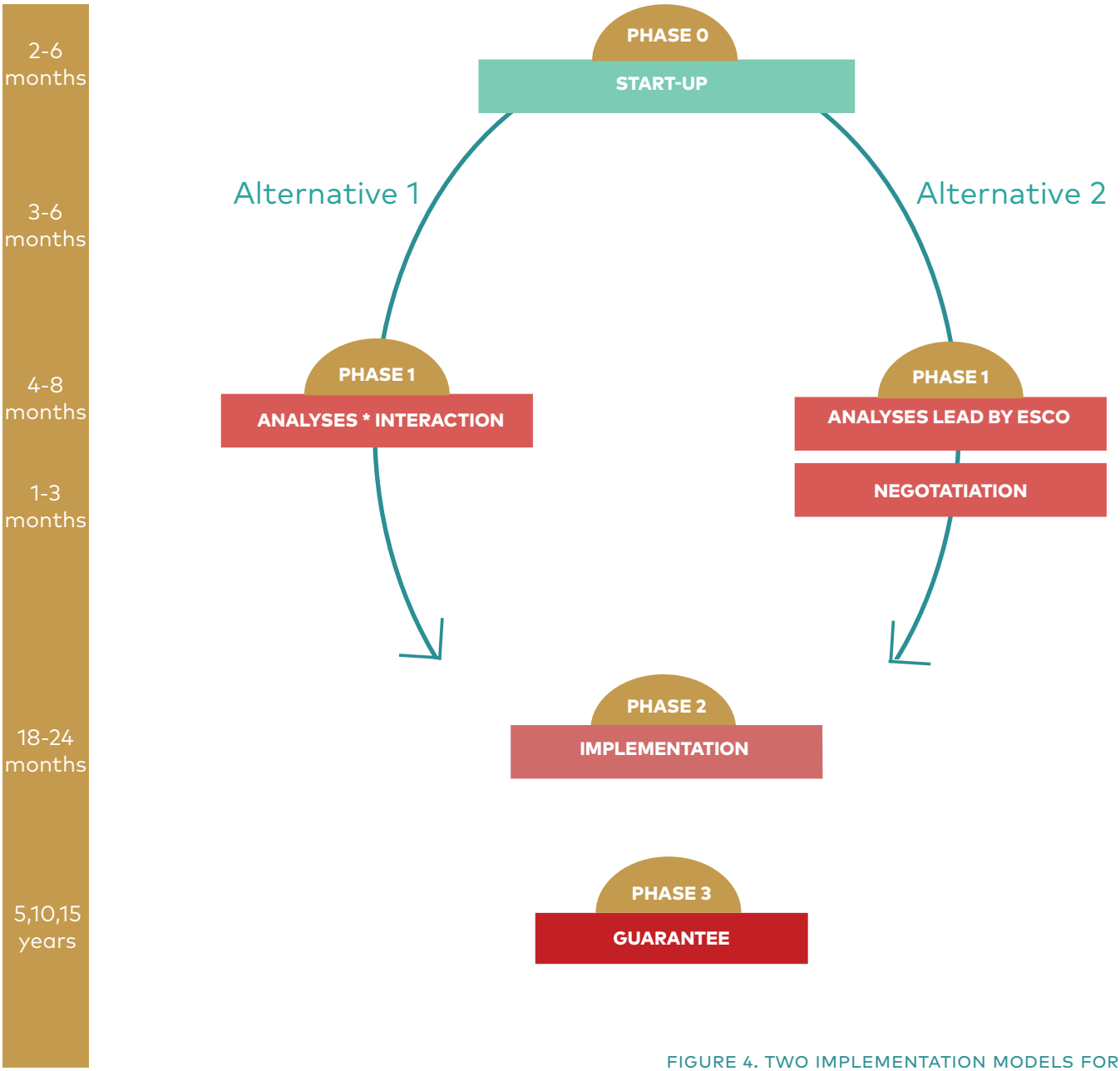

FIGURE 4. TWO IMPLEMENTATION MODELS FOR EPC

Figure 3 shows two possible paths of an implementation model: Alternative 1 includes a partnership in Phase 1 (the new implementation model), and Alternative 2 shows the more traditional implementation model for Phase 1. The latter divides Phase 1 into two steps.

The project results in (i) the description of a revised implementation model; and (ii) revised templates, gathered in a tangible EPC toolbox (see Annexes), which can be used by public building owners from the beginning (a start-up phase) of an EPC project to its implementation. The goal is that the newly developed templates will be used by all EPC-customers/building owners, regardless of the choice of partnership in phase 1.

Although elaborated, the documents are templates and examples. Hence, they must be adapted to each project to reflect the customer's goals and expectations. They should also be adapted to national laws and regulations and verified by national legal counsel / lawyer in each country.

The principles of EPC with guaranteed energy performance can also be used in maintenance contracts. To this end, the project developed templates for Energy Performance Maintaining Contracts.

Combination with other tools

Energy performance contracting (EPC) is one of the most used and tested instrument in implementation of energy efficiency. The EPC tool works together with financial calculations and energy monitoring, which is one of the technological solutions presented in the EFFECT4building project. Financial calculations, Bundling, Convincing decision makers, and Funding are used as a part of EPC. Green Leasing Contracts and Prosumerism can also be part of an EPC contract. Technological monitoring systems are necessary to measure the savings made, showing that EPC are largely integrated with other tools an instruments.

Conclusions

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

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

Increasing the use of EPC requires efforts to introduce it among building owners, deepen their knowledge about EPC and hence raise their interest and trust in the model. It calls for an emphasis on disseminating relevant information about the savings potential of existing building stock, knowledge of the different implementation models and their pros and cons, along with the new tools and instruments now available. To that end, this EPC guide and the new EPC toolbox has been developed.

TOOLS

1. Guideline for EPC customers - how to start an EPC project
2. EPC Training material
3. Tender for procurement of EPC supplier. Template.
4. EPC tender analyses. Template
5. Baseline data. Template.
6. Checklist for qualification and award criteria. Template
7. Partnership contract for Phase 1, Analyses. Template
8. Project development report and energy analyses. Template
9. Attachment to contract terms for Phase 3, Guarantee. Template

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/energy-performance-contracting/

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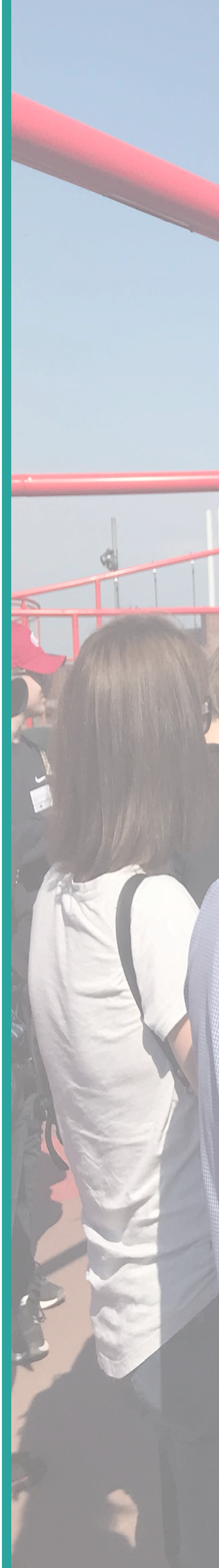

MULTI SERVICE CONTRACTING

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

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

Let's understand the problem

Buildings are a key to improving energy efficiency and enhancing decarbonization. Other motivators for energy efficiency include improved indoor climate and the states of maintenance and operation. A holistic approach to energy renovation also provides the best overall economy since the marginal cost of the simultaneous improving of several parameters is very low.

