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Thesis

For the Attainment of a

Master's Degree in Advanced Studies in Real Estate

The Potential and Challenges of the Implementation of Low-Tech Buildings by Institutional Real Estate Investors in Switzerland

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1. List of Abbreviations

Capex	Capital Expenditure
EIV	Energy Institute Voralberg
FOEN	Federal Office for the Environment
ISO	International Organization for Standardization
LEED	Leadership in Energy and Environmental Design
Opex	Operating expenditure
SNBS	Standard for Sustainable Building in Switzerland
UNEP	United Nations Environment Programme

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4. Executive Summary

To tackle climate change the construction sector has a large potential contribution. The Swiss real estate community is responding to this problem by phasing out fossil fuels and implementing sustainable energy sources, thus reducing CO_2 emissions. New construction projects and renovations are often planned as passive houses. Due to massive external insulation on walls, these houses use less energy than before, but they are equipped with a substantial number of building technologies, which have considerable expenses for the control and maintenance of devices, filters and other elements. As a response to this problem, there is a need to explore alternatives.

Low-tech buildings use a low level of technology. They are sustainable and inexpensive buildings over the entire period of their life cycle. Currently, private individuals, cooperatives and municipalities have been more inclined to construct low-tech buildings than have professional institutional investors, which have a considerably larger impact on the market. Thus, they set a direction for the whole real estate community: architects, planners, developers and others.

The aim of this thesis is to understand the potential and challenges of implementing low-tech buildings from the perspective of institutional investors, as well as of plans for future investment. Low-tech buildings have been recognized for all their ecological and economic advantages. However, a lack of possibilities for investing in them and a lack of knowledge about them have become the most important challenges.

Although possibilities to invest in low-tech buildings are currently quite limited, the attitude toward low-tech is positive, which should lead to higher implementation of low-tech buildings by institutional investors in the near and medium-term future.

1. Introduction

1.1 Starting Point and Problem Definition

The construction sector accounted for 39% of global energy and process-related carbon dioxide (CO_2) emissions in 2018 and comprised up to 40% of total energy consumption (UNEP, 2019, p. 9). The building sector in Switzerland is responsible for approximately one quarter of Switzerland's greenhouse gas emissions (FOEN, no date). The reduction of greenhouse gas emissions in the construction sector clearly offers great potential for tackling climate change.

At the international level, Switzerland has ratified the Kyoto Protocol and the Paris Agreement, whereas on a national level the CO_2 Act was passed on January 1, 2013. The primary focus of the act is fossil-fuel heating and motor fuels (FOEN, no date). Some of the main measures and instruments for CO_2 regulation are CO_2 levies and the buildings program (FOEN, no date), which "supports the energy-related upgrading of buildings and investments in renewable energies, waste heat utilization and the optimization of building services technology." The goal of the Swiss government is to bring CO_2 emissions down to zero by 2050. Long-term strategies to achieve this include the reduction of CO_2 emissions from transportation, buildings and industry by up to 95% by 2050 with the help of technologies that are already available and by using renewable energy sources (Federal Council, 2019).

One answer to the present problem of climate change is the development of low-energy consumption buildings, also known as passive houses. A passive house has massive external insulation on its walls and it is completely air-tight, which results in the implementation of forced ventilation. Ultimately, this results in a building that has never-changing physical properties (Sobek, 2016, p. 15-17). A passive house uses less energy; however, it is equipped with a substantial number of building technologies, which have considerable expenses for the control and maintenance of devices, filters and other components that have to be changed. Therefore, the current task is to use sustainable and simple technologies in the construction of low-energy consumption buildings (Steiner, 2016, p. 41).

Low-tech buildings aim to optimize the use of technologies or exclude them altogether. So far, private individuals, cooperatives and municipalities have been more inclined to construct low-tech buildings that have professional institutional investors. This research investigates the reasons behind their decisions.

Professional institutional investors have significant impact on the real estate market. Therefore, if they have an interest in implementing low-tech buildings, it will offer insight into the overall prospects of low-tech buildings in the Swiss market.

1.2 Research Objective

This paper aims to provide a deeper understanding of the potential and challenges of low-tech buildings from the perspective of Swiss institutional real estate investors.

The thesis examines what are low-tech buildings to provide a basis for the thesis' main part: empirical research aiming to understand how institutional investors approach implementation of low-tech buildings. This research gives insight into the reasons in favor or against investment into low-tech buildings, as well as up-to-date approaches and possibilities for the future.

Investigated topics include the following:

- Definition of low-tech buildings
- Strategies for sustainable and low-tech buildings
- The potential and challenges of low-tech buildings
- Key economic figures

1.3 Research Limitations

The theoretical component of the thesis examines the definition of low-tech buildings and provides examples of constructed buildings in Switzerland. Buildings made of materials such as straw, clay and bamboo are excluded from the research. It is expected that more-often used low-tech building materials are easier to implement for institutional investors, allowing for a stronger base for the empirical part of the research.

The second limitation results from the nature of the research. Because strategic decisions are examined, only a small group of institutional investors was appropriate for the research. Among this small group, only a few have experience with implementation of low-tech buildings.

1.4 Definition of Relevant Terms

Institutional Investor

Institutional investors are, according to Deutsche Bundesbank, institutions that operate in the capital market alongside private investors. They have significant size, which allows them to influence events in the financial markets. Institutional investors are, for example, banks, investment funds, insurance companies as well as public sector bodies (Deutsche Bundesbank, no date).

Institutional investors that took part in this research include insurance companies, pension funds, listed real estate investment companies and banks with real estate investment funds. For the purpose of this study, the term "institutional investor" describes the above listed legal entities, which contributed to the research.

Return on Investment

Return on investment is calculated by dividing the net return on investment by the cost of the investment and multiplying by 100 to get the percentage. Return on investment measures the profitability of an investment; it is a useful tool to make comparisons between investments (Beattie, no date).

