Framework for stepwise climate work with climate impact KPIs for the operation and management of buildings built before 2020

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Abstract

In 2019, the City of Malmö adopted a local roadmap called LFM30, in connection with Sweden's climate goals. The roadmap implies a climate-neutral construction sector in Malmö by 2030 and will be reached by commitments of participating organizations. To measure the improvements and that the commitment has been fulfilled, a new framework with clear key figures has been developed by researchers and property owners of existing buildings. The framework is used to determine a building's climate status and to practically guide managers and technical managers to systematically and continuously work on climate-adapting operations and management and to analyze the profitability and climate effects of technical measures. Within the framework, 27 Climate impact Key Performance Indicators, CKPI have been identified, key figures that show a building's current climate status. With the CKPIs a building's improvement over time can be showed within a property management, but also for comparing buildings with each other. To improve the CKPIs a tool with about 150 relevant climate actions for operation, management, building, building services systems and user engagement has been developed. The focus is on climate action, but these must not adversely harm other environmental and health factors, which the operation and management should continuously control. The climate actions are formulated as questions that can be answered with yes or no, each is rated in 1–5 depending on how cost- or time-efficient they are to implement. The framework also includes a process guide for the improvement work to be structured and that climate actions are implemented in the right order to avoid sub-optimization of climate effects and the economy. The guide helps managers and technical managers to implement climate actions that are relevant based on the building's conditions and the financial conditions. The property owners' commitments to LFM30 are to report annually from 2023 what proportion of their buildings have reached stage 1, step 2, etc. LFM30 is a good example of how property owners create pressure on themselves and collaborate with other organizations to get climate work started for real.

Background

Sweden has a parliamentary decision on net zero greenhouse gas emissions in 2045[1]. The City of Malmö has signed the supporting national roadmap towards 2045[2], which means that the city will actively work to meet this goal. The City of Malmö has therefore taken the initiative to create a local roadmap together with Malmö-based companies in the construction industry called LFM30 (Local Destination Malmö[3]). LFM30's ambitions are higher than the national targets, by 2030 Malmö will have net zero greenhouse gas emissions. As of February 2022, 210 companies, organizations and research institutes have signed up to work towards LFM30's goals. The commitment means that LM30's climate targets will be implemented, and that compliance will be communicated on regular basis. The roadmap consists of six different working groups with different focus areas: Business models, incentives and collaboration; Circular economy and resource efficiency; Design, process and climate calculation; Climate-neutral building materials; Climate-neu-

1. Swedish Government, www.regeringen.se/artiklar/2017/06/det-klimatpolitiska-ramverket
2. Fossil free Sweden, www.fossilfrittsverige.se
3. https://lfm30.se/

tral construction sites and transport; and Existing buildings' operation and maintenance.

The working group "Existing buildings' operation and maintenance" is tasked with developing and defining how to work to reduce climate emissions from existing buildings, how the goals should be formulated and reported on regular basis. The group includes about thirty property owners, managers, technical managers, environmental managers, specialists, suppliers, contractors and researchers.

Research and development have for a long time focused on reducing the climate impact of new construction of buildings and renovation of existing buildings, both residentials and non-residentials. However, achieving the climate goals also requires action in existing buildings that are not in need of renovation. Area-wise, the existing buildings in day-to-day operation and management make up at least 80% of the building stock. While they are not in need of renovation in the near future, there is great potential to reduce climate emissions through more efficient operation, better operating and maintenance procedures and analytical methods for energy-efficient measures that can be implemented during maintenance.

Regulation (EU) 2020/852 of the European Parliament and of the Council[4] (the 'Taxonomy Regulation') aims to be an ambitious and comprehensive strategy for sustainable finance with the aim of redirecting capital flows to help generate sustainable and inclusive growth. For acquisitions and ownership of buildings, i.e., the activity of buying real estate and exercising ownership of that real estate, the delegated regulation[5] (2021) defines the technical screening criteria for buildings built before 31 December 2020. It shows the importance to work with improvements of existing building sector.

One problem for operation and management is how the administration's climate goals should be broken down into actual actions in buildings, i.e., decisions made by the respective building managers and technical management. It is not possible to require equal climate reductions in each building due to different technical, economic, managerial and operational conditions. Property owners of existing buildings in ongoing operation and management need a framework to relate to in order to:

- get a measure of a building's current climate status
- formulate measurable climate goals
- get guidance in the improvement work
- report annual improvement with key indicators.

