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Sustainable buildings and facilities

Guidelines for higher education institutions in Sweden.

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Foreword

The societal challenges we are facing are many and complex. The need for transitioning seems to be never-ending. These challenges are not just about technology, but also about having functioning ecosystems and social and cultural infrastructures. Higher education institutions (HEIs) can play an important role in the climate transition – by contributing research, innovation and education about sustainable solutions, but also through being part of our cities, and being able to act as test beds for new, sustainable methods. Buildings and campus areas are the face of higher education institutions to the broader community. By being pioneers and showcasing sustainable solutions, our HEIs can inspire others, making this another way that they can contribute to sustainable development.

The Climate Framework[1] for higher education institutions was developed in 2019 with the aim of guiding HEI's in the climate transition. The Climate Framework was then adopted by the Association of Swedish Higher Education Institutions (SUHF) in 2021. The following year, *Lärosätenas klimatnätverk*[2] (the HEI climate network) was established with the aim of accelerating the climate transition by developing area-specific guidelines that can be used by all HEIs.

This document *Sustainable buildings and facilities – Guidelines for higher education institutions in Sweden*, which was developed and produced by the Buildings and Energy focus group within the HEI climate network, on behalf of the Expert Group on Facilities and Security.

The Guidelines contain recommendations in the form of suggested targets and methods for the HEIs' facilities management and energy use. The Guidelines also provide recommendations for reuse, and highlight the importance of cooperation between the HEIs and property owners in order to succeed in the climate transition.

The aim has been for the Guidelines' recommendations to be relevant and capable of enabling real change, and to be implemented and used by the majority of Sweden's HEIs. So that the Guidelines can also serve as inspiration, examples of best practice from different HEIs are highlighted in each section.

An important starting point for the focus group's work was the research overview titled *Lokalers klimatpåverkan*[3] that a working group on climate issues within the SUHF Expert Group on Property and Security developed in 2022–2023. Along with the HEIs' own data and experience, the new regulatory framework and EU directives such as the Energy Performance of Buildings Directive (EPBD) and the

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[1] SUHF (2024). *Expertgruppen för samverkan/Klimatramverk och exempelsamling till stöd för lärosätenas klimatarbete* (Expert group for cooperation/Climate framework and best practice examples to support the HEIs' climate efforts). https://suhf.se/arbetsgrupper/expertgruppen-for-samverkan/ [24 August 2024]

[2] SLU (2024). HEI climate network – working together for a better climate. https://www.slu.se/en/Collaborative-Centres-and-Projects/higher-educations-climate-network/ [24 August 2024]

[3] SUHF (2024). *Lokalers klimatpåverkan - Drift, förvaltning samt om- och nybyggnation: en vägledande kunskapsöversikt* (The climate impact of facilities – Operation, management and renovation and new construction: a research overview for guidance) Report from the Expert Group on Facilities and Security, Reg. no.: SU-850-0047-15 [20 March 2023].

Energy Efficiency Directive (EED), as well as reports on facilities sharing and circularity, formed the basis for the content of the Guidelines.

In May 2024, the focus group conducted a survey of all HEIs in order to get a picture of the HEIs' current work with buildings, facilities and energy. Twenty-five HEIs responded to the survey. The target group for the Guidelines is HEI managements, facilities and services units within the HEIs, the MLUH network (environmental management in higher education institutions) and the Association of Swedish Higher Education Institutions (SUHF). The work was limited to dealing with the higher education sector's spheres of responsibility and influence.

The Buildings and Energy focus group completed its work during 2024. The group consisted of Lisa Redin, Umeå University; Rickard Nilsson, Dalarna University; Elin Sundberg, Mälardalen University; Lena Söderlundh, Stockholm University; Felicia Widing, KTH Royal Institute of Technology; Ebba Karlsten, Akademiska Hus; Caroline Isaksson, Akademiska Hus; and Lisa Engqvist, Akademiska Hus.

A reference group was formed for this work consisting of representatives from Örebro University, Chalmers University of Technology, the University of Gothenburg, Uppsala University and Karolinska Institutet.

SUHF's Expert Group on Facilities and Security was the final referral body prior to finalisation of the Guidelines.

List of recommendations

All the recommendations are listed as an introduction to these Guidelines. Each section then contains a more detailed description of the approaches and methods recommended for each area.

Facilities management (Section 2)

- Work according to the four-step principle for sustainable facilities management:
  - **Step 1 Rethink.** By reducing the surface area of facilities, the HEI's climate impact can be reduced on average by 15 kg less CO_2 per square metre per year. If another actor can utilise the space and does not need to construct a new building, an average of 300 kg CO_2 is saved per square metre of the new building not constructed.
  - **Step 2 Optimise** By intensifying the use of the space, the climate burden of construction is reduced, as more people can utilise the same facility. Energy use will increase slightly if the utilisation rate is higher. The recommendations and goals listed below can serve as a guide for more sustainable facilities management.
    - **Offices:** Strive for a utilisation rate of 1,200 to 1,300 hours per year, corresponding to approximately 5.5 to 6 hours per working day. Permanent offices/workplaces are assigned only to those who 'regularly perform office work'. Share offices/workplaces if the utilisation rate for offices is lower. Measure the utilisation rate in offices, with support from AI if possible.
    - **Lecture rooms and lecture theatres:** Aim for a utilisation rate of 1,200 hours per year, corresponding to approximately 6 hours per working day with an occupancy rate of 80%. Measure the utilisation rate and planned use (booked times) in lecture rooms and lecture theatres; measure the occupancy rate, with support from AI if possible.
    - **Group rooms:** Strive for a utilisation rate of 1,400 hours per year, corresponding to 7 hours per working day. Measure the utilisation rate and planned use (booked times) in group rooms.
    - **Meeting rooms:** Strive for a utilisation rate of 1,200 hours per year, corresponding to 6 hours per working day. Measure the utilisation rate and planned use (booked times) in meeting rooms.
  - **Step 3 Renovate** Extend the service life, adapt, add to or renovate facilities or the spaces and functions in the immediate vicinity, which will facilitate sharing. Choose products and manage products to enable circular and non-toxic flows and reuse:
    - Reuse fittings and building materials according to the Reuse Principle in Section 4.
    - Certify to at least Green Building Silver standard or equivalent for major conversions.
    - Comply with the requirements in the Energy Performance of Buildings Directive.
  - **Step 4 Build new** New construction should be avoided because the utilisation rate analyses that we have today show at least a 20–30% overcapacity

of facilities within HEIs, often more. If there is a need for more surface area, the possibilities of sharing facilities with other actors within the campus area/city should be investigated and prioritised before new construction.
- Involve the affected activities and staff at an early stage.
- Measure the utilisation rate to be able to make data-driven, well-informed decisions.
- Use AI to analyse many buildings at the same time if possible.
- Share facilities where possible internally and/or externally.
- Monitor this work against set/achieved targets for reducing the environmental and climate impact of facilities.
- Communicate the work with sustainable facilities management before, during and after changes are made.

Energy use (Section 3)

- Work according to the management system's process: Plan, Do, Check and Act.
- Cooperate with property owners. Form an energy group that identifies measures, pursues issues, distributes the work and monitors the outcomes.
- Set targets:
  - The targets should be measurable in absolute figures – kWh per year, and kWh/m^2 per year.
  - For buildings, net zero emissions apply by 2050.
  - Energy efficiency improvements of at least 2% per year up to 2030.
  - At least the energy requirements for Green Building Silver or equivalent in the case of conversions, and Green Building Gold or equivalent for new buildings.
  - The electricity should be from 100% renewable sources.
  - Targets should also be set for the installation of solar panels and charging infrastructure.
- Prioritise and budget for these measures based on the Kyoto pyramid and BELOK's *Totalmetodik* (Total methodology).
- Communicate measures and their outcomes. Let energy efficiency be a standing item on the agendas of meetings with the property owner.

Reuse of fittings and building materials (Section 4)

- Make an inventory and document what can be reused.
- Plan this work at an early stage to enable the greatest possible reuse.
- In the case of conversions: cooperate with the property owner at an early stage to enable an inventory of the existing buildings prior to conversion.
- When needs change in facilities, work according to the Reuse principle for furniture and fittings needs, and/or for building materials in the case of conversions and new construction, where applicable.
- Calculate and analyse the effect of the reuse of these items on the climate and economy:
  - Fittings. To enable active choices to be made, it is recommended that you calculate carbon footprints and compare different choices with each other.

- Building materials. Request to see carbon footprint calculations of the reuse of building materials from the property owner for decision-making and communication purposes.

- Set targets:
  - Fittings. The target should be set at 90% of the number or volume of items reused according to steps 1 to 3 of the Reuse principle.
  - Building materials. Targets should be set in cooperation with the property owner. Here, key figures such as Percentage of reuse per product group (percentage by weight, number or volume) and Percentage of reuse from demolition (kg per tonne) can be used. Use the environmental certification systems listed in Appendix 1 to set a target value.

Cooperation with property owners (Section 5)

- Formalise and pursue cooperation between tenant and property owner, preferably by means of the Cooperation process outlined in Section 5.3.
- Raise the issue of financing and whether these matters should be included in the cooperation agreement, or have a dialogue on how financing issues should be dealt with once the cooperation agreement has come into force.
- Start with the standard templates that already exist (for example Akademiska Hus's template for cooperation agreements or Fastighetsägarna's Green Annex).
- Decide on cooperation agreements at the highest level and make the agreement as concrete and binding as possible.
- Allocate resources for this work and involve both administrative and academic staff – that is, those who work with these issues in the organisation or who have expert knowledge.
- Cooperate in the following areas and concerning the following ambitions:
  - **Building stock, new construction and conversion, and environmental certification**. This area is about a fundamental stance in relation to the HEI's building stock and facilities management, as well as new construction and conversion. The principle is that facilities and building development projects are preceded by an analysis based on the four-step principle of sustainable facilities management (see Section 2). This area may also include provisions to create flexible facilities to facilitate the climate transition over time. The area may also include environmental certification of conversions and new construction as well as any additional certifications regarding, for example, the climate or health. It may also include agreements to provide environmental certification of existing occupied buildings[4].
  - The agreements can also include material choices with stipulations that these must be approved materials in databases such as Sunda hus, the Byggvarubedömningen or Basta. This is often part of environmental certification but can be formulated in agreements even without any certification.

[4] SUHF (2023). Lokalers klimatpåverkan - Drift, förvaltning samt om- och nybyggnation: en vägledande kunskapsöversikt page 32 (The climate impact of facilities – Operation, management and renovation and new construction: a research overview for guidance) Report from the Expert Group on Property and Security, 20 March 2023 Reg. no.: SU-850-0047-15.

Agreements on reuse can regulate the reuse of both fittings and building materials (see Section 4). The agreement can also be about promoting circularity in a broader sense, or enabling circular services or the sharing economy among students and staff as well as external parties.