Rent

Three rents are distinguished in this research: gross rent, net rent and market rent.

From an investor's point of view, gross rent is the one payed by the tenant, composed of net rent and additional costs.

Market rent is the level of rent being charged in typically new leases, which are currently signed in a particular area (Geltner, Miller, Clayton & Eichholtz, 2014, p. 104).

1.5 Methodology

The theoretical part of the research focuses on examining what low-tech buildings are and what low-tech buildings have already been constructed, which is based on the research literature.

The purpose of the investigation is to provide an answer to most of the research questions, which is done via interviews with institutional investors.

2. Relevant Research

2.1 High-Tech vs. Low-Tech Buildings

The term “high-tech” describes complex processes and equipment that are based on the latest technical knowledge. Opposite of this is “low-tech” processes and equipment that rely on simplicity; low-tech thus foregoes complex technology. However, the boundary between the two concepts is not quite clear in the construction and operation of buildings. Furthermore, the terms’ meanings are changing. In most cases, new technology is considered high-tech because it is different from previous technologies and it is based on the most recent knowledge. If new technology is used frequently and if it spreads through mass production, it becomes low-tech. Ritter (2014) summarizes this as the following: “Thus, many low-tech products of today have been formerly high-tech products, which were originally only accompanied by costly production and possibly complex operation and maintenance” (p. 6). An example of this shift in the meaning of low-tech and high-tech is the electrification of buildings. One hundred years ago, electricity in buildings was high-tech, but today it is considered to be a bare minimum. A more recent example is windows glazing. In the last century, windows with triple-insulating glazing were perceived as high-tech, but now vacuum insulation glazing is seen as high-tech. Although the boundary between low-tech and high-tech changes over time, there are some characteristics that describe both in the construction sector (Ritter, 2014, p.6).

High-tech is mainly used in industrialized countries, while low-tech is perceived as a solution for emerging countries, which use simple building technologies and have a clever choice of materials. This division results in low-tech buildings being perceived in the industrialized world as simple, maybe even primitive solutions created out of necessity. However, low-tech is not necessarily a primitive technology that leads to a lower quality of life in comparison to high-tech. However, to accomplish high-tech quality in a low-tech building, one must increase planning efforts. For that reason, planning and investment costs are higher in low-tech buildings in comparison to standard buildings, for several reasons: a larger effort to adapt the building to the local climatic conditions and fewer standardized methods and products that such a building might require (Ritter, 2014, p. 7-8).

	HighTech	LowTech
1. Occurrence / Application	rather industrialized countries	rather developing and emerging countries
	urban environment	rural environment
2. Production	elaborate / complex	simply
3. Development Costs	high	low
4. Planning / Investment Costs	significantly higher than standard	higher than standard
5. Operating Costs	lower than standard	lower than standard
6. Functionality / Operability	comprehensive, unlimited	simple, limited function
7. Maintenance / Repairs	elaborate, complex	simple
	high level of expertise required	little specialized knowledge necessary
8. Durability	more sensitiver	more robust
9. Life Expectancy	building technology shorter	building technology longer
10. Precision	more precise than standard	lower than standard
11. Calculability	high, measurable, predictable	low, less plannable
12. General Appearance	particular	usual, simple
	rather artificial	rather natural
	ultramodern	traditional, conservative
13. Structure / Layering	complex	simple
14. Pers. Reference to Building	rather distanced	rather personal

Table 1: Demarcation between high-tech, low-tech and standard buildings (based on Ritter,2014, p. 9)

Table 1 shows a comparison between low-tech, high-tech and standard buildings. Aside from implementation of high-tech in industrialized countries and low-tech in emerging countries, some main differences are the general appearance and costs. High-tech is perceived as ultramodern, predictable and complex, while low-tech is perceived as simple, conservative and natural. Development costs for low-tech are low, whereas high-tech has high development costs. Planning and investment costs are higher for both low-tech and high-tech than they are for standard buildings; however, high-tech has the highest costs. Both have operating costs lower than standard, but operability and maintenance are complex in a high-tech building and simple in a low-tech building. High-tech is perceived as more sensitive, while low-tech is perceived as robust (Ritter, 2014, p. 9).

In the following the chapters, low-tech buildings are analyzed in more detail.

2.2 Definition of Low-Tech Buildings

Daniels (1998) published one of the first contemporary studies relevant for this area, in which he gave the definition of low-tech, light-tech and high-tech buildings. He described low-tech buildings as those that are designed in a simple way and with the highest possible usage of natural resources that can be find in the local area. Light-tech refers to buildings not only made from recyclable building materials, but also planned through smart design to save as much resources as possible. He described high-tech as buildings that reflect the influence of future information and communication systems (p. 7). The term low-tech was further developed in a comprehensive study by Haselsteiner, Bodvay, Gosztonyi, Preisler, Berger, & Gasser. According to their research, a sustainable low-tech building is a building that uses a low level of technology over its life cycle. Basically, a building should use a low level of technology in the planning and construction phase, in operation and renovation of the building and in the dismantling phase (2017, p. 24). The definition of a low-tech building is based on the three basic dimensions of sustainability: ecological, economic and social dimensions, to which was added a fourth dimension, the cultural dimension. According to Haselsteiner et al. (2017, p. 25-31), sustainability dimensions provide potential for low-tech buildings, which then help to define the main characteristics of low-tech buildings:

- The ecological potential of low-tech includes climate and location factors, form and design, energy supply, system cycles, as well as material and resources, which define a low-tech building as a construction that is designed to save resources and use ecological resources.
- The economic potential of low-tech includes its production, construction, operation, deconstruction, usage and life cycle, which characterize low-tech buildings as cost-efficient and robust, striving to reduce technology usage over the entire life cycle.
- The social potential of low-tech are comfort (thermal, hygienic and acoustic comfort), building health (biologically harmless building materials, daylight, etc.), supply and disposal, which specifies low-tech buildings as having guaranteed comfort standards, ensuring supply and disposal, as well as excluding potential hazards.
- Participation means that buildings are made in simple and self-maintainable building constructions and systems, control and regulation (intuitive operation and handling), with building components that are easy and simple to maintain

(possibly without technical aids) and consideration of experiences from local building traditions.