Energy efficiency already covers a good part of the costs in indoor climate and maintenance improvements, thereby nearly equalising the initial and transaction costs. Furthermore, efficient maintenance and operation are crucial to achieve an energy efficient building.

Such a holistic approach depends on the organizational and budgeting structures. Some public stakeholders have experienced that renovation tasks, including indoor climate and facility management, break down into several activities, each having its individual budget. So, at least from a financial perspective, a holistic approach stops being truly holistic, additionally complicating the process by erasing roles and responsibilities rather than promoting cooperation between different units in the municipality.

Currently, buildings are renovated with a certain purpose and expected performance, but the average renovation process is neither monitored nor evaluated, nor is its performance followed up.

This situation calls for general re-defining and re-scoping of currently run projects, in order to prevent public stakeholders from experiencing additional unnecessary costs pushed up by ill-designed or ill-implemented building renovation processes. Among the most complex tasks in renovation are to predict, plan and maintain the performance of energy and indoor climate in an existing building in use. Yet, this depends on having the right knowledge of the building's operation, installations and use. Knowledge that is hard to map and accurately maintain over time.

The above discussion clearly shows that there is a need for a new approach to help building owners plan, contract, monitor and evaluate their projects from a holistic point of view, in order to maximize the values of their investments.

Solution

One approach for a building owner to achieve such a holistic view is to start cooperating with the constructor from the early stages of the project, and continuing this cooperation into the operation phase. This gives the constructor a possibility to complement the building owner with necessary resources and competences, both needed to make good decisions throughout the whole renovation process.

Such a holistic approach unlocks enormous potential for improving renovation projects in terms of the optimal multidimensional performance of buildings. But to fully exploit this potential, both the building owner and the constructor must cooperate from the very beginning until the very end of the renovation project, not losing sight of all the important inner features of the investment.

In a multi service contract (MSC), the building owner signs a contract with a constructor – hereafter named the MSC supplier. The contract focuses on more parameters than just energy, including indoor climate, reducing the backlog of maintenance, and facility management. The contract also forces both parties to follow-up the performance of buildings after the buildings have been renovated. Extending the planning phase and involving an MSC supplier from the very beginning of the project increases the chance that the renovation will meet the building owners expectations, thanks to the supplier's support with resources and competences, and its taking responsibility for the performance of the project.

To understand the MSC model, one needs to note that the final design of the contract depends on the purpose and objectives of the project, since different types of services require different types of solutions.

Targeted at projects with renovation and retrofitting of a larger building portfolio in the existing building stock, the model derives from Energy Performance Contracting (EPC) and strategic partnerships, building on experiences from these two models. Although developed based on Danish regulations and practice, the model offers a generic frame for multi service contracting. When implemented in a project, it must be adjusted to both the project's scope and national regulations and practice.

START-UP phase 0

Start-up

- Vision and purpose
- Objectives
- Model
- Organisation
- Scope and content
- Procurement

PLANNING phase 1

Mapping

- Mapping of existing conditions/baseline
- Establishment of pre-measurements/ surveys
- Mapping of possible project
- Estimate potential and investment

Analysis

- Selection of scope and project
- Revisit objectives
- Defining KPIs

Programming

- Additional collection of data
- Design specification of project
- Determination of measurement programme
- Binding objectives

Consultant agreement phase 1

IMPLEMENTATION phase 2

Design

- Detailed design
- Planning logistics and execution
- Any authority processing

Execution

- Implementation
- Establishment of measurement programme for operation
- Performance test
- Handover

Initiation

- Education
- Balancing installations under load
- Adjusting KPI/ baseline
- One year inspection

Turnkey contract phase 2

OPERATION phase 3

Operation

- Follow-up on performance
- Cooperation regarding agreed services
- Cooperation regarding further improvements

Framework agreement covering the entire period of cooperation

FIGURE 1. A STRATEGIC MODEL FOR MULTI-SERVICE CONTRACTING

The generic model has four primary phases and includes several different contracts.

In **Phase 0,** the building owner identifies a vision, a purpose, and main objectives of the project, which will constitute a basis for designing the project's scope. An MSC supplier, consisting of a full delivery team being able to execute the whole project, is found in a public procurement process.

A **framework agreement** signed with the MSC supplier covers all the three following phases. It regulates mutual objectives, form of cooperation, financial aspects, incentives, and remedies. Based on the open book principle, the agreement grants full access for the building owner to all calculations, real costs, and the like. If the conditions and objectives agreed in Phase 1 have not been met, the building owner is not obligated to proceed to phase 2 and sign a Phase 2 contract, which is a strong incentive for the MSC supplier to do a good job in Phase 1.

Together with the framework agreement, both parties sign a **consultant agreement** for Phase 1. It defines requirements for methods to be used and the whole process, such as mapping and calculation tools.

The framework and the consultant agreement can refer to one project or to many projects to be executed in cooperation between the building owner and an MSC supplier. In the latter case, every time a new project is launched in Phase 1 (e.g., an energy and indoor climate project in five schools), the parties sign an allonge to the consultant agreement, dealing with this particular project. The supplier is paid by hours spent, and the allonge specifies the **A**ctivities, **T**imeframe and **R**esources (called an ATR agreement).

In **Phase 1,** both the building owner and the MSC supplier closely cooperate to analyse the project's scope, based on which they are to decide on the final contents of the project. This entails revisiting objectives and defining a measurement programme based on the knowledge gained during Phase 1's subphases: mapping and analysis. In order to reduce risks related to unexpected costs and problems during the project, the supplier examines important technical risks, including hazardous substances and constructability.

When the project is shifting from Phase 1 to Phase 2, the parties sign a **turnkey contract**, which includes a fixed price for Phase 2. In **Phase 2**, the project is designed in detail, executed and initiated for operation by the MSC supplier. Such a turnkey contract must include clear requirements in terms of handover and commissioning2 with performance tests, and inspections (in Denmark, normally one- and five-year inspections are carried out). The supplier has to rectify all defects identified at the handover and the inspections.

Phase 3 is relevant if the contract includes contractual obligations on performance after Phase 2, or if it includes operation and maintenance services. The length of Phase 3 must be customized to the project, taking into account procurement regulations.

Where does MSC differ from EPC?

MSC is based on the same basic ideas as EPC. A model founded on early cooperation with a supplier, it focuses on future performance in a situation in which, at the time of signing the contract, the building owner does not know what work will be done and what technical solutions will be executed. Therefore, an MSC will largely resemble an Energy Performance Contract (EPC) (more about EPC can be found in the EFFECT4buildings EPC guide).