- **Energy use.** Agreements on energy use are about making energy use more efficient and also about minimising the climate impact from energy use by switching to energy types with a lower climate impact (see Section 3).
- **Waste management and recycling.** Cooperate to increase sorting at source and recycling by enabling sufficiently dimensioned and standardised source separation sites, reuse and recycling rooms, joint information, indoors as well as outdoors, for students, staff and visitors.
- **Water use.** Cooperate for more efficient water use and to exploit potential opportunities for circular systems for stormwater management.
- **Outdoor environments.** Cooperate concerning campus area outdoor environments to promote and support biodiversity and ecosystem services, but also for the outdoor environments to offer places for recreation and well-being, as well as teaching outdoors. Cooperation concerning outdoor environments might also include measures related to climate adaptation.
- **Mobility, meetings and travel**. Cooperate to promote climate-smart commuting and measures that include better opportunities for students and staff to choose public transport, carpooling or vehicle pools. Cooperation can also improve opportunities for digital and hybrid meetings that can reduce the need for travel.
- **Carbon footprint.** Cooperate to enable annual monitoring of the climate emissions of property management operations. Do specific calculations prior to making decisions on new construction and conversion.
- **Climate budget.** Cooperate to facilitate joint climate objectives and climate budgets for future property management operations and construction projects.
- **Social and cultural sustainability.** Cooperate for increased safety for both indoor and outdoor environments, for example through joint *trygghetsvandringar* (safety walks) – a type of inventory and analysis of an area conducted with the occupants. Cooperate on measures to prevent discrimination, promote areas such as health and exercise, gender equality and equal opportunities, as well as the preservation and development of historic campus environments.

1. Introduction

The building and construction sector accounts for up to 40% of the world's resource and energy use.[5] In Sweden, the sector accounts for one third of the energy used, and generates just over 20% of greenhouse gases.[6] In order to reach the society's climate objective of net zero emissions by 2045, emissions from the building and construction sector need to be reduced and resources, waste and CO_2 emissions need to be minimised in all phases of a building's life cycle. This requires climate-smart choices as well as circular and non-toxic flows. Emissions can be reduced significantly by not constructing new buildings, although conversions and renovation also account for a significant share, up to 30%[5], of the industry's greenhouse gas emissions.

Buildings, facilities and energy account for about a quarter of the HEIs' greenhouse gas emissions and, together with business trips, purchasing and laboratory activities, generate the largest emissions. By making facilities management more efficient, sharing facilities more, reducing energy use, increasing reuse/recycling and extending service life, as well as imposing requirements on property owners regarding conversions and any new construction, HEIs can reduce their climate impact and resource consumption. In work with the climate transition, digitalisation can reveal potentials for facilities efficiencies and also facilitate reuse. Smart, renewable energy systems as well as sustainable materials choices will play a crucial role in the future, but water supply systems and waste management systems also need to be optimised. The life cycle perspective[7] is an important aspect where every phase of a building or product's life needs to be considered from a sustainability point of view.

In order to accelerate the climate transition and work related to buildings, facilities and energy, the HEIs and their property owners need to cooperate. This cooperation can be based on shared data, such as carbon footprint and climate budgets that in turn form the basis for common goals and joint action, which also enables innovative solutions. For this work to have a long-term impact, it needs to be integrated into the HEIs' routine work with facilities management and systematic climate and sustainability work. Here, the HEIs' property and facilities directors (*fastighetschef*) bear a special responsibility, along with the HEIs' other decision-makers, to take into account prudent management of resources when making such decisions, but also to pioneer new types of solutions and approaches.

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[5] World Green Building Council (2024). Bringing embodied carbon upfront. https://worldgbc.org/advancing-net-zero/embodied-carbon/ [24 August 2024]

[6] Swedish National Board of Housing, Building and Planning (2024). *Utsläpp av växthusgaser från bygg- och fastighetssektorn* (Greenhouse gas emissions from the building and construction sector). https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/miljoindikatorer---aktuell-status/vaxthusgaser/ [24 August 2024]

[7] Swedish National Board of Housing, Building and Planning (2024). *Vilka mervärden ger en LCA?* (How does an LCA add value?) https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/livscykelanalys/vilka-mervarden-ger-lca/ [24 August 2024]

Sustainable facilities management is not only about energy efficiency and efficient resource utilisation, but also about opportunities for a good, sustainable working life and student life, as well as opportunities for educational development and high-quality research. Attractive learning environments where students and staff can interact socially for their joint development play a major role. It is also important that the HEIs are designed so that students, staff and visitors enjoy being there. Everyone should feel included, and the conditions for equality and diversity must be in place. The overall design, the indoor environment and sound are important factors, as well as safe outdoor environments that can contribute to health and well-being.

In addition to technology and changes in technical and social infrastructures, if the HEIs' transition to climate neutrality is to be in line with the society's objectives, courage is needed, as well as clear and firm steering along with greater economic incentives. One way to create incentives and highlight the potential costs of society's climate transition and the costs that climate change may entail is to price carbon internally. This may mean, for example, that in their internal work, HEIs calculate using a fictitious internal charge, or 'shadow price', based on an investment's carbon emissions. The shadow price then becomes a theoretical cost. This means a cost that does not exist in actual financial terms but is nevertheless visible in the costings on which decisions to make new investments are based. Estimating such a cost is complex as it is based on potential future scenarios such as a higher carbon tax or the costs of climate adaptation measures as a result of more disruptive climate change. A cost model for CO_2 emissions will therefore always be an estimate. SUHF's research overview on the climate impact of facilities and the Swedish Financial Supervisory Authority's report on an internal price on carbon[8] provide a number of different levels of taxation and internal carbon pricing. Based on this, a cost model for HEIs is proposed that is higher than the current carbon tax in Sweden and the EU's Emissions Trading System. The proposed level in the SUHF research review is SEK 5 per kg of CO_2. This level provides a benchmark and a value to monitor and learn from over time, as well as preparing the organisation for any future climate-related cost increases.

Internal carbon pricing can be applied to all sections in these Guidelines as well as to other parts of the HEIs' activities. This can provide HEIs with tools and greater internal incentives to steer investment decisions in a sustainable direction. If HEIs are to be role models, they need to act and this requires implementing many different types of measures. To succeed in the climate transition, HEIs may need to challenge both themselves and current social structures, and they may also need to act to promote behavioural change and enable a sustainable lifestyle for everyone who spends time in and around the HEI's facilities.

Each section in the Guidelines includes an **Introduction**, which describes the area generally, followed by the **Current situation,** giving a picture of the status quo at Sweden's HEIs. Thereafter, **Methods and approaches** presents various approaches to working systematically with the area. The sections each conclude with **Recommendations** containing metrics and target levels, as well as processes and

[8] Financial Supervisory Authority (2021). Internal price on carbon – what and why? FI Analysis No 30, 18 March 2021. https://www.fi.se/contentassets/a252e77c5bea47adbdb95156890c3374/fi-analys_30-internpris-pa-koldioxid-eng-rev.pdf. [17 November 2024]

methods. In all sections, there is also a **Best practice** part with examples from different HEIs of what is currently working well in each of the different areas today.

2. Facilities management

2.1 Introduction

Sustainable facilities management means that the utilisation of existing buildings and their infrastructure is made more efficient so that the need for new, and even the existing, buildings is reduced. To achieve this, the spaces need to be flexible, multifunctional and adaptable over time. There must be a balance between supply and demand. From a climate perspective, an occupancy rate of about 60–80% of ordinary working hours can be considered efficient. This also means that the space is used for most of the working day and that there is enough time for maintenance and cleaning.

Digitalisation and data-driven decision-making can facilitate work with sustainable facilities management, since data from occupancy sensors, tally counters and lecture room/lecture theatre bookings all provide information about patterns, trends and correlations in the use of facilities. Digitalisation in the form of digital twins is also highlighted as a facilitating factor in the EU's Energy Performance of Buildings Directive.

Factors such as the principles governing office allocation, central timetabling, how booking rules are formulated, and sharing of facilities can affect utilisation. When sharing facilities, under-utilised spaces can be used by several parties, which thereby avoids new construction or new purchases.

In order for work with sustainable facilities management to be truly sustainable for staff and students, it is important to involve the relevant activities at an early stage. Especially when switching from individual offices to flexible workplaces, this work can be challenging, which is why it needs to take time. Sometimes there will be a need to get support from Human Resources units or trade union councils. Various checklists, such as Checkflex[9], can also be helpful.

It is also important for the HEIs to allow some of the facilities to remain a transition reserve, and this should be reviewed in conjunction with other work that will entail changes to facilities.

Work to make the most efficient use of facilities is based on the facilities management reform (*Lokalförsörjningsreformen*) from the early 1990s, and the audit carried out by the Swedish National Audit Office [10]in 2017, where the efficiency and appropriateness of the HEIs' facilities management were assessed. The audit resulted in the HEIs being tasked with ensuring systematic monitoring of the utilisation of facilities to continue improving efficiency in the utilisation of facilities; and an assignment to Akademiska Hus: to further strengthen its efforts to create joint incentives for reducing facilities costs.

[9] Umeå University (2024). Checkflex. https://www.umu.se/institutionen-for-folkhalsa-och-klinisk-medicin/arbetsmiljo-och-halsa/checkflex/ [24 August 2024]

[10] Swedish National Audit Office (2018). Higher education institutions' provision of premises – room for improvement. Report RiR 2018:15.

2.2 Current situation

Sweden's 38 HEIs[11] together lease over 4.5 million square metres of facilities, where Akademiska Hus is the biggest landlord. The National Property Board of Sweden, Vasakronan and Hemsö also have large building stocks leased to HEIs.

In May 2024, the Buildings and Energy focus group conducted a survey of Sweden's HEIs. Of the 25 HEIs that responded to the survey, 23 stated that they are working to optimise their facilities management. Some HEIs stated that they have targeted goals for facility efficiency, and one HEI stated that they have level-based targets. A number of the HEIs have implemented activities, such as changes in booking rules, to achieve a certain booking rate and are working according to the four-step principle of sustainable facilities management. Some HEIs stated that they have specific principles for the allocation of offices.

Since 2019, Akademiska Hus has been collecting occupancy data for a large portion of its building stock. In spring 2024, the material covers the utilisation of approximately 8,300 offices, 1,500 group rooms, 1,400 lecture rooms, 200 lecture theatres and 1,400 conference/meeting rooms. The utilisation rates on semester weekdays between 8 a.m. and 5 p.m. Have been compiled and the results show that there is great potential to increase the utilisation of the HEIs' facilities, during the day as well as at other times. After normal working hours, only a few facilities are used.

The emissions from all facilities can be calculated based on the average surface area from Akademiska Hus and annual average operating emissions of 15 kg CO_2 per square metre[12]. For a more detailed understanding of emissions for unused facilities, analyses should be carried out for each HEI.

Table 1 shows the average utilisation (occupancy rate) during normal working hours (8 a.m. to 5 p.m.) for the period 1 September 2023 to 31 May 2024, as well as the average climate burden of different types of facilities in Akademiska Hus's building stock. Offices and meeting rooms are primarily used on Mondays to Thursdays between 9 a.m. and 4 p.m. Lecture rooms and lecture theatres are usually used from Monday to Thursday between 9 a.m. and 3 p.m., while group rooms are used on all weekdays, usually between 9 a.m. and 4 p.m.