Every low-tech building must have all components in a sufficient and balanced proportion to each other.

Haselsteiner et al. (2017) went further and examined numerous low-tech buildings on a case-by-case basis, in the context of the buildings themselves and their surroundings. The aim was to analyze and demonstrate different low-tech approaches. Buildings were organized in three categories. The first category focuses on projects with the main goal of functionality: heating, cooling, ventilation and light with little technology and a high proportion of natural and renewable resources. The second category focuses on projects with use of naturally occurring building materials, which require minimal gray energy and maximal recyclability, and also with economic processing of materials and materials with properties that avoid the use of technologies. The third category includes projects in which the main objective is to achieve sufficient handling of the overall system. Furthermore, it has been proven that experimental ideas are often tested in small, individual buildings before they are implemented in large-scale buildings or building complexes (p. 32).

In addition to the theoretical understanding of low-tech buildings discussed above, a practical understanding of low-tech buildings is further gained with the use of another source, the Energy Institute Voralberg. A low-tech building is defined as a highly efficient building characterized by simple, very durable and resource-saving structural components that exist throughout the entire life cycle. It should be both energy and cost effective. Building materials should be local and natural. The façade should be simple, durable and easy to renovate, with the task of the building physics to protect against overheating in summer and cooling in winter. This allows the use of technology in low-tech buildings to be greatly reduced. Only necessary and economically efficient building technologies should be used and they should be easy to maintain and operate, which is particularly important due to differences in the life spans of buildings and building technologies. A low-tech building has a very low energy requirement and a high proportion of renewable energy for its heating and power supply, while it should also maintain a comfortable temperature, the best air quality and a high proportion of daylight. Resulting with a more comprehensive approach in comparison to standard to realize a low-tech building. However, deliberate temperature oscillations are acceptable if this means that additional technical components are not required. A low-tech building

should be easy to use for all generations; self-explanatory operation of the building should be comprehensively implemented in the planning, construction and building services engineering (EIV, no date).

The next chapter examines three low-tech buildings to demonstrate low-tech approaches in praxis.

2.3 Selected Projects of Low-Tech Buildings in Switzerland

Three projects were chosen based on geography, the low-tech building system and usage.

The chosen projects are in the German-speaking region of Switzerland. Buildings are in the same country, which means that they were built under the same building regulations. Theoretically, one could have looked at a neighboring country; however, those buildings are made within different regulatory environment. Furthermore, buildings come from the same cultural and climatic circumstances.

There is a basic difference in the approaches to low-tech buildings. One approach is to make buildings equipped with as little technology as possible, while the other approach is to completely eliminate building technologies. A general description of a low-tech building is that it uses a low level of technology over its entire life cycle, but sometimes it is not clear what exactly is a low level of building technologies. The first example demonstrates one low-tech approach. The building is planned in a way to enable passive solar use with a south-facing glass façade and a large thermal storage mass. The building was built in 1998 in Chur, Switzerland. The second example radically reduces building technologies. This building functions without a heating system, ventilation and air conditioning. The first building of this kind was built in Austria in 2013, and since 2018 there is one of these buildings in Emmenbrücke, Switzerland.

The selected examples have different usages. The first one is an industrial building, the second one is used for offices and a school and the third one is a residential building with ateliers. This last project was chosen also due to the specific target group for which it was developed.

2.3.1 Gewerbehaus Gasser in Chur

Investor: Josias Gasser Baumaterialien AG, Chur

Architect: Andrea Gustav Rüedi, Chur

Figure 1: External shading protection from heat in the summer (EIV, 2018, p. 82)

The building's construction is a mix of wood and sand-lime brick. The south-facing glass façade captures a great deal of energy from the sun. There is a large amount of thermal storage mass in beams on the ceiling, sand-lime brick walls and concrete floor; latter two have an excellent thermal absorption capacity. These two design elements, a south-facing glass façade and substantial energy-absorbing mass, enable passive solar use of the building. The ground floor is flexible, as well as the operation with the installations, due to the positions between the beams. Only ventilation pipes are visible. Durability is accomplished by the choice of the materials, such as solid wood, sand-lime brick and clay plaster. There is a pellets stove for heating; solar collectors provide hot water; and ventilation and electrical installations are visible and easily accessible. Therefore, the building is easy to maintain (EIV, 2018, p. 75-81).

Figure 1 shows the external shading that ensures that it does not overheat in the summer. They are automatically controlled by a room temperature and wind regulation. Cooling overnight is provided by an automatic ventilation flap on the roof and automatic window opening. Active air conditioning is not necessary because of the sun protection and night cooling. In the summer, the highest temperature in the building on the ground floor is 25.5 °C and on the second floor it is 28 °C (EIV, 2018, p. 78-79).

Generally, the main advantages pointed by the owner are a pleasant indoor climate, quite low operating costs and an easy construction process (EIV, 2018, p. 77).

The most important low-tech principles are usage of sand-lime brick and concrete, which provide thermal storage mass and robustness of the construction. Instead of forced ventilation, the building is cooled by natural ventilation overnight. Utilization of renewable energy sources, as well as separation of the load-bearing main structure and installations, make it easy to maintain and result in low operating costs (EIV, 2018, p. 75).