A compilation of knowledge, based on research results, industry standards and practices, shows that knowledge exists in the different places, but it is heavily fragmented in breadth, level of details, and does not exist where useful, operational decisions to reduce climate emissions are made. The knowledge compilation has also included the analysis of existing tools such as environmental certification systems for existing buildings. The most common systems in Sweden do not meet the necessary requirements to meet the ambitious climate targets. Breeam In-Use, Leed-EBOM and the Swedish system Miljöbyggnad iDrift assess buildings on many environmental aspects and therefore have a broad environmental extent and thus doesn't focus enough on climate-related indicators. None of the systems provide the requested practical guidance in prioritizing the choice of climate actions. Referring to a specific certification system would also constitute an obstacle to climate work since property owners have different economic, organizational and knowledge conditions. However, certification schemes can inspire when it comes to proposals for indicators. In summary, it can be concluded that there is a lack of frameworks for property owners of the large group of existing buildings that are not in direct need of renovation but which have great potential to reduce climate emissions by adapting their operation, management and maintenance to better counter climate change and by analyzing energy saving measures to improve maintenance.

Aim

The overall aim of the project is to develop a framework adapted for the practical and technical management with the possibility to identify, analyse and implement energy measures. It shall be used in the existing building stock of buildings that are operated, maintained and managed on an ongoing basis and do not need major renovation in the near future. It should be based on national and international knowledge, meet the real estate industry's need for simplicity and practicality, and reliably break down overall climate goals into concrete decisions on climate actions in each building.

Development of the framework

This section describes the method we used for the development work. The resulting framework is described in the next section.

The new framework has been developed at Lund University in collaboration with real estate companies, property owners, specialists, trade associations and other researchers. Property owners of multi-family buildings, schools, office buildings, hotels, retails, hospitals and so on (except one-family houses) involved in LFM30 have actively collaborated with academia. This is a prerequisite for the framework to be practically useful with a systematical approach for the intended user as the same time as integrity against lobbying are overseen for relevant research and development results. The implementation and making sure of acceptance by future users include the following elements:

- Study visits and seminars with property owners on good examples.
- Workshops with property owners, managers and technical managers about which aspects of buildings impact the climate and which requirements should be placed on a framework.
- Collection of qualitative data in the form of in-depth interviews with additional property owners, managers and tech-

4. Regulation (EU) 2020/852 of the European Parliament and of the Council on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (OJ L 198, 22.6.2020, p. 13).

5. Commission Delegated Regulation (EU) . . ./... of 4.6.2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives.

nical managers, trade associations, researchers and operational contractors to capture examples of significant climate actions or barriers affecting the structure and selection of indicators.

- Identification of overall requirements for the framework.
- Identification of guidelines for what characterizes a climate key performance indicator.
- Development of structure and user adaptation of the framework iteratively with intended users.
- Development of a process guide for stepwise improvement work.
- Open hearing process and referral procedure in larger group.

The requirements for the functions of the framework are numerous. It shall determine a building's climate status, be used to formulate realistic climate goals, prioritize improvements and be used to continuously report successes. Research results and management knowledge shall be combined. In order to structure the work, early principles and guidelines for the framework were identified. These have guided the development work by choosing which indicators the framework should contain and how they should be formulated. The principles and guidelines of the framework are:

- Inspire property owners to start climate work.
- Low entry to prevent extra obstacle.
- Focus on climate actions and avoid expansion to other environmental factors.
- Climate action should not impair other environmental factors and health effects, i.e., the DNSH (Do No Significant Harm) principle according to the EU taxonomy.
- Reasonable number of climate indicators.
- Self-monitoring climate classification system
- Regardless of the building's starting condition and the management's experience and knowledge
- Regardless the size of the real estate organization.
- Connect with the laws, rules and regulations that property owners must already follow today.
- Be easy to understand and use by people who work in property management.
- Serve as a source of knowledge about what in a building is a climate action.
- Concepts, terms and methods should be familiar by professionals.
- The framework should encourage property owners to engage the building users.
- Significant and relevant indicators
- Climate benefit should be scientifically proved.
- Should advise on verifiability.
- Proposed measures should be based on proven and available technologies.
- The property owner should have control over the indicator, i.e. be able to measure improvement.

The framework

The completed framework meets the requirements for functions and follows the guidelines and principles that were set up. It consists of three parts;

- Part 1: Indicators with measurement unit, purpose and instruction on what and how to measure.
- Part 2. Process guide for systematic and stepwise improvements.
- Part 3: Tool with 150 relevant climate actions for the practical work of determining the building's climate status, planning improvements and follow-up.

PART 1: INDICATORS

The framework contains 27 indicators which meet overall requirements and objectives. The indicator part describes these in detail with the purpose, justification of selection, instructions on what and how to measure. Calculation methods, possible link to legal requirements and concepts are explained, together with considerations that need to be made. Table 1 shows how the indicators are grouped with a brief explanation. In general, property owners are used to measuring and monitoring in different key performance factors, KPIs. However, they are not familiar with KPIs related to climate impact, called CKPIs in the framework.