Table 1 Average utilisation of different types of facilities during the period 1 September 2023 to 31 May 2024, weekdays 8 a.m. to 5 p.m., and average climate burden. Min – Max shows the HEI from the lowest average use to the highest average use per facility type, in hours. The average is an average of measurements from all HEIs for each type of facility. Net surface area is an average value for each type of facility. All figures in the table refer to Akademiska Hus's building stock.

Type of facility	Number of HEIs	Number of rooms	Min - Max hours	Average hours	Net surface area	kg CO2 per year
Offices	24	8,335	1.25 – 3.5	2.25	12	180
Group rooms	22	1,457	3 – 5.75	4	20	300

[11] SUHF (2024). *Medlemmar*. (Members) https://suhf.se/om-suhf/medlemmar/ [24 August 2024]

[12] Akademiska hus (2024). Related emissions for property management operations in 2023, Scope 1–3 according to the location-based approach. As reported.

Type of facility	Number of HEIs	Number of rooms	Min - Max hours	Average hours	Net surface area	kg CO2 per year
Lecture halls*	23	1,407	1.25 – 5.5	3.5	65	975
Lecture theatres**	16	215	1 – 6.75	3.25	132	1,980
Meeting rooms:	23	1,424	1 – 3	2	23	345

*The HEIs that show a high utilisation of lecture rooms have a higher proportion of spontaneous use, that is, that a lecture room is used without prior booking.
**Larger lecture theatres, with more than 100 seats, are more likely to have uneven utilisation, being nearly fully occupied one day and then standing completely empty the next. Larger lecture theatres often have a higher utilisation at the beginning and end of the semester.

In summary, there is over-capacity in all types of facilities at the HEIs where Akademiska Hus collects data. Utilisation is often concentrated to certain times of the day and week. By spreading utilisation more evenly throughout the day and the working week, capacity can be freed up and the number of facilities needed can be reduced while reducing the climate impact. Occupancy data from Akademiska Hus shows that there is no need for new construction to meet changing facilities needs.

2.3 Methods and approaches

2.3.1 The four-step principle for sustainable facilities management

The four-step principle for sustainable facilities management is used by many HEIs (Figure 1). It helps operators and property owners to evaluate the need for facilities in a systematic way. The aim is to make facilities management more efficient and to reduce their climate impact. The higher up in the four steps, the lower the carbon footprint and the lower the resource consumption.

Table 2 Four-step principle of sustainable facilities management

		One-time change*	Annual change
1. Rethink	Reduce surface area requirements by changing the way the activity is conducted	- 300 kg CO2/m2 if someone else does not need to build new facilities	- 15 kg CO2/m2 for lower service, reduced energy use
2. Optimise	Intensify the utilisation of the surface area, utilise existing facilities for a larger portion of the day, increase the occupancy rate	0 kg CO2/m2	Increased energy use
3. Renovate	Extend the life, add to, adapt, or renovate/convert to facilitate sharing of the facilities	+ 150 kg CO2/m2	Increased energy use
4. Build new	Construct new facilities in a sustainable and climate-smart way	+ 300 kg CO2/m2	+ 15 kg CO2/m2 for higher service, increased energy use

*The emissions cover the life-cycle stages A1–A5, i.e. natural resource extraction, the transportation of natural resources, production of construction products, shipment of these products to the construction site, and construction.

2.3.2 Facilities sharing

Shared bookable rooms and flexible workplaces are examples of facilities sharing. Facilities can be shared both internally and externally and may also include sharing installations and other equipment. Analyses show that shared facilities are normally utilised much more than those leased by the department. There may be some obstacles to sharing facilities, which is why the possibilities for facilities sharing always need to be investigated. Facilities sharing works best if activities with similar needs share the same facility. If a number of different organisations are going to share a facility, it is easiest if the property owner manages the sharing service. When sharing facilities, it is important to coordinate occupational health and safety responsibilities, and to ensure compliance with the relevant safety requirements, which is why risk and vulnerability assessments may be needed.

2.3.3 Calculate and analyse facilities management

In order to better understand how a facility is used, its utilisation rate and occupancy rate can be measured. This means measuring if and when people have been there and how many people were there. When this data is linked to information about when a facility is booked, it provides information about usage patterns and the rate at which a facility stands empty. While there may be deficiencies in the quality of the data, and run-in periods and evaluations to verify and quality-assure the data are needed, combined data from occupancy sensors, tally counters and lecture room/lecture theatre bookings can provide an objective basis that you can work further with when facilities needs change. In-depth analyses of usage patterns can be done if you also add in AI (machine learning algorithms) where information about how many facilities of a certain type are needed, and what size they should be. The utilisation rate can be measured in all types of facilities, while the occupancy rate is best suited to measurement in larger facilities such as lecture rooms and lecture theatres.

Utilisation rate

The easiest way to measure a facility's utilisation is to measure the time that the facility is used. For this, the metric Utilisation rate is used. This metric provides insights into how the facility is being used and how many facilities of a certain type are being used simultaneously, and can be used for all types of facility except open plan office areas. The utilisation rate is the same as the number of hours used divided by the number of possible hours (resources). The utilisation rate is normally measured in the number of hours used during a working day, or as a proportion (percentage) of the total number of hours in a working day. In order to increase the utilisation rate, the number of hours that the facility is used must either increase, for example by more people sharing it, or the resources used must decrease.

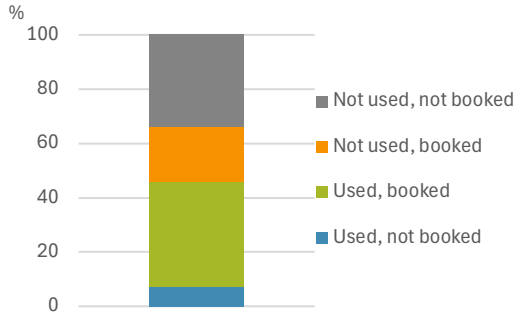
Example

A room can be used for up to 9 hours of a working day from 8 a.m. to 5 p.m. If the room is used for 3 hours during the working day, it has been used 3/9*100=33% of the time. In order to increase the utilisation rate, the number of hours that the facility is used must either increase, for example by more people sharing it, or the resources used must decrease.

Planned use

For bookable facilities, it is often interesting to find out how much they have been used during the time they have been booked. To measure planned usage (utilisation rate in bookable facilities), occupancy data are linked and matched with the facility's booking data. This results in four types of occupancy: Used – not booked (spontaneous use), Used – booked (planned use), Booked – not used (no-show), Not booked – not used (empty). The metric provides insight into the actual need for bookable facilities and to what extent capacity could be freed up if bookings were to be spread out through the working day. The metric also provides information about no-shows and spontaneous use.

Figure 1 The figure shows four types of occupancy: Used – not booked (spontaneous use), Used – booked (planned use), Booked – not used (no-show), Not booked – not used (empty).



Occupancy rate

In order to understand the extent to which a room or a building is used, tally counters can be installed. Tally counters record the number of people passing them and provide information about how many people have been in a particular building or room at a particular time. To calculate the occupancy rate, the number of seats used is divided by the seating capacity of the lecture room/lecture theatre. The occupancy rate is expressed as a percentage. The occupancy rate provides an additional dimension for understanding the need for facilities in terms of their size (seating capacity).

AI analysis

With the help of AI, you can perform in-depth analyses of usage patterns. AI can also suggest what would be an optimal mix of offices and lecture rooms.

When AI is applied to booking data and data on the size of lecture rooms, it results in information about the 'abundance' of lecture rooms, and what room sizes an HEI actually needs. The AI algorithm can also suggest an optimal local mix of facilities.

When AI has been used to analyse occupancy data from offices in Akademiska Hus buildings, three different usage profiles emerge:

- Daytime use, for long periods of time
- Use 2–3 days per week, long periods of time
- Rare use, short periods.

2.4 Recommendations

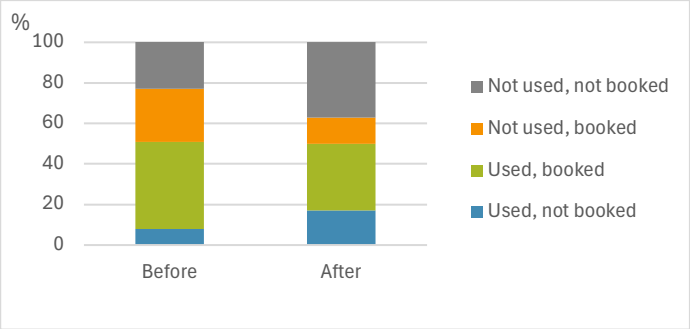
- Work according to the four-step principle for sustainable facilities management.
  - **Step 1 Rethink.** By reducing the surface area of facilities, the HEI's climate impact can be reduced on average by 15 kg less CO_2 per square metre per year. If another actor can utilise the space and does not need to build new facilities, an average of 300 kg CO_2 is saved per square metre of the new building not constructed.
  - **Step 2 Optimise** By intensifying the use of the space, the climate burden of construction is reduced, as more people can utilise the same facility. Energy use will increase slightly if the utilisation rate is higher. The recommendations and goals listed below can serve as a guide for more sustainable facilities management.
    - **Offices:** Strive for a utilisation rate of 1,200 to 1,300 hours per year, corresponding to approximately 5.5 to 6 hours per working day. Permanent offices/workplaces are assigned only to those who 'regularly perform office work'. Share offices/workplaces if the utilisation rate for offices is lower. Measure the utilisation rate in offices, with support from AI if possible.
    - **Lecture rooms and lecture theatres:** Strive for a utilisation rate of 1,200 hours per year, corresponding to approximately 6 hours per working day with an occupancy rate of 80%. Measure the utilisation rate and planned use (booked times) in lecture rooms and lecture theatres; measure the occupancy rate, with support from AI if possible.
    - **Group rooms:** Strive for a utilisation rate of 1,400 hours per year, corresponding to 7 hours per working day. Measure the utilisation rate and planned use (booked times) in group rooms.
    - **Meeting rooms:** Strive for a utilisation rate of 1,200 hours per year, corresponding to 6 hours per working day. Measure the utilisation rate and planned use (booked times) in meeting rooms.
  - **Step 3 Renovate** Extend the service life, adapt, add to or renovate facilities or the spaces and functions in the immediate vicinity, which will facilitate sharing. Choose products and manage products to enable circular and non-toxic flows and reuse:
    - Reuse fittings and building materials according to the Reuse principle in Section 4.

    - Certify to at least Green Building Silver standard or equivalent for major conversions.
    - Comply with the requirements in the Energy Performance of Buildings Directive.
  - **Step 4 Build new** New construction should be avoided because the utilisation rate analyses that we have today show at least a 20–30% overcapacity of facilities within HEIs, often more. If there is a need for more surface area, the possibilities of sharing facilities with other actors within the campus area/city should be investigated and prioritised before new construction.
- Involve the affected activities and staff at an early stage.
- Measure the utilisation rate to be able to make data-driven, well-informed decisions.
- Use AI to analyse many buildings at the same time if possible.
- Share facilities where possible internally and/or externally.
- Monitor this work and set/achieved targets for reducing the environmental and climate impact of facilities.
- Communicate the work with sustainable facilities management before, during and after changes are made.