2.3.2 2226 Building in Emmenweid

Investor: Brun Real Estate, Emmenbrücke

Architect: Baumschlager Eberle Architekten Zürich

Figure 2: Robust façade with substantial energy-absorbing mass (Baumschalger Eberle Architects Zürich, 2019)

A five-story building without a basement, with a gross floor area of 2,815 m^2 is used for offices and a school. The central zone of the ground floor contains the staircase, elevator and toilets, which is the core of the space. The rest is designed to be organized flexibly. The façade is simple. It has one shift in volume between the first and second floors. It is composed of a wall in plaster made of slaked lime and oak windows with lateral ventilation sashes. The façade has a relatively small proportion of space covered by windows; however, due to a room height of 3 m and the tall windows, sunlight comes deep into the room, which together with white plaster provides for a substantial amount of light inside. Windows are executed on the inner side of the wall, making sun protection unnecessary, but for the privacy purposes, the architects planed curtains. (Schiele, 2019, p.62-65; Baumschlager Eberle Architekten, no date).

The design and energy concepts are closely connected in this building. As the building's name (2226) implies, the temperature is never under 22°C or over 26°C. However, this building is constructed without a heating system; it also has no forced ventilation or cooling. This is possible due to tick walls, depicted in Figure 2, which thanks to bearing and insulating brick, have a mass with a capacity to maintain heat and humidity, providing warmth in winter and cool temperatures in summer. Another element contributing to this energy concept is the position of the windows. The architect put the windows on the inner side of the wall, thus protecting the rooms from overheating in summer. (Baumschlager Eberle Architekten, no date; 2226, no date)

There is a device with sensors in the room that measures temperature, CO_2 and moisture in the air. If, for example, the CO_2 content becomes too high, the narrow, closed wooden ventilation sashes integrated into the window, operated electrically, open to ensure fresh air. In the same way, this building uses nighttime cooling in summer to provide temperatures under 26°C without using additional air conditioning (Simon, 2020, p. 38).

The original plan was to install photovoltaics on the sloping concrete roof surfaces, but this was not allowed by the authorities responsible for preservation of historical monuments because the building is the replacement of an industrial monument in a historically protected area (Simon, 2020, p. 42).

The most important low-tech principles are the radical reduction in in the use of building technologies (no heating, forced ventilation or cooling) and temperature

regulation with the help of energy-absorbing mass, which also ensures robustness of the building. A lack of building technologies results in lower operating costs.

2.3.3 Residential Building with Ateliers for Artists in Erlenmatt Ost in Base

Investor: Coopérative d'Ateliers

Architect: Heinrich Degelo

Figure 3: Robust façade with wooden balconies (Gruntz, 2019)

A four-story building without a basement consists of 17 units with a surface area of 60 – 150 m^2, with a total gross floor area of 2,600 m^2. The room height is 3.50 m. It was designed for artists, with the objective of providing an affordable living space and studios. This resulted in minimum requirements for the living space. It is made to be raw and simple: The inner walls are not plastered, floors and ceilings are made of concrete and dividing walls are not planned. Every unit has a sanitary block, which consists of a kitchen and a bathroom, as well as a central connection for electricity and water. The interior fittings are completely left to the residents to design. The space has a high level of flexibility. The ground floor has a simple and modular floor plan system. The inner organization of the space within a unit can be customized individually; even the sanitary block can be planned according to individual needs. Every tenant can

decide if and how much they want to invest in interior design (Detterer & Bühler, 2019, p. 80-83; Breitenmoser, 2019, p.12-14).

Figure 3 shows the outer wall, which is made of 78 cm-thick insulating bricks and is covered by light sand-colored lime plaster, which are all natural and locally sourced building materials. Window portions in walls are reduced. Behind the façade overlooking the laud street are ateliers, where artists need good-quality light and in a sufficient amount. This was achieved with high windows that allow for light to enter deeper into a room (Detterer & Bühler, 2019, p. 80-83; Detterer & Bühler, 2019, p. 87-88).

The principle of low costs is evident in the energy concept as well. The architect visited the 2226 building in Lustenau and made the same low-tech system: no heating, no forced ventilation and no air conditioning, which reduces costs significantly. There was, however, an official requirement to be able to retrofit a heating system if the room temperature is too low. For this emergency, the building is connected to the area's district heating system. Electricity is provided from solar power systems on the roof (Breitenmoser, 2019, p.14-15; Gruntz, 2019).

Construction costs were CHF 4.4 million and rent is CHF 10 per 1 m^2 per month. All rooms are rented out and there is a waiting list (Detterer & Bühler, 2019, p. 80-82).

2.4 Focus on Ecological Components of Low-Tech Buildings

Low-tech buildings have an underlining philosophy of sustainability; their first dimension is ecology. One of the main low-tech ecological potentials is energy supply as well as materials and resources. Low-tech buildings should use natural and renewable resources and have very low energy requirements. Furthermore, they should be built with local and natural building materials produced with a small amount of gray energy and a high degree of recyclability.

In addition, an important quality of low-tech buildings is durability and a resource-saving structure. Furthermore, the façade should contribute to preventing overheating in the summer and excessive cooling in winter, so that the usage of technologies can be reduced. To satisfy these requirements, all presented examples used materials with thermal storage mass.

Thermal storage mass helps to balance interior temperature so it can remain stable over the course of the day or several days, regardless of changing external influences. For

example, heat from the sun entering the windows in summer can be stored in the first layers of the material, but at night natural cross-ventilation cools it down, thus providing a pleasant indoor climate during the day (Hegger et al., 2016, p. 158).

In the presented examples the choice of material for the thermal storage mass were brick and concrete, which have good storage properties. However, these materials have a high proportion of gray energy, which conflicts with the ecological requirements.

It is beyond the scope of this paper to go into detail about all the materials and to cross compare them to all low-tech systems; however, one calculation provides a deeper understanding of this problem.