Both EPC and MSC require necessary competences and experience in cooperation models, and both make the building owner work closely with the supplier. In both models, the final design depends on the purpose and objectives of a specific project, and demands close attention to the creation of a valuable cooperation.

Despite this resemblance, traditional EPC and MSC differ, mainly in terms of the following aspects:

- An MSC takes several parameters into account, and therefore the work on establishing the resulting framework and preparing the procurement is more comprehensive because objectives and technical knowledge on more parameters must be included.
- In the generic model for MSC, Phase 1 is not based on a fixed price, and it goes further in developing the project before entering Phase 2 than does EPC. In MSC, more parameters can affect the final scope of the project, key performance indicators, and, as a consequence, the overall project. Therefore, the MSC model more focuses on analysing and designing the final scope, and on reducing risks for all the involved parties, in this aspect somewhat resembling strategic partnerships.
- In Phase 2 of an MSC project, the building owner should ensure in the handover that the requirements on performance are met.
- In Phase 3, unlike an EPC, an MSC is not based on performance guarantee in terms of indoor climate parameters, energy savings, or other parameters over a longer period. Instead, it stresses a follow-up and the evaluation of key performance indicators, to keep attention to maintaining the project's effects. The contract can impose different legal obligations on the supplier in case of not meeting performance expectations, but it can also use certain incentives to help avoid such situations.
- MSC is not a funding model. Some elements, like energy savings, can be included in it in the same way as they would be in EPC or a shared saving model.
- An MSC is a framework agreement, meaning that the building owner can split the building portfolio into more projects and plans; the proje-

cts would then be executed in parts, depending on the available resources and other circumstances. In this way, the building owner can use one public procurement to execute many projects with different objectives, which would likely make him or her benefit from working with the same supplier on several projects, instead of starting each one from scratch.

Performance management employs both the purpose and the objectives

In MSC, in all the phases of the project, the objectives constitute the basis for decisions as well as the design and quality of technical solutions. Therefore, the building owner must invest time and involve key stakeholders, to determine a purpose and objectives, and to break down the objectives into to sub-objectives. For each sub-objective, they formulate a key performance indicator (KPI) and its acceptance criteria, indicating whether the sub-objective has been reached.

A set of these sub-objectives describes the indicators used to assess performance, with their acceptance criteria representing the minimum performance for reaching the objective.
Since multi service contracting includes several parameters and related sub-objectives, it is important to ensure that no conflict exists among them. This can be done by creating an objective hierarchy with the purpose, objectives, sub-objectives and KPIs.

For example, reaching energy savings and obtaining a better indoor climate can create a conflict if the latter objective can be achieved only by increasing energy use. With such conflicting objectives, the building owner must define their priorities in the objective hierarchy.

Moving from one phase to the next requires the objective hierarchy and the KPIs to be revisited, which should be done by both parties, taking into account the current situation and the knowledge gained in the previous phases. For example, the early-planning phase can provide new knowledge on the state of the building maintenance and the potential for improvement and savings; this knowledge, unknown before, can be used to redefine more precise objectives in the subsequent phases.

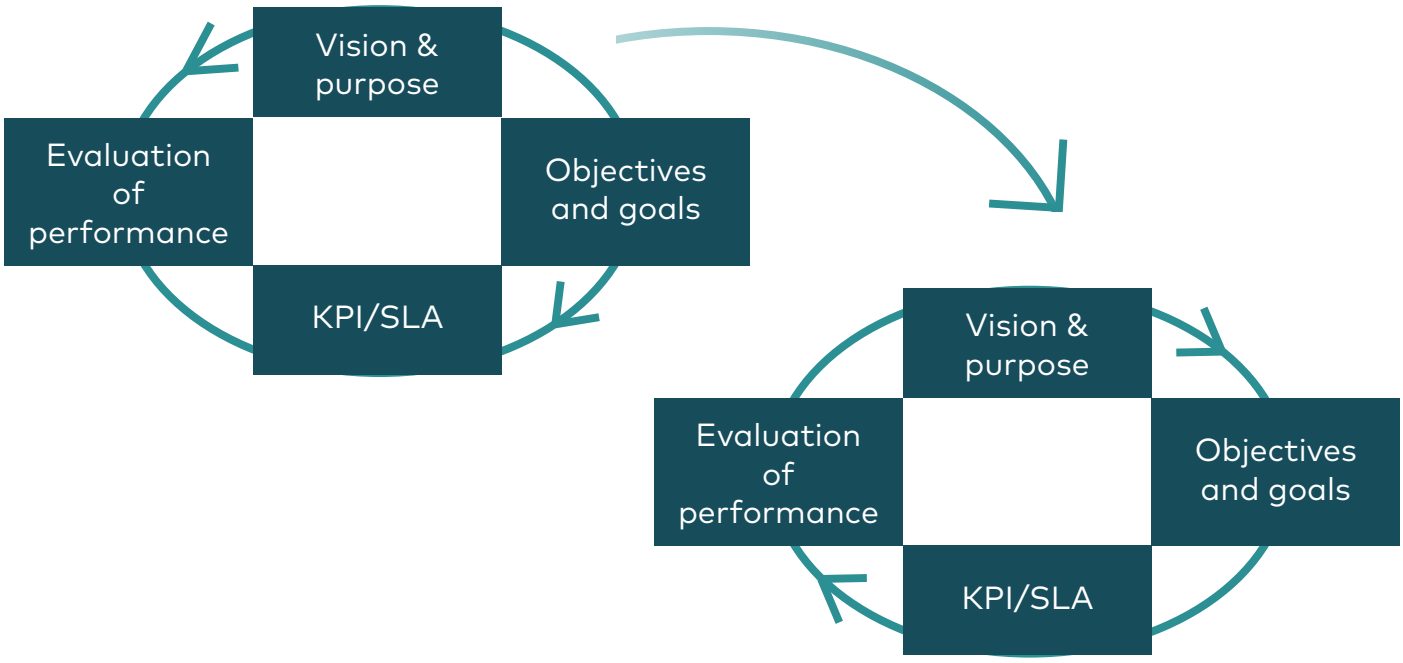

FIGURE 2. AN ITERATIVE PROCESS THROUGHOUT THE PROJECT, WHERE YOU USE KNOWLEDGE GAINED IN THE SUBSEQUENT PHASES TO CLARIFY AND REVISIT THE PROJECT'S PURPOSE, OBJECTIVES, KPIS AND EVALUATION METHOD.

Performance management employs both the purpose and the objectives

To ensure that performance is followed up during the whole project, the planning phase should produce evaluation methods for each KPI, for example, methods of validation, measurements, or other forms of documentation. Table 1 shows examples of KPIs and their corresponding methods.

This approach is an integrated part of performance management, it is not new: it is used, for example, in certifications on sustainability as DGNB. In the MSC model, performance management does not cover a single objective, such as sustainability, but all services, which makes it the main management tool in the contract and the main guide in designing the project's contents and the follow-up on performance.