Best practice

Check-in system reduced no-shows in group rooms

The general perception is that group rooms are scarce. This may be due to a real shortage or that group rooms are found in buildings that students normally do not visit, or that the rooms are blocked by bookings but not actually used. In order to reduce the time when group rooms are blocked by unused bookings, Umeå University has introduced a check-in system for bookable group rooms where check-in is required to keep a booked time. The introduction of the check-in system halved the proportion of no-shows from 26 percentage points to 13 percentage points. Capacity has been freed up and these rooms are no longer thought of as scarce to the same extent.



Central scheduling can increase the utilisation rate of lecture rooms
Most HEIs use their lecture rooms primarily from 10 a.m. to 12 noon and 1 p.m. to 3 p.m. – a total of 4 hours per working day. Such concentrated use can result in a perceived scarcity. At Luleå University of Technology, central scheduling is used to spread out utilisation throughout the working day and thus reduce the need for lecture rooms. The university has drawn up an allocation schedule of 24 sessions per week, which are allocated within 6 different time slots. Each working day is divided into five sessions of 1.5 hours each, except on Fridays where the last session cannot be booked. A course is allocated sessions within a specific time slot (1 to 6). Students at the university can choose to take several courses at once if they are taught in different time slots. The result is that the lecture rooms are utilised for up to 7.5 hours per working day Mon–Thu, and 6 hours on Fridays. This can be compared with HEIs without central scheduling, which on average utilise lecture rooms for 4 hours per working day.

	M	T	W	Th	F
Pass 1	1	3	4	5	2
Pass 2	6	3	5	4	2
Pass 3	5	1	1	3	6
Pass 4	4	2	6	3	1
Pass 5	4	2	6	3	

Supported by AI, an optimal office mix can be proposed
On behalf of an HEI, Akademiska Hus used AI to analyse occupancy data from offices. When occupancy data from a department's offices were analysed individually, an efficiency improvement potential of about 20% emerged. When occupancy data from three departments were linked and matched, and when an AI algorithm suggested an optimal mix of office workplaces (individual offices, bookable offices and 'touchdown' workspaces), an efficiency potential of almost 50% emerged, i.e. more than twice as much.

Shared bookable lecture rooms resulted in a higher utilisation rate
When the utilisation rate of facilities leased by a department was compared with shared bookable lecture rooms at Umeå University, it emerged that the shared bookable facilities were utilised 25% more than those leased by a department.

Policy for allocation of offices to increase the utilisation rate
At Dalarna University, an office policy has been introduced. The allocation of workplaces is based on the staff member's occupancy of the workplace and their needs. Staff present in the office/workplace 60% of the working day or more are allocated their own office/workplace, while staff who are not present as often are allocated a loan workplace. Own workplaces and loan workplaces can be located in open plan offices, separate rooms or in shared offices, and there are both bookable and non-bookable loan workplaces to ensure that staff have access to a workplace when they are in the office, and to enable drop-ins. The office policy has been implemented in connection with a move to new buildings.

External sharing of facilities can increase utilisation rate
In order to increase the utilisation and develop a meeting room, property owner Akademiska Hus 'returned' a meeting room from Umeå University. Today, this meeting room can be booked through a booking exchange for external users and through the university's booking system. The booking rate has increased by 80% compared to when the room could only be booked by the university.

3. Energy use

3.1 Introduction

In order to meet the targets in the EU's energy policy as well as Sweden's climate and environmental objectives, energy consumption needs to be reduced and the energy supply needs to have a low impact on the environment. So far, much of the work in the energy area has concerned technical solutions implemented by property owners or energy suppliers. But to accelerate the climate transition, behavioural changes are also needed.

The Energy Efficiency Directive (EU/2023/1791) or EED[13], and the Energy Performance of Buildings Directive (EU/2024/1275) or EPBD[14], are the two most important EU directives that concern the HEIs' use of energy and facilities in Sweden. These directives are part of the European Green Deal and the FIT for 55[15] legislation package, where the aim is to reduce the EU's greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels.

The EED aims to improve energy efficiency. It contains a goal that concerns Sweden's HEIs directly: From 2025 to 2030, public sector actors are required to implement measures that improve energy efficiency by at least 1.9% per year The EED was adopted by the European Commission in October 2023 and must be implemented nationally by 10 October 2025.

The EPBD aims to create a decarbonised (climate-neutral) building stock in the EU by 2050. The EPBD includes requirements on property owners that may affect the HEIs:

- All new buildings (non-residential) must be zero-emissions buildings from 2028.
- All new buildings must be designed to optimise their solar energy generation potential. Solar panels must be installed in stages as required by the EPBD, from 2027 to 2030, if technically suitable and economically and functionally feasible.
- The energy renovation rate of public buildings must be the equivalent of 3% of the public sector's buildings annually.
- Recharging infrastructure must be deployed in car parks of residential and non-residential buildings. The number of recharging points depends on the size and type of building.

[13] Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast). [2023] L 231/1

[14] Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings. [2024] EUT L

[15] European Commission (2024) The European Green Deal https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en [2 September 2024]

- The EPBD mentions that if building digital twins[16] exist, they should be used in the work to improve the energy performance of buildings and 'smart-ready' buildings.

The EPBD entered into force in May 2024, and will be implemented in Swedish legislation in 2026.

There is also an energy efficiency target relevant to Sweden[17]: By 2030, energy use is to be 50% more efficient than in 2005. In 2023, energy consumption was 29% more efficient than in 2005.

To successful save energy and improve energy efficiency, cooperation between property owners and HEIs is a key factor. This requires a consensus on the types of measures to be implemented as well as on how they should be prioritised and financed. Digitalisation is also a factor that will increase the potential for more efficient energy use.

3.2 Current situation

In a 2023 environmental management report to the Swedish Environmental Protection Agency[18], 32 HEIs stated that their total energy use during the year was 530 GWh, which corresponds to an average energy use of 164 kWh per square metre or 13,000 kWh per person-year. Broken down by energy type, an average electricity consumption of 76 kWh per square metre and heating consumption of 73 kWh per square metre were reported. Table 2 shows the average energy consumption of the HEIs in 2023.

[16] A building digital twin is a digital copy of a physical building and enables monitoring, analysis and optimisation of a building's operation. For example, by collecting data you can analyse how a property functions or is used over time.

[17] Swedish Government (2024). *Mål för energipolitiken.* (Energy policy targets) https://www.regeringen.se/regeringens-politik/energi/mal-och-visioner-for-energi/ [2 September 2024]

[18] Swedish Environmental Protection Agency (2024). Miljöledning i staten 2023: En redovisning av hur statliga myndigheter arbetar med att minska sin miljöpåverkan (Environmental management in central government 2023: A report on how central government agencies are working to reduce their climate impact) Report 7141, April 2024.

Table 3 The energy use of HEIs per square metre and per person-year, and the standard deviation (SD)

	Average kWh/m2	Average kWh/person-year
Total energy use	164 (46 SD)	13,174 (5,410 SD)
Electricity use (building electricity + activity electricity)	76 (28 SD)	5,924 (2,028 SD)
Total heating	73 (21 SD)	6,017 (3,154 SD)
Normal-year adjusted heating*	70 (24 SD)	6,056 (3,820 SD)
Cooling**	18 (18 SD)	1,461 (1,314 SD)

* Values for normal-year adjusted heating are based on data from 18 HEIs.
** Values for cooling are based on data from 27 HEIs.

In autumn 2022, central government agencies were tasked with taking energy-saving measures to reduce their consumption of electricity during the period September 2022 to March 2023.[19] The task yielded results and compared with the base month, September 2018, the government agencies reduced their electricity consumption by approximately 20%. Since autumn 2023, the Swedish Energy Agency has had a nationwide task to guide and inform central government agencies in their efforts to reduce their energy use and improve energy efficiency. The Swedish Energy Agency's website[20] contains a lot of information and guidance on specific measures but also tips on how to set up a process for working to improve energy efficiency.

3.3 Methods and approaches

Work to improve energy efficiency and reduce consumption never ceases and should therefore be integrated into the HEI's routine environmental management work (and property owners' energy management systems, where applicable). The management system's process consists of four steps: Plan, Do, Check and Act.

3.3.1 Plan

- **Appoint an energy group** of representatives from both the HEI and property owners. This group identifies measures, pursues issues, distributes the work, and monitors implemented measures.
- **Map energy use and the potential of the buildings**
  - **Introduce separate measurement.** Add meters to be able to separate activity energy from building energy where not currently found.
  - **Identify energy guzzlers.** By identifying where big users of energy are located – the extent to which activity electricity, building electricity and

[19] Swedish Government (2022). *Uppdrag att vidta energibesparingsåtgärder inom den statliga förvaltningen.* (Task to take energy-saving measures within public administration) Decision 8 September 2022, Fi2022/+2571. https://www.regeringen.se/contentassets/8a8d8683084d48308e8aed5c32d60e8f/uppdrag-att-vidta-energibesparingsatgarder-inom-den-statliga-forvaltningen.pdf [24 August 2024]

[20] Swedish Energy Agency (2024). Effektiv energianvändning för offentlig sektorn. (Efficient energy use for the public sector) https://www.energimyndigheten.se/effektiv-energianvandning/offentlig-sektor/ [24 August 2024]

facilities are used – one can obtain information about where energy-saving measures could be viable. It may sometimes be necessary to include the activity, students and researchers in order to identify opportunities for improving energy efficiency in laboratories, for example. Get support from delimitation schedules and the property owner's energy-savings plan. Analyse data from energy audits to identify areas with potential for improvement.

  - **Night walks.** Night walks can identify unnecessary energy use such as machines, fans, computers and lights left on, and open windows. This is then documented and can form the basis for measures in an action plan. Night walks are carried out at least once per year, and it may be advantageous to coordinate these with safety walks.
  - **Map each building's potential.** The potential to optimise operations will differ from building to building, but in most buildings there are relatively simple means by which the property owner can optimise energy use. Differences in the structure of the ventilation system whether or not rooms can be sectioned off in order to shut down or reduce the air flow in certain sections.

- **Set targets** in line with society's climate objectives and the requirements in the EED and EPBD. For energy work to have a real impact, the objectives need to be feasible and measurable. Energy use should be monitored in absolute figures, kWh/year, and per square metre, kWh/m^2, year along with CO_2 emissions.
- **Prioritise and budget for measures**. The nature of the contracts between the property owner and HEI affect who invests in which energy measure. BELOK[21] has developed what it calls a 'Total methodology', where measures with short payback times as well as measures that require major investment are combined into a total viability requirement while reducing energy needs and climate emissions. This package means that more cost-effective investments can be made in energy efficiency than if a single measure had been evaluated separately.