Figure 4 depicts a result of the calculation done by Pelzeter (2017, p. 200-206) of the proportion of CO_2 emissions of building components through the life cycle of a massive and a standard building with a thermal insulation composite system façade. The massive building was created with the exact same specifications as those of 2226 in order to compare it to the standard building. The calculation was made based on a life cycle of 50 years. The foundation, floor and roof have identical CO_2 amounts, while there is a difference in the façade walls and in the operation of technical installations. The massive building, based on the 2226 principles, has a massive 76 cm-thick brick wall, which has a slightly higher proportion of CO_2 emissions, while the operation of technical installations in the standard building is produced with over 40% more CO_2 emissions than for that in 2226. Finally, total amount of CO_2 emissions in the massive building, based on the 2226 principles, is approximately 25% smaller than that in the standard building. The difference would be greater if the calculated life cycle was longer.

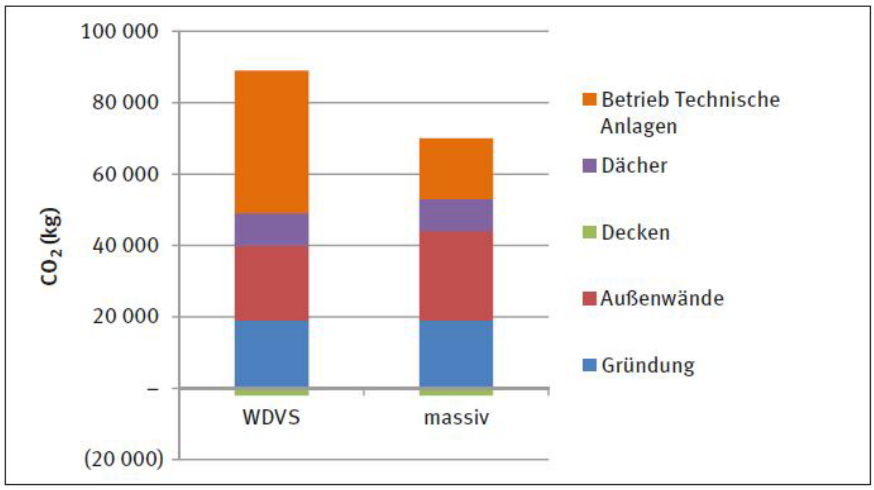

Figure 4: CO_2 emissions share per building element (Pelzeter, 2017, p.204)

Generally, wood is a much better material if one wants to reduce CO_2 emissions, but it has a significantly lower level of thermal storage capacity, and the material requires numerous building technologies to ensure a pleasant indoor climate in summer and winter (Pelzeter, 2017, p. 206). This affects not only the costs of the building, but also CO_2 produced by building technologies, especially from renovation due to the production of installation materials with a high proportion of gray energy.

2.5 Focus on Economic Components of Low-Tech Buildings

Cost effectiveness is an important part of the low-tech building philosophy. The correlation between the costs of low-tech, standard and high-tech buildings is described above. This chapter examines the basic allocation of costs in the life cycle of buildings in general; this correlation is then projected onto low-tech buildings.

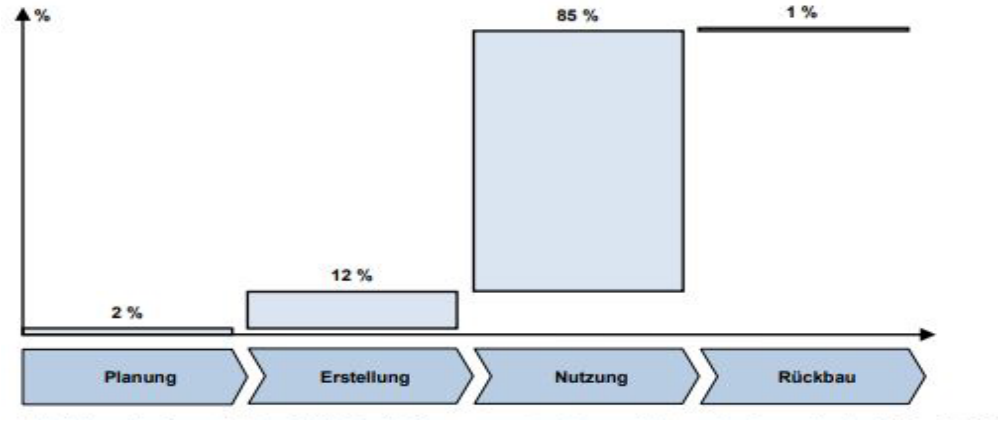

Figure 5: Life-cycle costs of a building (Gantenbein,2003, p. 91)

As shown in Figure 5, according to Gantenbein, planning costs add up to 2% of all life-cycle costs, while construction costs account for up to 12% of life-cycle costs. The largest portion of life-cycle costs are usage costs which add up to 85% of life-cycle costs. For a building that has a life span of 50 years, usage costs are 3–10 times higher than planning and construction costs (2003, p. 90). Furthermore, high usage costs can be optimized either by suitable measures in the operation of the building or by influencing them in the planning phase.