MSC elements in a traditional renovation project

This guide describes a strategic generic MSC model. If a building owner, however, is carrying out a traditional renovation project, he or she does not have to fully stick to the tradition: the MSC methodology offers hints on how to enhance such a project.

Examples of such actions include the following:

- maximize chances to meet expectations of your organization, be specific when shaping the project's objectives, and take care to balance conflicting ones. Consultants and constructors should make every effort to understand these expectations.
- Be ready to redefine the objectives during the project when new knowledge emerges.
- From the beginning, think of which key performance indicators to use and design how to evaluate them. Define who will be responsible for evaluating performance, but also consequences of not meeting the expectations.

	ENERGY/CLIMATE	INDOOR CLIMATE	MAINTENANCE	OPERATION
EXAMPLE KPI	MWh, CO2 emission, Flow, COP, alarms	Temperature, ppm, humidity, noise, sickness absence	Condition level, level of emergency maintenance	Complaints, alarms, reaction time, plant failures
EXAMPLE OF METHOD OF PERFORMANCE VERIFICATION	Energy monitoring with a performance budget, CTS monitoring of key factors with alarms	Monitoring indoor measurements from sensors, yearly interviews, time registration	Average condition level, calculation of reduction in backlog and budget for emergency maintenance	Alarms in CTS, helpdesk system, number of inquiries and complaints from users, measurement of reaction time

TABLE 1. EXAMPLES OF KPIS AND THEIR CORRESPONDING METHODS FOR MONITORING AND EVALUATING PERFORMANCE.

Combination with other tools

Multi service contracting (MSC) is like EPC but has a more holistic approach. It is based on the same underlying idea but takes into account more parameters than just energy savings. All other tools can be part of a Multi Service Contract, either to support the process, to be included as a goal or to be used when designing the project. This tool works well with supportive tools like convincing decision makers to support the process and bundling. EPC or financial calculation can support the financing of MSC.

Experience from testing and recommendations

Multi service contracting is a new concept building on experiences and best practice from EPC, strategic partnerships, and traditional methods of renovation and maintenance projects.

Like any project, multi service contracting requires necessary specific professional expertise to make the public procurement process and cooperate with the supplier. The building owner must organize the project in phases and, if necessary, supplement its organization with external consultants. Specific knowledge is required from the start, especially to design functional requirements for services (indoor climate, energy, commissioning, maintenance etc.), contract conditions, and the frame for cooperation.

It is important that the contract clearly divide responsibility and state legal requirements for the supplier to achieve the objectives and KPIs. An MSC supplier can only take legal responsibility for work and parts it has full control over, like the design of the project, but not for the use and behaviour of the building.

Therefore, the generic model cannot guarantee performance in Phase 3 if the performance either depends on behaviour or cannot be evaluated in an objective or quantitative way. Other types of incentives are proposed instead, and it is recommended that the contract focus on performance management in terms of the technical and quantitative objectives. Certainly, for the cooperation to be effective, the contract must clearly describe responsibilities, contract conditions, and roles of both involved parties.

The model requires particularly close cooperation with the MSC supplier in the designing phase (Phase 1), handing it much influence on the design and final objectives. The building owner is not obligated to proceed with this particular supplier to Phase 2 but can choose another one, which constitutes a great motivator for the MSC supplier to deliver an attractive project that would live up to the expectations in price, quality and time. What is more, when the supplier has been involved in formulating KPIs and success criteria, it is more willing to take responsibility for the performance.

Among the main barriers for implementing a multi-service concept, two key ones are a lack of time, hindering in-depth work on shaping both the contract and the project itself; and a lack of knowledge of the benefits that following up and evaluating the performance can offer. The latter correlates with a long tradition in building projects that neither performance nor its follow-up during the subsequent phases gains much attention.

Overly disregarded during the project, the follow-up on performance is often left to facility management – but it is rarely accomplished. What is more, traditional contracts do not impose on the supplier any precise obligations and requirements on performance, neither during nor after the project. MSC was developed, among others, to break this tradition and, hopefully, begin a new one. It will do so by enriching contracts and the corresponding projects themselves, by imposing relevant activities on the suppliers, in order to ensure that the necessary attention be paid to the monitoring and evaluation of performance.

Conclusions

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

References

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2. Definition of strategic partnerships as used in MSC guide:
   https://www.designingbuildings.co.uk/wiki/Partnering_in_construction

3. Tools and contract for strategic partnerships in Swedish:
   https://www.byggherre.se/library/2421/tillaempningsfoereskrift-partnering-abt-180322.pdf

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5. Definition of open book in contracts:
   https://www.designingbuildings.co.uk/wiki/Open_book_accounting

6. General conditions for turnkey (design and build) contracts (ATB 18) from Denmark:
   https://www.danskbyggeri.dk/media/36840/abt_18_en.pdf

7. Standard for commissioning:
   https://www.techstreet.com/ashrae/standards/ashrae-202-2018?product_id=2025517

8. Collection of relevant links to commissioning guidelines and standards. Is in Danish but refers to guidelines and standards in English:
   https://cxwiki.dk/p/generelt/standarder-og-vejledninger

TOOLS

1. Guideline for MSC phases and toolbox
2. Guideline for MSC decision process
3. Content in an MSC procurement and performance requirements

4.1 Financial benefits of improved indoor environmental quality

4.2a Introduction to mapping and evaluation of building performance

4.2b Mapping and evaluation of building performance. Excel tool.

4.3 Questionnaire for users on energy and indoor climate. Template example.

4.4 Mapping of indoor environmental quality in schools by students. Template example.

5. Guideline for planning of indoor climate in schools
6. God inomhus i skola och förskola (Swedish)
7. Introduction to measurement and verification
8. Introduction to performance verification during implementation
9. Performance operation test
10. MSC Training material
11. MSC Presentation

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/multi-service-contracting/


KITCHEN
PANTRY
DINING AREA
STUDY ROOM
LIVING ROOM

GREEN LEASE CONTRACT

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

Let's understand the problem

To achieve energy and climate goals users of the buildings have to be involved. Most building managers also act as landlords, renting out premises or apartments. A building manager can also often have the task to rent premises from private or public organizations for own use, for example for municipality needs.

Goals for energy and environment in those cases need to be communicated and worked on in cooperation between the parties, although forms for such collaborations where energy efficiency is fully utilized are rare. Evaluation of previous attempt highlight problems with follow-up, evaluation and including a long-term perspective.

Experience show that building managers often lack the knowledge of how the use of premises (like schools, preschools, nursing homes, sports facilities, administrative buildings) affect energy use, power demand and

other environmental aspects. Even when building managers have high construction skills and understand how their buildings works, they often lack the ability to estimate and follow up energy savings from different measures.

The building manager needs to motivate the tenants to get involved in energy efficiency. Increased use of electricity can lead to power peaks during certain times of the day and the year. Cooperation is also needed to manage power loads and to reduce this vulnerability. Including heat and electricity in rentals makes it difficult for the tenants to monitor energy use, demotivating them to control power consumption. So, to get tenants involved, they should be informed in a clear way about energy use, which calls for using simplified systems of energy use reporting. In countries in which building owners make profit out of selling energy to tenants, tenants (e.g., a public organization) can have problems with motivating the owner to reduce energy use.