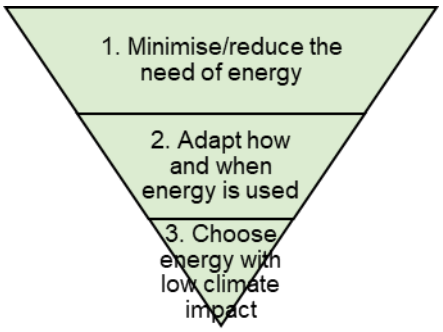
3.3.2 Do

The Kyoto pyramid[22] can be used to support the implementation of measures (Figure 2). Energy needs for heating, cooling and electricity are the first to be reduced. Secondly, we want to adapt how and when we add energy to our buildings based on when and how they are used. Thirdly, we need to choose energy types with minimal climate impact.

[21] BELOK is a network whose mission is to drive development to reduce energy consumption in non-residential buildings. It is part-financed by the Swedish Energy Agency. All its materials are free to access and download. https://belok.se/ [2 September 2024]

[22] The Kyoto pyramid aims to help reduce energy use in buildings. It is an interpretation of the 1997 Kyoto Protocol, when many of the world's countries agreed to reduce greenhouse gas emissions. The intention of the Kyoto pyramid is also well aligned with the EU's current energy efforts, where the guiding principle is 'energy efficiency first'.

Figure 2 The Kyoto Pyramid helps to implementing energy measures



- **Minimise the need for heating, cooling and electricity.** Although many energy-saving measures are in the property owner's sphere of control, HEIs as tenants can contribute by means of some simple measures that reduce heating and cooling needs or electricity use. For example, unnecessary energy use can be significantly reduced by regular servicing of their own equipment. In conversions and new construction, HEIs can impose requirements on measures that are in the property owner's sphere of control, such as insulation, energy-efficient ventilation, and general lighting. Simple measures that HEIs can implement are listed below.
- **Control and regulate.** When property owners and HEIs cooperate, many different measures can be implemented to reduce energy consumption. By adjusting temperatures, and controlling the ventilation based on occupancy rate, need and the season, energy consumption can be greatly improved.
- **Select the energy type.** Once the need for energy has been minimised, the choice of energy type is what determines the ultimate climate impact. The best solution will vary between the HEIs. At some sites, waste heat from industry might be available for use via the district heating network, while in others, geothermal or ground source heat combined with heat pumps could work well. In some campus areas, local networks can increase energy security and facilitate an efficient integration of renewable energy. Local networks can also smooth out peak load times, and distribute the energy to the actor who needs it most in the moment. The installation of solar panels will rise as a result of the EPBD's requirements, and continued development towards a more flexible energy market will enable consumers to purchase their electricity, heating and cooling when it has the smallest climate impact.

3.3.3 Check

For work with energy savings to be effective, it is important that the measures implemented are monitored and evaluated in relation to the targets. Energy consumption is monitored and followed up, for example, by means of energy management systems and sensors. Activity electricity and building electricity should be monitored separately, as should heating and cooling. Regular energy audits can also be part of the follow-up.

3.3.4 Act

Let energy matters be a standing item on the agendas of meetings with the property owner. To achieve continuous improvement, 'corrective' measures should be taken continuously based on the follow-up. Adjust strategies and action plans to ensure that energy targets are being met. Document the lessons learned and successes to improve future processes.

Communication about efforts in energy savings and energy efficiency and their results strengthens these areas. Combining different ways of communicating helps this information to reach more people. For example, communication helps to make staff and students more aware and knowledgeable, and to strength trust in the HEI in its relationships with stakeholders and external actors.

Communication can also reinforce the seriousness of these matters, and thus increase motivation and enhance engagement with the climate transition.[23]

3.4 Recommendations

- Work according to the management system's process: Plan, Do, Check and Act.
- Cooperate with property owners. Form an energy group that identifies measures, pursues issues, distributes the work and monitors the outcomes.
- Set targets
  - The targets should be measurable in absolute figures – kWh per year, and kWh/m^2 per year.
  - For buildings, net zero emissions apply by 2050.
  - Energy efficiency improvements of at least 2% per year up to 2030.
  - At least the energy requirements of Green Building Silver/equivalent for major conversions and Green Building Gold/equivalent for new construction.
  - The electricity should be from 100% renewable sources.
  - Targets should also be set for the installation of solar panels and charging infrastructure.
- Prioritise and budget for these measures based on the Kyoto pyramid and BELOK's *Totalmetodik* (Total methodology).
- Communicate measures and their outcomes. Let energy efficiency be a standing item on the agendas of meetings with the property owner.

[23] E2B2 (2024). Kommunikation för hållbara energisystem. (Communication for sustainable energy systems) https://www.e2b2.se/forskningsprojekt-i-e2b2/beteende/kommunikation-for-hallbara-energisystem/intervju/ [2 September 2024]

Examples of measures that reduce the need for heating, electricity and cooling

- Turn off lights. During night walks, identify lights that left on unnecessarily.[24]
- Don't leave IT equipment on in standby/sleep mode. Turn it off entirely. In offices, this can account for up to 10% of electricity consumption.[25]
- Raise freezer temperatures. Do not store items in freezers more than is necessary. Raising the temperature of an ultra-low freezer from -80 to -70 degrees Celsius reduces energy consumption by 30%. If the material only needs a standard freezer (-18 degrees C), the energy consumption is as much as 80% less compared to an ultra-low temperature freezer . Coordinate freezers and backup freezers.
- Adjust the ventilation in the laboratory. Laboratory environments require a lot of energy. Have a dialogue with these activities concerning their air quality requirements in order to optimise air flows.
- Close fume cupboards. An open fume cupboard consumes about 4.5 times more energy than a closed one. The energy consumption of ten open fume cupboards over one year corresponds to the annual energy consumption of seven detached houses.[26]
- Server halls. If possible, use free cooling to cool server halls. Take advantage of surplus heat. Cooperation between server halls can free up capacity.
- Use effective shading from the sun in summer to reduce cooling requirements. Take advantage of the vegetation in the environment outside the building which can also affect the indoor climate.
- Think about smart ways to position furniture. Do not position workplaces directly adjacent to windows where there is a risk of the cooling effect of window surfaces making them colder. Flexible workplaces give staff the opportunity to choose a place that suits them best.

Examples of measures that optimise operations

- Adjust temperatures. A large portion of the energy in a building goes towards achieving a certain indoor climate. Permitting a lower or higher temperature outside of the recommended temperature range when the facilities are not in use can reduce energy consumption. One degree lower temperature usually corresponds to 5% lower heating consumption.
- Occupancy-based control. If possible, control the ventilation and lighting based on occupancy sensors or facility booking systems.
- Adjust to the season. There is good potential to adjust the ventilation/cooling/heating to a lower occupancy rate during the summer and winter.[27] In particular, first-cycle education environments can generally be closed down during semester breaks.

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[24] Akademiska Hus and KTH (2023). Energy saving tips https://intra.kth.se/polopoly_fs/1.1262261.1686812513!/Energispar_bilder_eng_samlade_KTH_AH_.pdf [2 September 2024]

[25] KTH (2023). Sustainable use of IT equipment. https://intra.kth.se/en/it/hallbar-anvandning/hallbar-anvandning-av-it-utrustning-1.1165065 [24 August 2024]

[26] Akademiska hus (2022). Energibesparande åtgärder i Akademiska hus lokaler. https://files.akademiskahus.se/inlagg/3062/energibesparandetgrderiakademiskahuslokaler.pdf [2024-09-02]

[27] University of Borås (2024). University implements "red zone" – reducing ventilation and cooling this summer https://www.hb.se/en/about-ub/current/news-archive/2024/february/university-implements-red-zone--reducing-ventilation-and-cooling-this-summer/ [2024-02-19]

Examples of measures in connection with renovations

- Think through how the facilities will be used and if possible plan for sectioning off and create the conditions necessary for occupancy-based control and seasonal adjustments to heating and cooling.
- Identify which workplaces are at risk of getting cold in winter or becoming too warm in summer. Improve shading from the sun.
- If possible, place equipment that gives off heat such as -80 degree Celsius freezers together to create better opportunities for harvesting their surplus heat.
- Plan electrical installations and control so that it is easy to switch off all lighting and unnecessary equipment at the touch of a button outside of working hours.

Seasonal adjustments in summer and winter save energy

- During summer 2023, KTH closed down its first-cycle education facilities entirely in nine buildings, and in two buildings with lower occupancy rates, adjusted the ventilation system's operating hours. Thanks to these measures, which lasted from 3 to 5 weeks, the use of cooling decreased by 21% and electricity consumption by 11% compared to the previous summer. The total decrease corresponded to the annual energy consumption of three detached houses. For a week or so during the Christmas holidays in 2023/2024, first-cycle education facilities were closed in seven buildings at the same university. The closure reduced energy consumption by 6% compared to the same period the previous year. This reduction corresponded to the annual energy consumption of four detached houses

4. Reuse of fittings and building materials

4.1 Introduction

The construction sector accounts for 40% of the waste generated annually in Sweden.[28] By working with circularity, reuse and prolonging the life of furniture and other fittings, HEIs can reduce waste generation, resource consumption and greenhouse gas emissions. By imposing requirements on property owners, and working together with them, HEIs can also help to reduce the environmental impact from building materials.

Reuse and circular flows are about more than just recycling. It means planning for products to be reused or recycled right from the design stage, and that these flows should be circular and non-toxic. This often involves complex value chains and is about what substances are emitted/discharged into the environment throughout the product's life cycle, and how much energy is required. It is also about us as consumers.

In Sweden's HEIs, workplace furniture and furniture for lecture rooms constitutes the largest share of furniture and other fittings. It is estimated that bookshelves along with office chairs, lecture room chairs and tables account for approximately 70% of the carbon emissions from the HEIs' purchases of new furniture.

The buildings used by the HEIs have a long service life and constitute significant material banks. By reusing resources from these, the climate impact of conversion and, where necessary, the construction of new buildings can be greatly reduced. Put simply, three groups of building materials have been identified that, when reused, lead to significant climate savings:

1. Building materials with high climate emissions in their resource extraction/manufacturing phases
2. Large-volume products and heavy materials
3. Products with large flows.

Studies[29] show that reuse provides climate savings even when it involves more transport as well as storage and reconditioning. It is estimated that some building materials can be:

- stored for 23 to 93 years before the climate impact from storing them exceeds the climate savings from reuse;
- transported 18,000–500,000 kms by truck before the climate impact from transport exceeds the climate savings from reuse;

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[28] Swedish National Board of Housing, Building and Planning (2024). *Bygg- och fastighetssektorns uppkomna mängder av avfall.* (The amount of waste generated by the construction and property management sector) https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/miljoindikatorer---aktuell-status/avfall/ [2 September 2024]

[29] IVL (2022). *Klimateffekter av återbrukade byggprodukter och möbler - Metoder för värdering av klimateffekter samt produkter vid mellanlagring och försäljning* (Climate effects of reused building materials and furniture – Methods for calculating climate effects and product when stored and sold) Includes English summary. Report No C696, September 2022. https://www.diva-portal.org/smash/get/diva2:1696735/FULLTEXT01.pdf [3 September 2024]

- reconditioned to a relatively high degree without a significant effect on the climate savings from reuse.