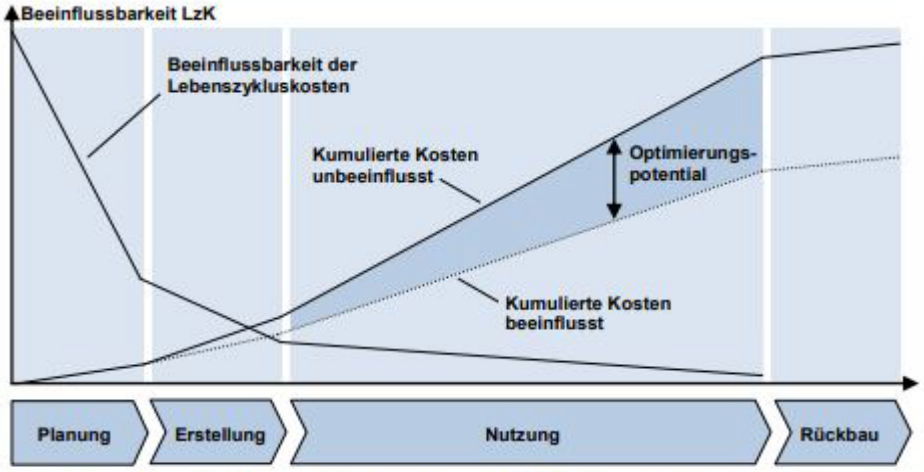

Figure 6: 80% of the life-cycle costs is defined in the planning phase (Gantenbein,2003, p. 92)

Figure 6 illustrates that there is a substantially higher influence on the life-cycle costs in the planning phase because 80% of the usage costs are defined in the planning phase.

Planning costs are higher in low-tech buildings than in standard buildings because of the substantial effort to adapt the building to local climatic conditions and the less standardized methods and products. However, usage costs are lower than in a standard building (Ritter, 2014, p. 9). If the planning phase costs, which account for 2%, are increased, then the usage phase costs, which account for 85%, are decreased. The question, then, is how does this affect the overall life-cycle costs?

A calculation of the life-cycle costs of a massive building based on the 2226 principles and of a standard building with a thermal insulation composite system façade made by Pelzeter (2017, p. 206) resulted in the following: the life-cycle costs of the standard building with a thermal insulation composite system façade are about 43% more expensive than that of 2226. The basis for the calculation was a building life cycle of 50 years. Longer life cycles would have even larger differences in costs.

2.6 Conclusion

Haselsteiner et al. define low-tech buildings as buildings that use a low level of technology over the life cycle. They are defined according to four dimensions of sustainability: ecology, economy, social and cultural in sufficient and balanced proportions to each other. Moreover, Haselsteiner et al. provided with vast analysis of low-tech buildings, organized in three categories: function of the building, building material and the overall system.

A practical, low-tech description is provided by the Energy Institute Voralberg. The main low-tech qualifications identified by the Institute are energy and cost efficiency. Buildings should be durable and made out of natural and local materials. The façade should protect the building from getting too hot in summer and too cold in winter, which enables reduced usage of technologies over the building's life cycle. The building should be designed to allow easy maintenance and operation. Energy efficiency is enabled by very low energy needs and a very high proportion of renewable energy. The building should provide sufficient daylight, the best air quality and thermal comfort, but temperature oscillations are acceptable in a low-tech building if they are a result of a reduction in the number of technical components in the building; they should also be easy to use. A furthered detailed analysis was given in the examples of low-tech buildings. Gewerbehaus Gasser and 2226 present two different low-tech principles, while the residential building with ateliers in Basel is a representation of a product developed for a target group.

All three building use the advantages of thermal storage mass to reduce the need for building technologies. Instead of forced ventilation, the buildings are cooled by natural ventilation overnight. The key difference between 2226 and all other low-tech approaches is that 2226 does not need heating, forced ventilation or cooling. Gewerbehaus Gasser uses renewable energy sources. It also has a separated load-bearing main structure from installations, which make it easy to maintain and lowers operating costs.

The residential building with ateliers was developed for artists, both for their needs to have an atelier and an affordable living space. The building is raw and simple, and it has the same energy concept at 2226, resulting in competitive prices. It offers a high level of flexibility to decide on the interior fit-out. This building was implemented by a cooperative, which does not have requirements for additional profits, thus further enabling competitive pricing.

The main criticism of materials with thermal storage mass is the high grey energy consumption. Pelzeter calculates the CO_2 consumption of a massive building, based on the 2226 principles and the standard building with a thermal insulation composite system façade, over a life cycle of 50 years. The result is that the massive building, based on 2226 principles, is significantly better. Moreover, it has been pointed out that one should pay attention to several key figures when comparing buildings. For example, wooden buildings have better CO_2 figures, but a building with solid construction with a great deal of thermal storage mass has much better cost figures. Both materials have their advantages. Wood is produced with less CO_2 consumption, but it needs a high level of building technology to ensure a pleasant indoor climate in summer and winter. In contrast, materials with thermal storage mass have the opposite as an advantage. Wood is flammable, it has low sound insulation and it has a limited service life in weathered areas, while solid construction materials such as brick are not renewable raw materials and their recycling is limited.

One advantage of low-tech buildings pointed by practically all researchers are lower costs in comparison with standard buildings. Ritter's research gives a basic understanding of the difference between low-tech and other buildings. Low-tech buildings have simple production processes, and their development costs are lower, as well as maintenance and operability of the buildings, which results in operating costs lower than standard; however planning costs are higher than standard.

If 80% of the usage costs are determined in the planning phase (Gantenbein, p. 92) and these are lower in low-tech buildings, while the planning costs are higher than that of standard buildings, then the question arises: how is this connection between planning and usage costs reflected the total life-cycle costs of the building?

Pelzeter’s calculation comparing a massive building based on the 2226 principles and a standard building with a thermal insulation composite system façade resulted in significantly lower life-cycle costs for the radically low-tech massive building than that for the standard building.

The empirical research chapter further examines the potential and challenges of low-tech buildings from the perspective of institutional investors as well as prospects for future implementation of low-tech buildings.

3. Empirical Research

3.1 Methodology of the Empirical Research

Fourteen institutional investors were contacted, among whom eight took part in the research. Among those, there were representatives of one pension fund, two banks, three insurance companies and two shareholder companies. The interviews were conducted between July 21 and August 26, 2020. Interviewees who took part in the discussions were heads of development, asset managers and fund managers. Therefore, relevant to ask questions regarding strategies for the implementation of low-tech buildings as well as the potential and challenges of low-tech buildings. Table 2 provides information about the companies and interviewees in a systematic overview.