Landlords/building managers are demanding new methods and tools for increasing energy efficiency, and broader collaboration with tenants using Green Lease Contracts can be a solution for this.

Solution

The green lease contract method is based on a collaboration between both parties towards the optimization of energy use by a real estate. Together, it creates a win-win concept designed to give both parties an economic advantage. Always energy-related, a contract's content is often supplemented with other forms of action, such as the choice of materials, waste management, information dissemination, and training activities.

Instead of employing costly energy measures in a real estate, it is better to start motivating its tenants to change their way of using energy in order to reduce their energy consumption. The resulting economic savings can then be used to implement additional energy efficiency measures in the real estate. An initiative for implementing a green lease contract in a real estate can also come from a tenant renting a building who wants to contribute to energy savings and sustainable buildings.

Green lease contracts supply tenants and landlords with a structure to communicate and cooperate. In green lease contracts, the parties involved build up a dialogue about the real impact of the building and its operations on energy and the environment, thereby forming a common platform for monitoring future changes, discussion about them, and their implementation. This platform stimulates continuous improve ment. In a green lease contract, the parties undertake to regularly communicate energy and climate issues, that way opening opportunities for further improvements. The platform can also be used for pedagogic purposes, teaching energy issues in schools.

The landlord controls the building's heating system, ventilation, climate shells, lighting, and the like. The tenants can change their energy use, report on deficiencies in climate shells, operating times on lighting and ventilation, temperatures in different parts of rooms, and so on. Through proper communication between the two parties, possible adjustments are facilitated. Before investing in costly energy measures and supporting reinvestments in buildings, the landlord should collect feedback from the building's users.

In certain situations, the greatest motivator for partners to sign the contract and fulfil their commitments may prove to be a financial one. If heat and electricity are not included in the tenants' rent, they can be motivated in other ways; for example, a contract can be used to minimize power peaks by optimizing energy use during the day, thereby resulting in lower energy costs. An improved indoor climate may encourage the tenants to commit.

Buildings	Scope	Cross sectorial	Energy/Peaks	All/part Electicity	Period
Buildings may need different contracts.	Incentives in a contract can be informative and/or economical.	Contracts can include other environmental aspects, e.g., recycling and water use.	Contracts can lower energy, electricity and energy peaks.	Contracts can include part of or all electricity in the real estate, e.g., car heaters and charging stations for cars.	Contracts can vary in their timelines, depending on their goals.

TABLE 1. EXAMPLES OF IMPLEMENTATIONS OF GREEN LEASE CONTRACTS.

Experience from testing and recommendations

The most common mistake made during contract implementation is neglecting the follow-up. Follow-up meetings are crucial for both the landlord and the tenants, letting them share what they have done and what they could do better.

The landlord can use quantitative data to show whether and how the changes enhance the situation. Initial agreements should not be treated as constant. Instead, their final versions should be derived by an iterative procedure, with each step being an adjustment resulting from the increasing experience of both parties gained during the contract implementation.

Conditions changing over time and the contract will need to be improved to adapt to new reality. For building owners who have not signed any contract with their tenants, green lease contracts offer a soft start for the dialogue. The guide is based primarily on experience from contract processes between property managers and schools, but also from a health care centre.

Studies in Dalarna have shown that during the first year of a green lease contract, at least 5% of the property's energy can be saved.

Most of it comes from savings due to adaptations of ventilation, heat and lighting to the tenants' needs.

(During five years before signing the contract, no energy action had been made and no active energy saving measures had been implemented.)

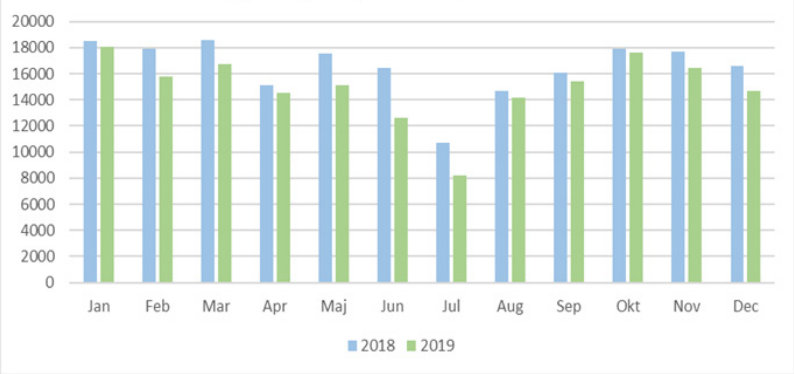


FIGURE 2. A SCHOOL'S ENERGY SAVINGS AFTER THE IMPLEMENTATION OF A GREEN LEASE CONTRACT.

Benefits from a well-designed green lease contract

Cooperation strengthens the relationship between tenants and landlord, improving their communication and mutual understanding.

Knowledge. The real estate's environmental and energy performance is increased by communication, sufficient gathering of information, and dissemination of key ratios.

Environmental. Performance is improved by more efficient use of resources and sustainable property management.

Cost effectiveness. Thanks to decreasing energy and resource use, cost effectiveness increases in both operations and management, with both landlord and tenants benefiting from it.

Pro-activity. A contract provides a competitive position when the demand for greener properties increases, especially when stricter environmental legislation is introduced. It also reduces sensitivity to increasing energy prices.

Goodwill. A contract created by parties working together on reducing the environmental impact can be used as a marketing tool to attract new stakeholders.

TABLE 2. BENEFITS FROM A WELL-DESIGNED GREEN LEASE CONTRACT.

Summary of experiences from testing and main challenges

Commitment: Both parties need to be committed to lowering the environmental impact of the real estate.

Knowledge: Poor knowledge about the real estate's environmental impact, measurements and environmental measures is key to making the real estate more environmentally friendly.

Trust: The landlord usually possesses the highest level of expertise in the field, meaning that for the cooperation to work, he or she needs to gain the tenants' trust.

Time: To get a good result, both parties' must be willing to allocate time to the contract.

Resources: A lack of resources for dialogue, measurements, and evaluations, together with a lack of financial resources, hinders the implementation of a contract.

Law: Low legal requirements favour passivity and goals that are difficult to set.

Incentives: To keep both parties motivated, it is important to find incentives that benefit both parties to keep them motivated.

Follow-up: Follow up the implementation in order to assess the contract and, if such a need arises, introduce required adjustments.

Combination with other tools

This tool can be combined with most other tools, as they can contribute to on another. The financial calculations are always behind Green Lease Contract. Funding and convincing the decision makers are supportive tools that can help achieve the goals. With MSC there is no direct combination. Nevertheless, it is important to pay attention to all green leasing contracts when performing MSC.

Conclusions

Green lease contract is a potential tool for sustainability, reduced energy use and increased profitability. A green lease contract can be applied for to all buildings in which energy efficiency can be increased. Signing a contract is fairly easy, but keeping it useful and alive is not. Key implementation challenges include a lack of time and motivation as well as poor communication. To overcome them, a contract should set up clear goals and impose an open and continuous dialogue between both parties.