Reusing building materials often entails practical challenges such as guarantees and CE marking, lack of interim storage, obstacles in the building permit process, price rises, and being unprofitable.[30]

4.2 Current situation

In the survey conducted by the focus group, 22 out of 25 HEIs responded that they reuse fittings. Most HEIs have some form of internal interim storage, and repair furniture themselves or hire external actors for this. Some HEIs have digitalised their stores of furniture and created internal market places which facilitate and increase reuse while communicating the benefits of reuse. Just under half of the HEIs responded that they use the Swedish Legal, Financial and Administrative Services Agency's framework agreement for circular furniture flows[31] (10 out of 25) and that they benefit from this.

Work is under way to scale up the reuse of building materials – from testing reuse in individual projects to developing processes at a system level. Cooperation is seen as an important aspect of this work and is national but also local. In almost all of the major cities in Sweden (such as Stockholm, Malmö, Uppsala) we are seeing that climate networks, recycling initiatives/hubs/warehouses exist or are being discussed.

4.3 Methods and approaches

Many of the HEIs have developed their own methods and approaches for the reuse of fittings and/or building materials. The following Reuse principle has been formulated based on these.

4.3.1 Reuse principle

The fittings, such as furniture, that are purchased should also be well-designed, long-term sustainable and designed for reuse and also capable of helping to make work and study places pleasant and comfortable. The same applies to building materials. It should be possible to include them in circular and non-toxic flows. By working according to the Reuse principle, the HEIs can reduced their climate footprint and resource consumption. The Reuse principle is preceded by an inventory and recommends direct reuse in the first instance, then adaptation, purchase of recycled goods, and new purchases of goods from circular systems. Selling them is recommended only as the last resort.

[30] Klimatarena Stockholm (2024). *Vanliga föreställningar om återbruk av byggprodukter* (Common myths about reuse of building materials) https://klimatarenastockholm.se/aterbruksmyter/ [2 September 2024]

[31] Avropa.se (2024). *Cirkulära möbelflöden*. (Circular furniture flows) https://www.avropa.se/ramavtal/ramavtalsomraden/kontor-och-inredning/mobler-och-inredning/cirkulara-mobelfloden/ [2 September 2024]

Table 4 The Reuse principle for fittings and building materials

Reuse principle		**Climate savings compared to purchasing new items**
1. Direct reuse	Use of existing fittings or building materials	Large
2. Adaptation for direct reuse	Adaptation, reconditioning, renovation	Large
3. Purchase recycled goods	Purchase from a circular system, sustainable and non-toxic flows	Large
4. New purchases in a circular system	New purchases from a circular system, sustainable and non-toxic flows	Medium
5. Selling in a circular system	Selling to a circular system If goods contain toxins, phasing out	Small None

A detailed description of how to work according to the Reuse principle is given below:

Step 1 Direct reuse

- **Fittings.** Some materials are particularly durable and can be reused for a long period. Examples are good quality timber, and metals. Design/interior design concepts often facilitate direct reuse. Digital platforms can also be used for inventories and bartering, which can facilitate direct reuse. One challenge is that these days, fittings often need to be more flexible than previously. For example, castors may to need to be fitted to tables and chairs. These items of furniture thus need to be adapted. See Step 2.
- **Building materials.** An inventory of building materials for reuse lays the foundations for direct reuse. The inventory should answer questions such as what materials are available, does the material have reuse potential (easy to dismantle/disassemble, large climate savings, good economic trade-off); what is the condition of the building materials with reuse potential; and what is the plan for how to realise their reuse potential.

Step 2 Adaptation for direct reuse

- **Fittings.** With relatively simple solutions, existing fittings can be adapted (reconditioned and/or renovated) to suit today's facilities. For example, the central government framework agreement for furniture and fittings can be used for reupholstering chair seats, replacing table/desk tops, or lacquering the frame.
- **Building materials.** Like fittings, building materials can be reconditioned. Doors can be repainted, lighting can be given a new light source, etc. Some building materials may have new areas of application. For example, a brick from a façade can be used in the outdoor environment to surround flowerbeds or on pathways.

Step 3 Purchase recycled goods

- **Fittings.** If the existing stock of fittings needs to be supplemented, purchasing recycled fittings is recommended. A number of furniture manufacturers have begun receiving older furniture to recondition and then sell. The Swedish Legal, Financial and Administrative Services Agency's framework agreement for circular furniture flows permits the purchase of recycled goods.
- **Building materials.** A fundamental challenge for reuse is ensuring that supply and demand can be met. To address this challenge, projects should require the purchase of recycled products in the first instance, and to help search for them, the use of established digital marketplaces (e.g. CCBuild) or local marketplaces for reuse.

Step 4 New purchases from a circular system

- **Fittings.** If after steps 1–3 you still need some new fittings, these should be part of a circular system, with requirements on their quality, climate and environmental impact, and non-toxicity so that they can be recycled. Manufacturers should have a plan for how the fittings they make can be reused/recycled in the future. The Swedish Legal, Financial and Administrative Services Agency's framework agreement for circular furniture flows permits new purchases of recycled goods in a circular system.
- **Building materials.** When purchasing new building materials, specifications regarding their ease of disassembly/dismantling and their end-of-life processing should be clear. This is so that facilities can be designed with building materials that can be easily disassembled/dismantled and reused in circular systems. You can also look at the flexibility and adaptability of facilities to avoid major conversions in the future when the needs of an activity change.

Step 5 Sale

- **Fittings.** After steps 1–4, there may still be fittings that do not fit in anywhere. These should then be sold off in circular flows, so that they can be of use to others. The Swedish Legal, Financial and Administrative Services Agency's framework agreement for circular furniture flows permits the sale of furniture and fittings in a circular system.
- **Building materials.** When a building material cannot be reused in projects within the organisation, it should be made available to others via a recycling market (digital or local). If a building material cannot be recycled, reconditioned or used for another purpose, it should be sorted for material recovery. The quantities of end-of-life building materials that are incinerated for energy recovery or are sent to landfill should be minimised. Hazardous building materials should be handled separately.

4.4 Recommendations

- Make an inventory and document what can be reused.
- Plan this work at an early stage to enable the greatest possible reuse.
- In the case of conversions: cooperate with the property owner at an early stage to enable an inventory of the existing buildings prior to conversion.

- When needs change in facilities, work according to the Reuse principle for furniture and fittings needs, and/or for building materials in the case of conversions and new construction, where applicable.
- Calculate and analyse the effect of the reuse of these items on the climate and economy
  - Fittings. To enable active choices to be made, it is recommended that you calculate carbon footprints and compare different choices with each other.
  - Building materials. Request to see carbon footprint calculations of the reuse of building materials from the property owner for decision-making and communication purposes.
- Set targets:
  - Fittings. The target should be set at 90% of the number of items or volume reused according to steps 1 to 3 of the Reuse principle.
  - Building materials. Targets should be set in cooperation with the property owner. Here, key figures such as Percentage of reuse per product group (percentage by weight, number or volume) and Percentage of reuse from demolition (kg per tonne) can be used[32]. Use the environmental certification systems listed in Appendix 1 to set a target value.

Best practice

Estimated climate savings when reusing fittings
The reuse of fittings reduces climate footprint compared to new purchases. The climate savings are different depending on whether an item of furniture is reused directly or whether it needs to be repaired or reconditioned. Likewise, the materials used in an item of furniture or other fittings play a role. For example, a reused office chair saves about 90 kg CO_2 per unit, and a reused height-adjustable desk means climate savings of about 80 kg CO_2 per unit. A recycled lecture room chair corresponds to between 10 and 20 kg CO_2 in climate savings, depending on the seat padding and frame materials, while a reused lecture room table means approximately 25 kg CO_2 in climate savings.

Reuse of fittings reduces carbon footprint
When constructing the new Campus Borlänge in 2024, Dalarna University chose to reuse as much as possible of the existing furniture and fittings when early analyses showed a nearly halved carbon footprint compared to purchasing new items (approximately 92,000 instead of 170,000 kg CO_2). Figure 3 shows 30-year-old bookshelves with drawer units that have been converted into storage cabinets to match the needs and design in a new building.

[32] Byggföretagen (2023). *Nyckeltal för bygg- och rivningsavfall samt återbruk.* (Key figures for construction and demolition waste and recycling) Annex 22. *Resurs- och avfallsriktlinjer vid byggande och rivning* (Resource and waste management guidelines for construction and demolition) December 2023.https://byggforetagen.se/app/uploads/2023/12/Bilaga-22-Nyckeltal-for-bygg-och-rivning-savfall-samt-aterbruk-231127.pdf [2 September 2024]


Digitalisation of furniture stores promotes internal reuse
Several HEIs have started using digital platforms to promote internal reuse of their furniture and fittings. The platform is used to create a register – a marketplace of what furniture and fittings are available. Furniture and other fittings are presented with pictures, location, carbon savings and a price where applicable, as well as brief information about the item's condition. Digitalisation is expected to have a significant positive impact on reuse.

Reuse of building materials for conversions
For its new campus in Borlänge, Dalarna University has used existing structures and foundations instead of demolishing them and building new ones. Through the reuse of structures and foundations, the climate impact of the 'new' building was reduced by almost 60% compared to producing an entirely new framework/structure, equivalent to 1,933 tonnes of CO_2 equivalents.

Innovation projects for reuse
The project *Återhus – att bygga hus av hus* (Building from buildings) [33] is developing innovative and sustainable solutions for the reuse of heavy construction elements such as frameworks and façades of concrete, steel and wood. The solutions are then tested in a number of demonstration projects in which their environmental and socio-economic benefits are calculated. Finally, models, methods and processes that support circular material and product flows are compiled. The hope is to standardise and scale up the reuse of heavy construction elements.

[33] Återhus (2024). Återhus – att bygga hus av hus. https://aterhus.nu/ [2 September 2024]

5. Cooperation with property owners

5.1 Introduction

In order to reduce the climate impact of HEIs from buildings, facilities and energy, it is often essential for property owners and HEIs to cooperate closely. This is also often in the interests of both parties. The HEIs have far from full rights of disposition over their buildings, and most property owners have high ambitions for their sustainability work, which means that cooperation is often fundamental to achieving these goals.

There are formal cooperation agreements for sustainability issues, but cooperation also happens without formal agreements. However, formalised cooperation more often leads to these issues being placed higher on the management's agenda, and may also facilitate the management of financing issues. Furthermore, formalised cooperation can mean that the work is less dependent on individuals and less vulnerable to organisational changes, and may facilitate the integration of sustainability aspects into ordinary processes.

In this section, the term *cooperation agreement* is used as an umbrella term to describe various forms of agreements or formalised cooperation between HEIs and property owners covering issues that concern buildings, facilities and energy, as well as other relevant environmental and sustainability issues.

5.2 Current situation

In the survey conducted by the focus group in May 2024, a clear majority (23 out of 25) of the HEIs responded that they cooperate with their property owners on sustainability issues. About one third of these HEIs have formalised this cooperation in cooperation agreements, tenancy agreements or similar.