The interviewees were anonymized. The symbols representing each interviewee were determined according to the core business of the interviewee's company.

Institutional investor	**Expert**	**Place of interview**	**Date and time of the interview**
Bank A (BA-A)	Fund Manager	Telephone call	21.07.2020 at 14:00
Insurance A (IN-A)	Asset Manager	Headquarters of Insurance A	22.07.2020 at 15:00
Shareholder Company A (SC-A)	Director of Asset Management	Headquarters of Shareholder Company A	23.07.2020 at 13:30
Bank B (BA-B)	Fund Manager	Telephone call	30.07.2020 at 14:30
Pension Fund A (PF-A)	Head of Real Estate	Telephone call	12.08.2020 at 15:15
Shareholder Company B (SC-B)	Head of Development	Telephone call	24.08.2020 at 13:00
Insurance B (IN-B)	Head of Projects, East Switzerland	Headquarters of Insurance B	26.08.2020 at 13:00
Insurance C (IN-C)	Head Asset Manager	Telephone call	26.08.2020 at 16:00

Table 2: Overview of interviews organized chronologically

The aim was to understand the largest part of the real estate market for institutional investors. One criterion for choosing interview partners was the size of the portfolios they manage and consequently their impact on the real estate market. Another criterion was whether they invest in real estate directly.

Due to the lack of experience among institutional investors in investing in low-tech buildings, among eight interviewees, only two shareholder companies were chosen due to their experience with low-tech buildings.

All institutional investors, when contacted, received an email with a questionnaire and a brief explanation of what low-tech buildings are, according to the research conducted by Haselsteinr et al. Collected data is examined for each interviewee and in cross comparison.

3.2 Questionnaire

Interviews were conducted on the basis of a questionnaire (see Appendix 1), which was used as a guideline during the interview. It was divided into three parts: general information on strategy and investment, potential and challenges and key economic figures.

The first group of questions examines the broad strategy of the institutional investors for investing in sustainable and low-tech buildings. The main criteria in the decision-making process were discussed as well as the reasons in favor or against investing in low-tech buildings, now and in the future.

The second group of questions is focused on the potential and challenges of low-tech buildings, as well as on target groups and marketing.

The third group of questions examines key economic figures for the return on investment, rent and life-cycle costs of low-tech buildings.

3.3 Interview Results

3.3.1 Bank A

The first interview was conducted on July 21, 2020 with the fund manager. The fund has mostly residential properties and is focused on the German-speaking region of Switzerland.

General Information on Strategy and Investment

Banka A has a sustainability strategy, but there is no explicit strategy to invest in low-tech buildings. Low-tech building are understood as buildings with substantial thermal storage mass in the walls and regulated ventilation with sensors.

It is considered that the general reason for the lack of investment in low-tech buildings is that institutional investors are not as experimental as private individuals, cooperatives or municipalities. There are no low-tech buildings on the transaction market for institutional investors, but there is no possibility of acquiring such a building. In addition, low-tech buildings are not among the new projects from developers offered to institutional investors. Therefore, they do not invest in them. However, there are opportunities to renovate or rebuild older properties, and in this area, they want to focus more on low-tech potentials. One precondition of investing in low-tech buildings is to learn more about these buildings. The fund manager's attitude toward low-tech buildings was quite positive: "I like the goal of low-tech, to use as little building technology as possible. It seems to be much easier than forced air conditioning, ventilation systems, et cetera."

For decision-making processes, return on investment is one significant criterion. The target group is also important because the product is developed according to the target group's needs. New, stricter sustainability cantonal laws are expected in the future; therefore, Bank A already invest in sustainability. They are moving toward CO_2 neutrality and moving away from reliance on fossil fuels.

The Potential and Challenges of Low-Tech Buildings

There is no experience in implementing low-tech buildings, but there are many properties with architecture that supports low-tech principles, natural and sustainable materials or renewable energy.

There are no direct challenges that have been encountered. The main challenge is to better understand how low-tech buildings function, as well as finding ways to implement low-tech buildings into the portfolio.

Demand is recognized as originating from "people who can identify with the idea of such a building. People for whom climate change and sustainability are a topic, i.e. people who have an affinity with the environment."

Actual marketing documents describe in detail all aspects of the elements that stand out for their sustainability in the project. However, there is no expected difference due to sustainability when renting property for the first time and later re-letting it, because other elements such as location are more important. The residential tenant is even less sensitized to sustainability than are corporations; however, this is expected to change in the future.

Key Economic Figures

Whether returns on investment of low-tech buildings are higher or lower was difficult to answer due to numerous characteristics that influence this.

There is also no certainty that one can expect a willingness from tenants to pay higher gross rent, however:

> "As a rule, sustainable buildings have lower additional costs due to, for example, reduced energy consumption, solar power, et cetera. If these are lower, more is left for the net rent. This means that higher net rents can be charged."

Tenants of residential buildings are not willing to pay more to rent in a sustainable building. This is different in the case of companies that rent office space and investors that are prepared to invest in sustainable buildings.

Experience with evaluating life-cycle costs and usage costs is missing, but these costs are expected to lower due to a smaller proportion of technology and robust construction, especially in radically low-tech building such as 2226.

The fund manager could not say if it is more expensive to invest in low-tech buildings. However, he is of the opinion that thermal storage mass in thick walls could lead to higher construction costs. He would accept higher planning and construction costs if the low-tech building functions with all its advantages.

It was not possible to answer whether there is any difference in the vacancy rate of low-tech buildings, because there are other important components influencing vacancy rates, such as location, connection to public transportation and competition in the area. These elements affect first-time letting and re-letting. Sustainability is not the decisive factor for vacancy rates.