Collaboration is key to get the most out of the agreement and it will lower the buildings climate impact if its achieved. Keeping the dialogue alive increases the likelihood that the agreement and lowered energy use in the building will last.

TOOLS

1. Guideline for Green Lease Contracts
2a Green Lease Contract. Template.
2b Green Lease Contract. Template for building owners
3a Green Lease Contract. Example for health care facilities
3b Green Lease Contract. Example for schools
3c Green Lease Contract. Example from BBP for commercial buildings
4. Green Lease Contracts Presentation
5. Green Lease Contracting training material

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/green-lease-contracting/


BURTON

PROSUMERISM

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

This guide helps building managers to with deeper insights in steps for learn how to become a prosumer, by (i) introducing legislation frameworks regarding prosumerism in the EU and each participating country; (ii) tackling PV market trends and costs; and (iii) discussing future development and barriers, using case studies and lessons learned from them. Finally, it provides the reader with a step-by-step instruction on how to implement prosumerism, using solutions the EFFECT4buildings tool provides, with an example from Latvia.

Let's understand the problem

Access to energy and its production has proven to be a key aspect of modern life. Until recently, most of energy in the world was produced by means of combustion, the only exception being hydroelectric power. However, recent technological developments have made it possible to obtain energy in cleaner forms, from sources such as sun and wind energy, which are free and inexhaustible and whose costs arise only from the installation of the equipment needed for producing it.

Energy prosumer is an energy consumer that produces energy. Prosumer buildings are becoming increasingly common (e.g., nearly zero-energy buildings and plus-energy buildings). Buildings that can become a net-producer of energy create new technological, juridical and socioeconomic challenges for public authorities as producers, distributors and consumers in smart grid systems.

Energy pricing in a two-way distributed energy trading usually ends up with prosumers selling energy when it is cheap and buying it when it is expensive. With energy-brokering–related pricing and a tool supporting selection of the optimal solution, electrical equipment can be optimized from an energy perspective and lower high peak-lasts. Investments in systems for energy exchange and optimal consumption can lower the costs

for energy and help finance other savings. Negotiations on the energy price tariffs between the building owner and the energy grid owner via related protocols are needed to help financing investments in energy production. Better management of energy loads results in reduced primary energy consumption and costs. This creates new business opportunities for building owners and facility managers.

The calculations of a prosumer value are explicitly impacted by regulatory policy in each country. Thus, to take the right financial decision, the project's target group needs detailed knowledge in order to take the right financial decision: on

- how to become a prosumer of energy; e.g. price regimes, legal issues, contracting.;
- when to invest in production capacity, and when to lease or co-own it;
- how to include socioeconomic benefits; and
- how to negotiate contracts to benefit from energy investments.

The joint focus of buildings as active partners in the energy system goes hand-in-hand with technological advancements in the area. For example, the cost of building integrated photovoltaics (BIPV) has been greatly reduced; recent advances in heat atlases have improved the planning basis in relation to low-temperature district heating systems.

Solution

Prosumerism guidelines for building managers show how to tailor energy production/consumption solution; how to manage energy loads to develop smart prosumer-friendly energy management; and how to take into account relevant laws, tax situation, and regulations at a local/regional level, to help inexperienced prosumers navigate through administrative hurdles to complete installation, start energy production, and share energy with the municipality. Prosumerism aims to stimulate access to the benefits of producing renewable energy, to make real estate management more efficient, and even to reduce energy poverty.

The first step in tackling this problem is to understand EU and country-specific laws and regulations regarding prosumerism. This is what the first section of the guideline helps to achieve, in additional summarising information on support schemes, support tools, and guidelines for each project country. The main strategy of the existing EU energy policy is to place consumers at the core and encourage them to take the ownership of energy transition. They are expected to actively participate in the market, at the same time fundamentally transforming the energy system of Europe. Regarding each member state, currently none of them has specific legislation that would fully regulate the prosumer issue. Instead, most countries have adjusted existing regulations and legislation, regulating either the electricity sector or the use of renewable energy sources, or both, to include and define prosumers, and to regulate various related aspects.

Currently, governments use several methods to support, incentivise and remunerate the generation of electricity from renewable resources. There are currently several methods governments use to support,

STEP 1
Understanding country specific lawa, regulations and support schemes regarding prosumerism

STEP 2
Understanding available tools and guidelines that assist prosumers

STEP 3
Understanding the trends and current situation of the PV market

STEP 4
Understanding the main barriers from experiences from existing projects

STEP 5
Understanding the implementation of a solar project

STEP 6
Understanding the application of the EFFECT4buildings instrument

FIGURE 1. PROSUMERISM GUIDELINES' CONTENTS.

incentivize and remunerate the generation of electricity from various renewable resources. This includes quota system, tenders, tax regulations, subsidies, loans and grants. Many tools and guidelines also exist to assist prosumers, including CAAD, visualization and simulation tools.

The next step is understanding the trends and current situation of the PV market. Therefore, the next section gives insight into global PV market trends and costs, including installed capacity trends, model cost trends, PV technology, and its efficiency trends. The installed PV capacity has witnessed rapid growth in the last decade. Europe has the second highest level of installed capacity, with its annual new capacity additions decreasing since 2011. Despite all that, in countries participating in this project less than 1% of produced energy comes from solar power. Even though installation costs of PV systems differ between and within regions, PV module prices have been rapidly declining in the last 10 years.

To motivate PV system implementation, it is necessary to understand its main barriers. Since experiences from related projects and implementations can help, the guidelines include them. The next step is to understand the implementation process itself. The guidelines describe four steps on how to implement prosumerism:

STEP 1 Planning of the installation

- Access the potential of PV in the desired site
- Determine the consumption profile and the power of the PV installation to cover the energy demand
- Access rooftop or wall orientation and estimate sunlight availability
- Determine appropriate system size and components
- Calculate necessary investments and payback, access the overall profitability of the installation
- Prepare and certify of the project of the installation

STEP 2 Understanding the main barriers from experiences from existing projects

STEP 3 Understanding the implementation of a solar project

STEP 4 Understanding the application of the EFFECT4buildings instrument

FIGURE 2. FOUR STEPS OF IMPLEMENTING PROSUMERISM

An essential part of every project is planning. For PV projects, it first of all translates to determining the overall feasibility of becoming a prosumer, which is done by assessing the consumer's energy needs and the optimal size and power of the planned PV site. First, PV potential in the desired site must be assessed using various available tools, and industry professionals can be consulted if necessary.

Then, the consumer needs to take into account the site's energy consumption, to determine the consumption profile and the power of the PV installation that would cover the energy demand; he or she can consider installing a storage unit to save energy for later usage. Then, after assessing the rooftop or wall orientation (for wall integrated systems), sunlight availability must be estimated.

This is followed by using available simulation or calculation tools, in order to determine the appropriate system size and components to achieve the necessary production of electricity. In the final step, one calculates necessary investments and payback time, and assesses the overall profitability of the installation. When the project proves to be optimal, it must be prepared and certified by a qualified technician or institution.