The survey responses show that the processes and organisations for this cooperation vary between the HEIs. For example, there is great variation regarding how often the HEI and the property owner check on progress under the cooperation agreement, ranging from once a year when the parties review their tenancy agreement, to more regular updates during the year in various constellations. A handful of HEIs have organised this cooperation in one or more working groups/steering groups with representatives from both parties. Some HEIs are also responsible for holding dialogues with staff and students, for example through workshops, to gather suggestions for action. Follow-up is usually based on a joint action plan containing activities, along with the HEIs' own monitoring of progress towards environmental and sustainability targets.

In the survey, the HEIs were also asked to indicate the areas in which they cooperate with property owners. The areas in which most of them cooperate are Energy, Outdoor environments/biodiversity, Waste and Mobility. Figure 3 visualises the areas of cooperation that the HEIs have indicated.

Figure 3 Word cloud (in Swedish) on the sustainability areas where Sweden's HEIs indicated in survey responses that they cooperate with their property owners. The size of each word indicates how often the words were used in the survey responses. Some of the biggest words are Energy, Waste, Outdoor environment, Biodiversity, Mobility and Climate impact

5.3 Methods and approaches

The form of cooperation agreement that an HEI chooses to sign is determined by what the parties themselves find most appropriate. But some parameters that could be taken into account when choosing the terms in cooperation agreements are listed below.

5.3.1 Type of cooperation agreement

An HEI-wide cooperation agreement can cover all buildings and tenancy agreements, with one or more property owners. The agreement can be signed at any point in time, that is, there is no need to wait for the renewal or renegotiation of an existing tenancy agreement. The agreement can be freely formulated based on how the parties themselves wish to cooperate. Some HEIs refer to this as a cooperation agreement, while others have signed a letter of intent. Others may have formal agreements linked to specific development projects or similar contractual undertakings.

A green tenancy agreement[34] is based on a template from Fastighetsägarna's green annex. A green annex is directly tied to a specific tenancy agreement, which can have the effect of tying the contract items more concretely to a specific tenancy. It is possible to add cooperation areas.

[34] Since the publication of SUHF's report on the climate impact of facilities, in which green tenancy agreements are described in a section on Sustainable conditions of tenancy, the green annex has been updated. In the previous version, voluntary contract items could be masked while the new version always looks the same. However, there are still optional sections of the tenancy agreement that are applied only if the box next to the text is ticked. Furthermore, areas such as reuse and the climate impact from conversions have been included in a clearer way in the new Annex.

Environmental certifications[35] may impose requirement on cooperation. Environmental certifications, like green tenancy agreements, are based on templates with a number of criteria. For example, environmental certifications may require information sharing between the parties, or contain requirements that both the HEI and property owners need to relate to. Today there are certifications that clearly include climate impact throughout the building's life cycle. An example of this is the Sweden Green Building Council's *NollCO2* (Zero CO2) supplementary certification, which can be added to its certifications such as *Miljöbyggnad* (green building), Building Research Establishment Environmental Assessment Method – Sweden (BREEAM-SE), Leadership in Energy and Environmental Design (LEED), or the Nordic Swan Ecolabel36.

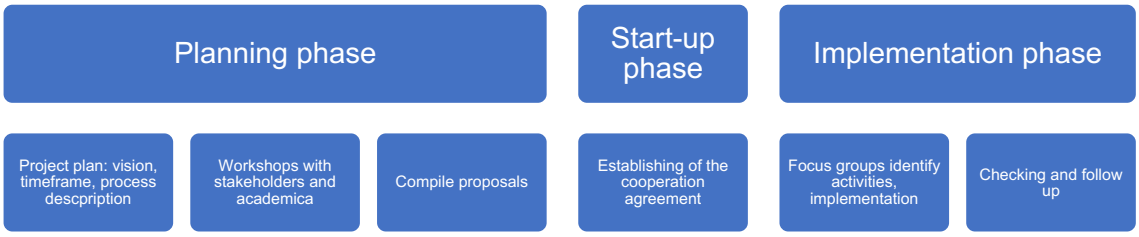
If an HEI is going to sign a green tenancy agreement or is using an environmental certification as a tool for cooperation, it is a good idea to review whether the parties wish to add areas for cooperation that these forms of cooperation do not contain.

Regardless of the type of cooperation agreement that the parties choose, it is the action that follows which determines the actual effect of the cooperation agreement. For efficient cooperation over time, the parties should also agree on how the cooperation should be organised, and how the cooperation agreement should be followed up.

5.3.2 Cooperation process

It can be a good idea for the HEI's cooperation with property owners regarding buildings, facilities and energy as well as other sustainability issues to be part of the HEI's systematic climate and sustainability work and routine work with facilities management. The road to a cooperation agreement is also a process that can serve several purposes. One of these is that both parties agree on the forms of cooperation and sustainability areas covered by the cooperation. Another is that the process can help to anchor and encourage engagement with the issues more broadly within each party's organisation. The process for developing and getting started with work based on a cooperation agreement has several phases: Planning, Start-up and Implementation. See Figure 4.

Figure 4 Phases in the process of developing and getting started with work based on a cooperation agreement.



[35] SUHF Expert Group on Property and Security. 2023. Pages 32 – 33; *En kunskapsöversikt över de största certifieringssystemen på marknaden* (A research review of the major certification systems on the market). *Lokalers klimatpåverkan - Drift, förvaltning samt om- och nybyggnation: en vägledande kunskapsöversikt* (The climate impact of facilities – Operation, management and renovation and new construction: a research overview for guidance)

[36] Sweden Green Building Council. 2024. Web page: https://www.sgbc.se/certifiering/nollco2/ [2 September 2024]

In the planning phase, a project plan is developed to determine the framework for the process. After this, a working group can be formed tasked with proposing forms and areas of cooperation. In this phase, the working group can gather comments and suggestions from staff and students through, for example, a workshop. The Start-up phase is about establishing the cooperation agreement and the forms of cooperation, which is done by a steering group for example, before the people empowered to make decisions (management) adopt it. Activities are identified and implemented in the implementation phase. This work can then be done in one or more working groups/focus groups and be monitored through regular progress reviews with a view to continuous improvement. In addition to reporting to the steering group and management, the outcomes can be included in the HEI's annual environmental and sustainability reports.

5.3.3 Financial obligations

A cooperation agreement may contain agreements on how financial obligations and investments are to be distributed, either linked to a specific area in the agreement or more generally. Because it can be difficult to know exactly what future projects or costs the cooperation agreement will lead to, one alternative is to outline more of a fundamental stance linked to the tenancy relationship and the financial obligations. For example, it may involve an agreement that any cost savings (for example, related to energy measures) will accrue to the party that bore the cost of the investment.

SUHF's research review on the climate impact of facilities[37] lists a number of areas and how the costs for these can be distributed based on which party has the greatest control (right of disposition) over the cost. The research review shows that the property owner usually has the greatest control over the operation and energy use linked to heating/cooling and building electricity, and can thus be responsible for these costs. The HEIs are often able to influence the consumption of activity electricity and the amounts of waste generated and its sorting, especially when the HEI leases entire buildings, in which case it can be advantageous for the HEI to be responsible for these costs, for example, by having its own electricity account or own waste management contract with a supplier for all or part of its waste management.

As part of the work on the research review, a survey was conducted where several real estate companies operating in the community service properties area were asked about their work with environmental certification, sustainable conditions of tenancy, and the financing of sustainability measures. Some of the survey responses highlighted several financing options, such as the property owner's option to issue green bonds, the option to apply for grants for innovation projects, and the review of internal terms for net operating income and direct yield. The property owner also has the option of utilising a 'green exchange' where, for example, the surplus from a raised parking fee can be used to fund sustainable investments in the HEI's campus areas. Investing in sustainability measures can also be about how the

[37] SUHF Expert Group on Property and Security. 2023. Pages 32 – 43; *Hållbara hyresvillkor* (Sustainable conditions of tenancy. *Lokalers klimatpåverkan - Drift, förvaltning samt om- och nybyggnation: en vägledande kunskapsöversikt* (The climate impact of facilities – Operation, management and renovation and new construction: a research overview for guidance)

property owner profiles itself to its customers and shareholders, which can mean that investors accept reduced profit margins in sustainability-related investment projects.

5.3.4 Areas of cooperation

Below are the areas that a cooperation agreement for sustainable development might contain. These areas are based on the environmental and sustainability aspects over which HEIs and property owners share a right of disposition, and which several HEIs already include in their cooperation agreements.

- **Building stock, new construction and conversion, and environmental certification**. This area is about a fundamental stance in relation to the HEI's building stock and facilities management, as well as new construction and conversion. The principle is that facilities and building development projects are preceded by an analysis based on the four-step principle of sustainable facilities management (see Section 2). This area may also include provisions to create flexible facilities to facilitate the climate transition over time. The area may also include environmental certification of conversions and new construction as well as any additional certifications regarding, for example, climate or health. It may also include agreements to provide environmental certification of existing occupied buildings[38].
- The agreements can also include material choices with stipulations that these must be approved materials in databases such as Sunda hus, the Byggvarubedömningen or Basta. This is often part of environmental certification but can be formulated in agreements even without any certification.
- Agreements on reuse may include and concern the reuse of both fittings and building materials (see Section 4). The agreement can also be about promoting circularity in a broader sense, or enabling circular services or the sharing economy among students and staff as well as external parties.
- **Energy use.** Agreements on energy use may deal in part with making energy use more efficient and be about minimising the climate impact from energy use by switching to energy types with a lower climate impact (see Section 3).
- **Waste management and recycling.** A cooperation agreement may include agreements on the management of waste from routine operations and from construction projects. Examples are agreements on good sorting-at-source facilities including sorting biowaste (formerly food waste)[39], indoors and outdoors where possible, reduced quantities of residual waste/combustible waste, and targets for reuse and materials recycling in construction projects/facility development projects.
- **Water use.** A cooperation agreement may include agreements that the parties have to work towards more efficient water use. For example, this could mean

[38] SUHF (2023). *Lokalers klimatpåverkan - Drift, förvaltning samt om- och nybyggnation: en vägledande kunskapsöversikt* page 32 (The climate impact of facilities – Operation, management and renovation and new construction: a research overview for guidance) 32. Report from the Expert Group on Property and Security, 20 March 2023 Reg. no.: SU-850-0047-15.

[39] Swedish Environmental Protection Agency (2024). *Krav på separat insamling av bioavfall* (Requirements for separate collection of biowaste) https://www.naturvardsverket.se/vagledning-och-stod/avfall/krav-pa-separat-insamling-av-bioavfall/ [2 September 2024]

technical solutions such as water-saving aerator mixer taps, but it may also mean more extensive ambitions to have circular systems for stormwater management. It can also mean that rainwater is used for planted plots and beds and green areas.