The CKPIs measure different key figures, i.e., they have different metrics. The most natural metric for all buildings would be annual greenhouse gas emissions, however this requires that there are well-founded and transparent emission figures such as kg CO_2e/kWh or kg CO_2e/kg available. This is not always the case. Several of the indicators are both climate and resource-impacting, e.g., energy use, water and sewerage, and waste. For these, consumption is used as metric of the climate impact. Indicators measuring the climate status of management, operation, maintenance, and user engagement measures are assessed by the quality and content of the management system's routines, instructions, training activities, etc. The category of climate-related regulatory requirements is measured by the number of legal requirements that are checked annually. Accounting for the DNSH principle is raised as its own indicator to be clearly visible. The indicator part also provides information about appropriate verifications that indicate that an action has been implemented.

PART 2: PROCESS GUIDE AND PART 3: TOOLS FOR METHODOLOGICAL IMPROVEMENT WORK

As a complement to the indicators, the framework contains a process guide that describes step by step how the work with climate actions is done methodically to avoid economic or environmental sub-optimization. The tool is used in the practical work of managers and technical managers to determine climate status and prioritize environmental measures. It describes 150 climate and resource-related actions.

Table 1. Climate impact Key Performance Indicators (CKPIs) grouped in categories with measurement units and comments. Note that measurement refers to a 12-month period.

Categories & CKPI		Measurement unit and comment
Energy		Energy use This is the indicator that causes the largest climate emissions from a building in operation. Energy is a climate-impacting resource and therefore both energy use and corresponding climate emissions are monitored. The emission figures are based on the electricity grid and energy sources for heat, e.g. the local district heating supplier.
	1	kWh per m²
	2	kg CO_2e per m²
		Heat power need at dimensioned outside temperature during winter season (DWOT) Climate emissions from heat and electricity production are highest when it is coldest outside, it is also a limited resource. The most effective measure of follow-up is the size of the heat power requirement, which can be measured with a power signature.
	3	W per m² at DWOT
		The share of locally generated renewable energy, e.g., solar cells or solar collectors, as a way to show own investments in energy supply. The share of renewable energy sources through agreed and allocated "green energy" purchase which provides climate benefits only in the long term and is a signal to energy suppliers that there is interest in renewable energy sources, it is a system for consumers allocation of emissions, so called market-based system.
	4	Share of kWh from solar cells or solar collectors of total energy supply
	5	Share of kWh purchased as "green energy" of total energy supply
		Refrigerant leaks from chillers and heat pumps
	6	kg CO_2e per building
Water and sewerage		Water use is a climate-impacting resource and therefore both quantity and CO_2 emissions should be monitored. CO_2 emissions occur in wastewater treatment plants and transport of both water and sewage and are obtained from the municipal water treatment plant.
	7	m^3 per m²
	8	kg CO_2e per m²
Waste		Taking care of waste causes large emissions of greenhouse gases. As long as there are no relevant emission figures, property owners can be encouraged to reduce the amount of waste generated in the building and to increase the sorting opportunity by adding waste sorting fractions. The better waste gets sorted, the more it can go to reuse and regeneration instead of energy extraction and landfill.
	9	Kg per m² and per waste sorting fraction
	10	Number of waste-sorting fractions
Construction and installation materials		New production of construction and installation materials for maintenance and tenant adaptations causes a major climate impact. Encouraging reuse reduces the need for new production. When purchasing new products, priority is given to goods with low climate emissions.
	11	Coverage rate (percentage of recycled goods of total use)
	12	kg of CO_2e per m²
Outdoor environment		The aim is to work to reduce emissions caused by fuel and fuel for tools, machines and transport needed for the operation and management of plots of land.
	13	kg of CO_2e per building
Operation and maintenance		The aim is to adapt the existing management system for operations and management. The framework's tools listed what distinguishes climate-adapted instructions, rounding schedules, routines, etc. Measured in the number of inserted climate actions.
	14	Operating and maintenance instructions
	15	Rounding schedules
	16	Routines for continuous operation optimization
	17	Training of operational and management personnel in the climate impact of buildings
Management and maintenance		The aim is to adapt the existing management system for management and maintenance. The framework's tools listed what characterizes climate-adapted routines, design instructions for tenant adaptation, maintenance measures, etc. Measured in the number of inserted climate actions.
	18	Routine for managing tenant adaptation, minor conversions and maintenance measures
	19	Climate calculation tools and profitability tools
	20	Instructions for purchasing and procuring services

The actions are formulated so that they can be answered yes or no. Each of them is rated between 1 and 5 depending on how demanding they are to implement in terms of time and money. Classes 1–3 can be defined theoretically without site inspection and are very cost-effective actions, normally fit within the year budget, and they take little time to implement. Actions classified 4 and 5 involve technical improvements that require financial or time budgeting. A visit to the building itself is needed to determine whether these actions have been implemented.