The EFFECT4buildings toolbox contains several financial instruments for building managers to implement energy-efficient measures. The guideline also includes a manual for the procurement of PV Systems, including general recommendations, a manual, and technical descriptions.

The Prosumerism calculation tool helps building owners:

1. To determine the optimal size of the PV system
2. To find out how much electricity can be produced from a selected area
3. To make financial calculations to identify savings, income, necessary investments, repayment time and the overall profitability of the system
4. To find out how much a storage system would improve PV systems efficiency

Results from testing and recommendations

The tool was tested in Gulbene municipality in Latvia, which plans to install a solar power plant on a local government administration building. Using this tool, Gulbene calculated the amount of electricity that the planned PV system can produce, and determined that the project would be profitable. Data gathered later using this tool will be used when making procurement.

Benefits derived from own energy production partly depend on legislation and available support mechanisms regarding prosumerism in the given country. One should thus analyse these issues, to learn the current PV market and understand how PV systems are implemented.

Combination with other tools

Prosumerism focuses more on energy production and use, it can be integrated with EPC and MSC or used individually. Municipalities may want to become prosumers and this can be incorporated with other goals. Supportive tools like funding, bundling, convincing decision makers and technical solutions are all necessary to make Prosumerism more effective.

Conclusions

Thanks to producing energy and returning the surplus to the grid or other energy consumers, prosumerism helps reduce electricity bills and become more environmentally friendly. Before deciding whether to become a prosumer, one needs to analyse the current situation in terms of legislation, laws, and support mechanisms in one's country.

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

TOOLS

1. Guideline for Solar energy (strategic) planning
2. Guideline for Step-by-step to become a prosumerist
3. Guideline for Procurement of solar energy

4a Guideline for Prosumerism calculation tool
4b Prosumerism calculation tool
4c Prosumerism calculation tool. Example Gulbene.

5. Prosumerism training material

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/prosumerism

TECHNOLOGICAL SOLUTIONS

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

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

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

Let's understand the problem

As EU has set a target for all new buildings to be nearly zero-energy by 2020, currently about 35% of the buildings are over 50 years old and almost 75% of the building stock is energy inefficient. Thus, smart and validated solutions are inevitable.Buildings are the largest energy-consuming sector in the world, accounting for overdone third of all carbon emissions. 75–90% of OECD building stock will still be in service by 2050. Yet the performance of most existing buildings is below current standards. Energy efficiency in buildings is a key focus in European and global climate and energy policies. Building energy efficiency has not increased in recent decades compared to other sectors especially transportation. Building component technologies have become more energy efficient but buildings as a whole have not.

A new approach to energy system integration and the extension of the research at district and community levels have started but still require supplementary developments.
Computational tools are necessary to take account of the complexity of buildings during design, assessment and operation. These should be supported by a series of targeted tools and solutions enabling better

decision-making, plus education and awareness on available innovative techniques. It is known that energy efficiency planning can be much more efficient when constructing a new building. It starts with the correct positioning of the building and the selection of the building envelope. But when it comes to renovating existing buildings, experience and proper planning require guidance and the experience of others.

To support building managers in taking investment decisions in energy efficiency solutions they need a better overview of available solutions, more knowledge about the technic as well as their profitability, together with experience from other that has implementing the solutions. At the same time, solution providers need feed-back from the market on new needs.

Solution

This is more than a technological challenge; the technology needed to achieve reduction in building energy use exists. Wise thinking, knowledge, experience is the basis for maximum results.

Available solutions

The catalogue of available technological solution mapped and recommended by project partners can be found in the annex to this guide. The list is up-to-date and often contains various references. It consists of 162 solutions grouped into 8 categories:

Building envelope (24 solutions):
In this category energy efficient and environmentally friendly solutions are listed. Here we see different insulation solutions, energy saving glass on existing windows, highly energy efficient external doors, integrated solar roof and solar facade solutions, different eco materials, wood building systems and installation techniques.

Ventilation (19 solutions):
This category includes different heat recovery ventilation systems, smart ventilation systems, ventilation sensors, managing and controlling systems, software solutions.

Heating and cooling (22 solutions):
Heating and cooling category includes combined heat and power plant, wood stoves and boilers and systems for wood chip burners. Hybrid heat pumps, heat recovery heat pumps and air treatment units. Radiant heating and cooling systems. Heat recovery from wastewater.

Water (11 solutions):
Water solutions are associated with both heat savings and utility water savings. There are simple and often affordable solutions for this. Our list contains solutions for heat exchanger for wastewater (for swimming halls, sport arenas and hotels that uses a lot of water), energy efficient tap water taps/showers, radiator thermostats and the automatic differential pressure controllers and more.