- **Outdoor environments, biodiversity and ecosystem services.** Outdoor environments can perform many functions. They can be a meeting place or a place for events and gatherings, or a study or work environment. They can also be a place of recreation to promote well-being. Furthermore, outdoor environments can be designed to contribute to biodiversity, where certain areas are set aside as meadows or other species-rich biotopes. It may also include agreements to promote good stormwater management or access to water for insects and birds, for example. Green spaces can also help to reduce cooling requirements for the HEI on warmer days because vegetation reduces a high outdoor temperature inside buildings as well as outdoors. The outdoor environments of a campus area can also enhance green corridors or thoroughfares in cities, benefiting animals and insects by giving them more natural pathways to move across and between larger areas.
- **Climate adaptation.** A warmer climate will result in changes in the amount of precipitation, an increased risk of flooding, drought in some parts of the country and changes in temperature zones, which will also affect the buildings on HEI campuses. The EU's taxonomy for sustainable investment requires property owners to carry out climate risk and vulnerability assessments and to develop an adaptation plan for their buildings.[40] This includes mapping how vulnerable a property is in a 100-year rain or extreme heat event, and how to plan to manage these types of risks. A cooperation agreement can include agreement between the parties on these matters, improving the chances of the HEI successfully adapting to the climate. This area can also be part of the outdoor environment area.
- **Mobility.** The area may include a broad palette of agreements all of which aim to make it easier for students, staff, visitors and suppliers of goods to reduce their emissions from travel to and from the campus, and on campus. It could also include mobility solutions for getting to and from the campus area in a climate-smart way, such as through access to sharing services, or it might concern options for secure bicycle parking out of the weather, or more structural issues such as public transport options and avoiding car travel, or goods groupage to reduce transport within an area.
- **Carbon footprint.** Calculating the carbon footprint for buildings can be used as a basis for deciding on new construction or conversion. This is also a prerequisite for setting and monitoring joint climate targets or climate budgets (see below). HEIs can also use the property owner's calculations of carbon footprint[41] as a basis for making climate inventories for buildings and facilities. In

[40] Fastighetsägarna (2024). *EU:s taxonomi för fastighetsägare.* (The EU's taxonomy for property owners) https://www.fastighetsagarna.se/fakta/fakta-for-fastighetsagare/energi-miljo-klimat/eus-taxonomi/ [2 September 2024]

[41] Within the next few years, companies, including property owners, will be required to submit sustainability reports pursuant to the EU's Corporate Sustainability Reporting Directive (CSRD). This means that most major companies will have to report their climate impact according to the Greenhouse gas protocol for the entire value chain.

most cases, HEIs that have made climate inventories have used Environmental Spend Analyses based on economic data, which only give a general picture of the buildings' climate impact.[42]

- **Climate budget.** A climate budget clarifies the emissions reductions needed in order to achieve set climate targets for the entire building stock or individual construction projects. If the parties work together on a climate budget, it becomes easier to tackle the work of reducing climate-impacting emissions from all angles.
- **Social and cultural sustainability.** Social and cultural sustainability includes a number of sub-areas. Agreements concerning social issues may include work to prevent discrimination or to promote areas such as health, gender equality and equal opportunities, as well as security aspects for both indoor and outdoor environments. Cultural sustainability can be about preserving and conserving historical campus environments and making them more attractive by using design elements and artworks.

5.4 Recommendations

- Formalise and pursue cooperation between tenant and property owner, preferably by means of the Cooperation process outlined in Section 5.3.
- Raise the issue of financing and whether these matters should be included in the cooperation agreement, or have a dialogue on how financing issues should be dealt with once the cooperation agreement has come into force.
- Start with the standard templates that already exist (for example Akademiska Hus's template for cooperation agreements or Fastighetsägarna's green annex).
- Decide on cooperation agreements at the highest level and make the agreement as concrete and binding as possible.
- Allocate resources for this work and involve both administrative and academic staff – that is, those who work with these issues in the organisation or who have expert knowledge.
- Cooperate in the following areas and concerning the following ambitions:
  - **Building stock** Cooperation for a sustainable and flexible building stock based on the four-step principle for sustainable facilities management, its proposed objectives, and environmental certification requirements for conversions and new construction according to Section 2.4. Cooperate to increase non-toxic circular flows of building materials according to the Reuse principle in Section 4. Consider implementing one of the recommendations of the environmental certification bodies on the reuse of building materials in Appendix 1. In addition, cooperate to achieve attractive facilities that promote a sustainable working life and student life. Cooperation that concerns the building stock might also include measures related to climate adaptation.
  - **Energy use.** Cooperation based on the Total methodology (*Total-metodiken*) for more efficient energy use and fossil-free energy. Set joint

[42] Nine out of eleven HEIs stated that they used Environmental Spend Analysis as a method for conducting climate inventories (*Lokalers klimatpåverkan*, page 9).

and measurable targets in accordance with the recommendations in Section 3.

- **Waste management and recycling.** Cooperate to increase sorting at source and recycling by enabling sufficiently dimensioned and standardised source separation sites, reuse and recycling rooms, joint information, indoors as well as outdoors, for students, staff and visitors.
- **Water use.** Cooperate for more efficient water use and to exploit potential opportunities for circular systems for stormwater management.
- **Outdoor environments.** Cooperate concerning campus area outdoor environments to promote and support biodiversity and ecosystem services, but also for the outdoor environments to offer places for recreation and well-being, as well as teaching outdoors. Cooperation concerning outdoor environments might also include measures related to climate adaptation.
- **Mobility**. Cooperate to promote climate-smart commuting and measures that include better opportunities for students and staff to choose public transport, carpooling or vehicle pools. Cooperate to reduce transport on campus through, for example, groupage, joint goods reception, etc.
- **Carbon footprint.** Cooperate to enable annual monitoring of the climate emissions of property management operations. Do specific calculations prior to making decisions on new construction and conversion.
- **Climate budget.** Cooperate to facilitate joint climate objectives and climate budgets for future property management operations and construction projects.
- **Social and cultural sustainability.** Cooperate for increased safety for both indoor and outdoor environments, for example through joint *trygghetsvandringar* (safety walks) – a type of inventory and analysis of an area conducted with the occupants. Cooperate on measures to prevent discrimination, promote areas such as health and exercise, gender equality and equal opportunities, as well as the preservation and development of historic campus environments.

Best practice

Organisation of cooperation at several levels

At Stockholm University, work with cooperation is on several levels: in a steering group and in working groups (one for each sustainability area). The steering group and working groups consist of representatives from both the university and the property owner. The working groups are responsible for developing proposals for measures in each area, while the steering group decides on the prioritisation of these measures.

In the working groups, the university has representatives from the university's administration as well as its academic faculty. When developing measures, as instructed by the steering group, the working groups have to also carry on a close dialogue with the university's staff and students. The working groups meet at regular intervals to ensure that the process of putting activities and documents into concrete action does not come to a standstill. It is up to each working group to determine the forms for their work.

The steering group approves proposals for measures developed by the working groups. Measures requiring monetary investment are decided according to the regular decision-making processes. The steering group meets at least twice a year. The steering group monitors progress on the action plan, identifies strategic areas for cooperation, prepares and develops proposals for activities and, if necessary, proposes assignments for the working groups. The steering group also acts as a catalyst for cooperation by inviting the working groups to progress review meetings or participating in some of the groups' meetings.

Cooperation in specific building projects
At Mälardalen University, the university and the property owner have formalised their cooperation through green tenancy agreements and by jointly designing ways of working and governance for current and future facilities development projects. Initially, joint ambitions have been formulated in the campus plan for Campus Vasterås 2030. Using a checklist for circular construction that the parties have developed together, the parties work towards jointly set and project-specific goals for climate impact, environmental certification, reuse, waste management, energy, ecosystem services, water and social sustainability. The checklist is regularly reviewed at meetings attended by representatives from the university, the property owner and the contractors for ongoing subprojects. During the start-up phase, progress is jointly reviewed weekly, then approximately 1–2 times per month. Designing approaches and setting concrete goals jointly creates a good basis for cooperation. It establishes a learning process where all parties need to actively participate in the design, compliance and monitoring of the governance as well as the goals and approaches that have been jointly developed.

Appendix 1 Examples of targets for the reuse of building materials

	Type of requirement	Description
Nordic Swan Ecolabel buildings43	Points are awarded for the reuse of products based on a calculation of a minimum proportion of the total need.	There is a long table in the criteria document with percentages and product categories, for example: 2pts = 25% of the façade material 3pts = 50% of the façade material
Nordic Swan Ecolabelled renovation44	• At least 30% of the concrete elements are reused. • At least 50% of the façade panels or the structural steel construction consists of reused steel elements.	Besides level-based requirements, there are requirements for: • an inventory prior to demolition • establishing a plan for reuse • selective demolition
Miljöbyggnad 4.0 (nyproduktion) (Green Building 4.0 (new construction)45	• At least 20% by weight of at least one type of building material has to be reused. (Silver) • At least 20% by weight of at least two types of building materials have to be reused. (Gold) • At least 40% by weight of at least one product group has to be reused. (Gold)	In addition to the level-based requirements, there are risk assessment requirements to avoid circulating hazardous substances and to document reuse in a logbook.
Miljöbyggnad i Drift 2.0 (Green building in Operation 2.0)46	• 1 point: The property owner utilises reused materials where reuse is possible (e.g. in the case of tenant adaptations). • 2 points: The property owner offers support, such as services or reuse stockpiles so that users (residents and/or businesses) can reuse things.	The aim is to promote self-managed reuse and among users.
BREEAM-SE 6.047	No specific requirement for reuse. But many requirements that reward it in the form of requirements for calculating the carbon footprint at different stages of the construction process, material efficiency, etc.	

[43] Svanen (2024). Nordic Swan Ecolabel buildings. https://www.svanen.se/en/nordic-swan-ecolabel-buildings/ [2 September 2024]

[44] Svanen (2024). *Svanenmärkning av* Renovering *av byggnader* (Nordic Swan Ecolabel for the Renovation of buildings, in Swedish only) . https://www.svanen.se/4956e1/contentassets/c485a61788f44e059779e0e111b929be/kriteriedokument-for-produktgrupp-102_102_renovering-102_svenska.pdf [2 September 2024]

[45] SGBC (2024). Miljöbyggnad 4.0. https://www.sgbc.se/app/uploads/2022/12/Manual_MB_4.0_1.pdf [2 September 2024]

[46] SBGC (2024). Miljöbyggnad i Drift 2.0. https://www.sgbc.se/app/uploads/2022/10/Manual_MBiD_2.0.pdf [2 September 2024]

[47] BREEAM-SE (2024). *Nybyggnad v6.0, teknisk manual.* (New construction v6.0, technical manual) https://www.sgbc.se/app/uploads/2023/05/Manual_BREEAM-SE_SV_v6.0.2.pdf [2 September 2024]

	Type of requirement	Description
LEED48	• 1 point: Retain 20% of the existing building. • 1 point: Make 50% of the demolished material available for reuse. • 1 point: Reuse 25% of the demolished material in the project.	There are a number of requirements where the aim is to reduce environmental effects by reusing existing resources or promoting recycling markets.

[48] SGBC (2024). *LEED-manualer och verktyg.* (LEED manuals and tools) https://www.sgbc.se/certifiering/leed/anvandarstod-for-leed/leed-manualer-och-verktyg/ [2 September 2024]