Each of the actions is tagged to which administrative area they belong: building, building services, operation, administration or user participation. The measures are applicable to apartment buildings, premises with or without comfort cooling and to buildings with light industry.

The process guide for improvement work is following 4 steps:

Step 1: The climate status of the building, operation and administration is determined

Managers and technical managers review the respective indicator in the tool. The questions are formulated as "It is known if..." and can easily be answered with yes or no. The questions do not require an inspection of the building itself.

Step 2: Measures rated 1–3 are implemented

For example, Class 1–3 improves the quality of operating statistics to meet certain requirements for sub measurement and reading intervals. The management system for operation and management is climate adapted.

Step 3: Actions rated 4–5 are analyzed

For example, energy-saving measures regarding profitability, climate effects, coordination with other actions and with the maintenance plan are examined. The analysis takes place partly per measure and partly in different packages of measures. Soft actions can also be included here, such as implementing incentive agreements, which may take time to be accepted in the organization. The analysis starts with an inventory of the energy status of the building and installations based on an action list in the tool.

Step 4: Relevant measures or packages of measures are implemented

According to the framework, the building is now climate-optimized (not climate-optimal) based on its and its management's conditions. The established routines and monitoring of the CK-PIs will facilitate the results to last over time.

Discussion and conclusion

REQUIREMENTS VIA LIMIT VALUES OR METHODOLOGY

During the development work, quantified limit values on CO_2-emissions were discussed. However, the buildings vary greatly with age, condition, operations, type, size, micro location and the property owners have different financial and organizational conditions. Extensive analysis would thus be required to find adequate emission limit value.

The framework will be put into operation during the autumn of 2022. But already during the development period, it has been tested by various property owners. Tests were performed by Regionfastigheter Skåne, which manages 1 million square meter of real estate for healthcare, Stena fastigheter a real estate company that owns and manages residential properties, Whilborgs fastigheter, a commercial company that owns and manage buildings for office, industrial buildings. The tests were carried out on managers and technical managers who had not participated in the development work themselves. Observations and comments from the tests were of great importance for the development of the framework.

Results from the tests were that it is a pedagogical challenge, but not impossible, to formulate academic research results so that it will be of practical use. When the framework was presented to the test persons, they were initially skeptical. It was thought that it was another tasks added to their work load and would mean a lot of new things to learn. However, after a while they realized that it was adapted for their usual work and that it would create understanding for tasks they are already doing. Furthermore, it was positive for increased cooperation between management and technical management. Especially for technical management, it was an eye-opener that a large part of their day-to-day work is climate work without it is being called so. This gave them confidence and was motivating to use the framework.

To be successful, one must be clear that climate measures for the management and operation of existing buildings are not an extra task but a more systematic way of supplementing routines and descriptions and to orderly include climate analyzes in for example exchanges of equipment.

The framework that will be implemented implies that each building and each real estate company reduces climate emissions according to their conditions, but has to follow the framework in the improvement work and report their results at the real estate company level. This increases the possibility of broad use and buildings can begin climate work regardless of starting condition.

RENOVATION AND MAINTENANCE MEASURES

During the development work, the importance of vocabulary has become clear. The term "renovation" is sometimes used misleadingly and can become an obstacle to climate action. A renovation is a large and extensive project that is perceived by property owners as resource-intensive which many do not have the conditions for. As an alternative to specific initiatives such as renovation, it is better to educate or inform property owners about how the ongoing and planned maintenance can be used to reduce climate emissions. The method described in the framework with well-thought-out operation and management can achieve emission savings from the buildings without being renovated. The measures are instead implemented stepwise within the maintenance plan. The framework is not the same as the renovation passport (according to EPBD proposal[6]) According to practice and based on EPBD[7], a major renovation is defined as if the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land. In the framework the stepwise measures are much more limited in investment costs. This is also the

6. Energy Performance of Building Directive (recast), proposal 2021/0426(COD), 2021.

7. EPBD, Energy Performance of Building Directive 2010/31/EC.

difference from step-by-step renovation in a renovation passport where the renovation is divided into stages which requires larger investments. In LFM30, the goals are the highest. With the framework the property owners are inspired to get going with the climate work and to step by step reduce the climate impact by coordinating the work with the maintenance plan. It gives results already the first year and provides an overview and knowledge for the next years to come when allocating resources across the building portfolio.

GOALS AND REPORTING AT COMPANY LEVEL

The framework is designed for climate work per building. Reporting of results according to the framework starts in 2023 within LFM30 and by 2030 100 % of existing buildings must be climate optimal, i.e. have reached step 4 in the framework. The sub-targets to be reported every year are based on the proportion of buildings within the real estate company that have achieved step 1, step 2, step 3 and step 4, respectively.

The development work with the climate framework with objectives as in the Malmö initiative LFM30 is a good example of how property owners create pressure on themselves and collaborate with parts of knowledge so that climate work can get started for real.

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