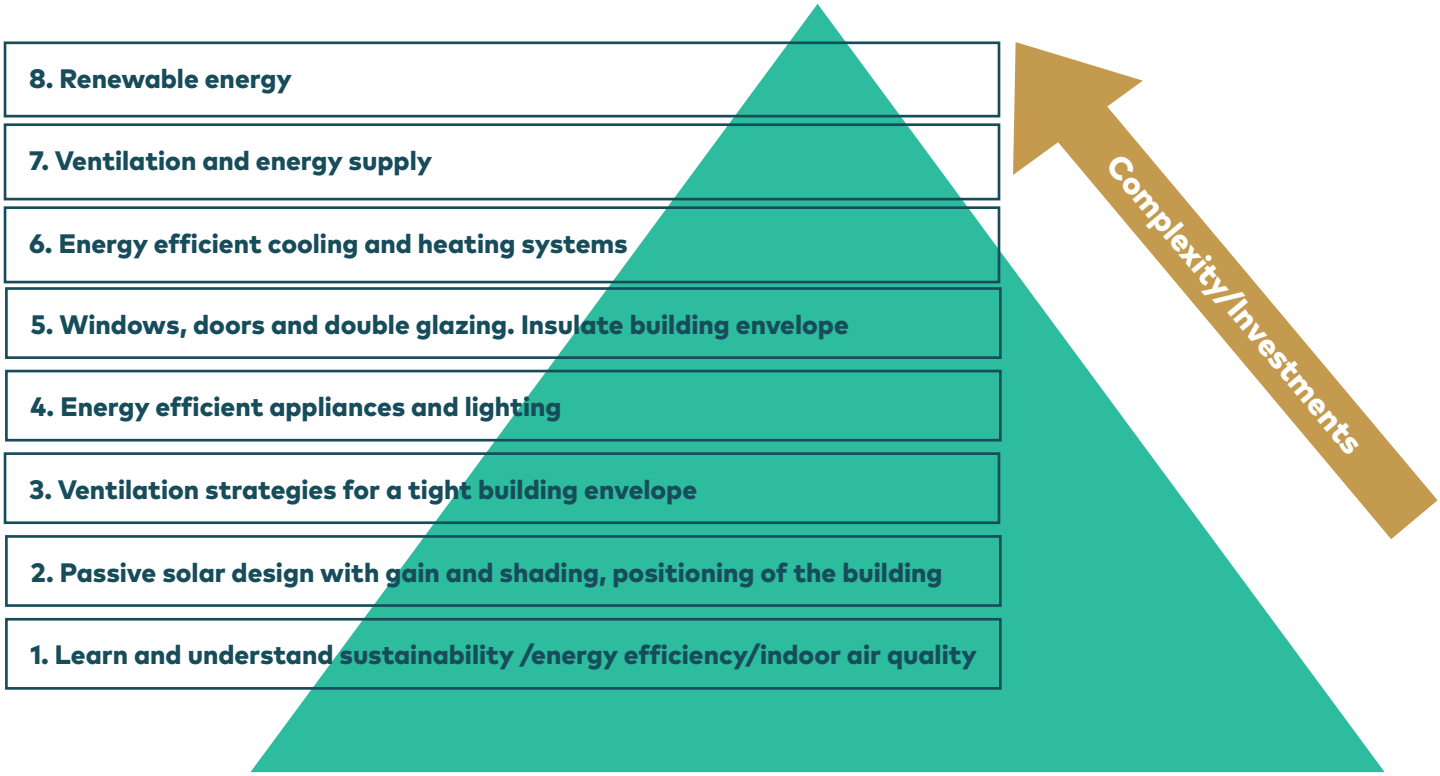


FIGURE 1. THE PYRAMID FOR RENOVATING SMARTER

Lighting (16 solutions):
Outdoor and indoor lightning with IoT backed up systems, from standard office solutions to solutions with special needs. Solutions that save up to 70% energy.

Electricity (20 solutions):
There are many photovoltaic solutions in this category, ranging from services to energy distribution to cable management and building automation. Includes power optimiser and micro-inverters for solar panels and solar power consumption and management systems.

Building management systems/ICT solutions (37 solutions):
There are most companies in this category. Mainly we find here managing, monitoring and visualization systems. Building automation, regulation and smart metering solutions. And demand-controlled solutions.

Others (13 solutions):
This category includes special solutions that can be placed under several categories at the same time. It's a good inspiration. What is done already and what can be done at all. All solutions focus on savings, both in terms of environment and money/energy.

The EFFECT4building project highlight some solutions of special interest and with the capacity to reach a larger market in the Baltic Sea Region. The catalogue of energy efficient solutions also contains articles about those solution providers, some of them also presented in a recorded webinar.

Experience and profitability of the solutions

Interviews by project partners, with nearly forty building managers, highlight experience from using many of the proposed solutions. Questions were asked about issues connected to technological solutions. Questions were also asked about experiences from technological solutions as well as what their needs are. We received comprehensive answers. Mostly are building managers satisfied with the improvements and the result is good. You can find a summary of the interviews in the appendix to the document.

To find out how profitable different categories of solutions in general are, an analyse of 500 energy audits with a total of 5 000 energy measures in Swedish real estate companies has been done. By calculating saved MWh per invested 100€ (MWh/100€) the most cost-effective measures have been identified. Results are presented in a web-tool as well as in fact sheets for four categories:

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.

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.

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.

To make such analysis possible data from energy audits need to be standardized and collected into a common database.

Summary/conclusions from the cases

We have a very good description of how to obtain photovoltaic solutions. Things to look out for that should be considered. This material can be found in the annex "Technical description for procurement of photovoltaics systems" document.

New needs

Based on interviews with target group there is a need of new or better solutions for to see all the parts together. Continuous development and monitoring are required. Good knowledge of the different types of financing is also very helpful. Knowledge has the greatest impact. Old opinions are very rooted. Public building managers are open for new knowledges and example cases. We believe that regular innovation meetings should be held at least twice a year.

Experiences and recommendations

The market for energy efficiency solutions in the Baltic Sea Region is growing and there is a large range of offers. Building managers have limited financial resources and are restricted in terms of taking financial risks. In addition to that, technical building systems are integrated, and each solution need to be carefully

evaluated in combination with other already existing systems. Because of this, building managers need to be well assure that the solution that they invest in really will perform as expected. For this, the performance of a technology solution has to be confirmed by other building managers, sharing experience that they actual work. Investment decisions cannot be taken only based on sale pressure. Based on our practice, more meetings between public building managers and technology providers should be organized. This must be done in the framework of an explanatory seminar. To organize such meetings well, we recommend involve independent parties, like Effect4buildings partners. Asking feedback and organizing follow-up meetings are recommended.

To standardize categories for energy efficient solutions in energy audit and collecting data from them into a common platform/database will generate valuable knowledge and help other building managers to identify possible solutions. Standardization make benchmarking possible and could also lower the cost for energy surveys. Such platforms do not exist today and should be promoted in the Baltic Sea Region.

Combination with other tools

Technological solutions are part of each tool and can also be used as additions. A vast array of different energy efficiency measures popular in the Baltic Sea area are presented in the technological solution guide. In addition, there is a longer description of a new energy monitoring system/software (EMS) that helps to measure and monitor the savings made with other energy efficiency measures. It works well in combination with EPC, MSC and Prosumerism.

Conclusions

Several results have arisen from this project on cost-effectiveness and reliability of products and technologies, and from "low-energy" and "nearly zero-energy" buildings for penetration in the market. Although progress is being made, deep renovation remains a priority if the potential for substantial savings and multiple related benefits is to be realized.

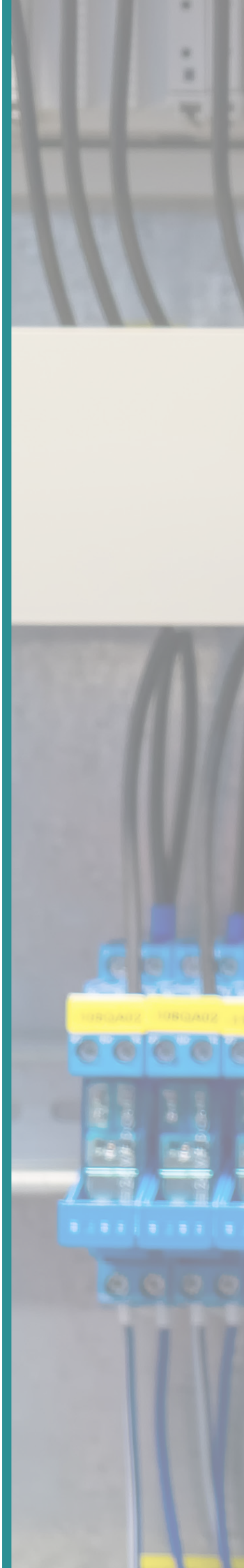
With technical solutions, the best effect is achieved when domains are implemented together, integrated or synchronized with each other. Projects that look at all possible improvement in different categories together are most successful. Categories we consider important here are building envelope, ventilation, heating and cooling, water usage, lighting, electricity usage and building management systems.

TOOLS

1. Technological solutions for energy efficiency
2. Experiences and procurement of technological solution

FIND ALL TOOLS HERE

www.effect4buildings.se/toolbox/technological-solutions/

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200 Ω
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MAX
600 Ã
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600 V̂
OFF
COM
V/Ω
CAT.III 600V
13 NO
21 NC
31 NC
43 NO
100QA01
22 NC
32 NC
44 NO


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