3.3.2 Insurance A

The interview with the asset manager was conducted on July 22, 2020. The insurance company's portfolio has a substantial number of office and commercial properties.

General Information on Strategy and Investment

Insurance A has a sustainability strategy, which obliges it to pay attention to sustainability when choosing energy sources and materials. The company is successively reducing the CO_2 footprint of its existing buildings.

A low-tech building is understood as a building with few technologies and one that regulates itself as much as possible in terms of temperature and air exchange. Currently, there is no strategy to invest in low-tech buildings now or in the future. However, the attitude toward low-tech buildings is not negative:

> "It would be nice if the use of the technology were to become somewhat easier. I think the operating costs are relatively high for ventilation, air conditioning and so on. Maintenance and replacement are correspondingly high. And if you could offer tenants the same experience with less technology, that would be ideal."

When investing in real estate, two aspects are examined: economic aspects, such as rental income, operating costs and capital expenditures, and sustainability. The company examines what kind of heating system is installed and what could be installed in the future. In the decision-making process, the location and the condition of the property are decisive, whereby the location is far more important.

Most buildings in the portfolio are office and commercial properties, which are relatively well equipped with technical aids. They have heating and ventilation systems, and many have cooling systems. Their tenants usually have a high need for a large air exchange and, with warmer summers, an increasing need for cooling. This is especially noticeable in the central locations of cities such as Zürich, Basel and Geneva, where tenants rent office space at a high rent in buildings with cooling systems. One more

reason not to invest in low-tech buildings is regulations, which determine that in the commercial sector, for example in a restaurant, one must provide certain amounts of air. When investing in residential buildings, Insurance A invests in buildings with labels (for example, Minergie).

There are no special reasons for not investing in a low-tech building if the product is in accordance with the target group, according to the asset manager:

> "…if you can save on construction costs and rents don't drop significantly as a result, that could be exciting, especially in a region where renting is very demanding because there is already a lot of competition. Then it could be interesting to offer an attractive product with low investment costs."

In general, the company has a strong label strategy. This means that they like to have a label when constructing a new building or investing a great deal in a renovation. In this way, tenants can see the added value, and ideally, they are willing to pay for the greater comfort. Another argument in favor of labels is that investors are increasingly demanding sustainable investment products with labels; therefore, it is important to label as many properties as possible.

The Potential and Challenges of Low-Tech Buildings

Insurance A has no experience with implementing low-tech buildings, so no challenges were encountered. There are concerns that there is a limitation of the number of potential tenants due to the reduced level of comfort. The expected advantages are reduced construction and operating costs, which would have a positive effect on the tenants' additional costs.

The tenant must have a positive attitude toward radical low-tech buildings. They must accept that it might be somewhat warmer or colder in the building, and one must communicate clearly how the building works. Some uses would be excluded, such as gastronomy, because of the need for ventilation. In low-tech buildings that only have a reduced number of building technologies, the tenant would not notice much difference; therefore, the size of the target group would not be reduced. It could be more of an advantage, because there are companies, especially international companies, that would like to be in a sustainable building.

There is an image benefit from sustainable building. Investors are investing in sustainable buildings. In this regard, “I also see the topic of low-tech buildings as positive. It's just that there is a lack of experience and availability.”

Key Economic Figures

It was not possible to assess if the return on investment is higher or lower. Gross rent is expected to be lower, as well as additional costs. It was not possible to assess if the net rent changes, which depends on other criteria, mostly the location of the building.

Life-cycle costs are expected to be lower; usage costs are expected to be lower as well.

It is expected to be less expensive to invest in low-tech buildings because there are not as many technical installations. The same is true with the planning costs.

A willingness to pay more for the planning and construction of low-tech buildings would depend on an economic perspective. If planning and construction costs are higher, Insurance A would expect higher rent so that the return on investment stays the same.

For the vacancy rate, the most important factors are location and the condition of the building, competition in the area and what tenants are willing to pay, not sustainability. Even if the Insurance A has a building with a label, they do not push it strongly in their marketing because many people are not so interested in that either.

3.3.3 Shareholder Company A

The interview with the director of asset management of Shareholder Company A was conducted on July 23, 2020. A substantial portion of the company’s portfolio is offices.

Basic Information on Strategy and Investment

There is a sustainability strategy with the main objectives to preserve resources and reduce CO_2 emissions. When planning a new building, renovating a building or purchasing a property, the company always takes sustainability into consideration, throughout the life cycle of the building. The company employs energy specialists, as well as an expert in facility management that is responsible for maintenance in terms of sustainability. There is no exact strategy for low-tech buildings. However, when investing, the company always tries to do as little as possible in a technical sense.

In the decision-making process, the company examines economic components, CO_2 emissions and sustainability. They additionally invest in sustainability because it is good for renting and stock owners. When deciding between low-tech and high-tech approach, they explore all options throughout the life cycle of the building. Location, the tenant and the building itself provide a basis for such a decision.

The company has many old properties in their portfolio for which they search for slim technical solutions. The director of asset management explains the reason for this: “Especially in the old buildings, we don't want too much over instrument with technology. In the end, the building alone helps. In an older building, people tend to accept that it can be 28 or 30 degrees.” However, the main driver is the comfort of the tenant, which is determined by the location of the property and the rent. A large part of the portfolio are offices, many of which are in city centers and in old buildings. In these areas, tenants are willing to pay more but expect in return a level of comfort provided by technology (for example, air conditioning).

The Potential and Challenges of Low-Tech Buildings

Shareholder Company A has two low-tech buildings in their portfolio, which are named here low-tech building SC-A1 and low-tech building SC-A2.

Low-tech building SC-A1 is an industrial building from the 1950s, which was converted into a low-tech office building with an open floor plan. There are only radiators for heating but no air conditioning or forced ventilation. The building is located in the area popular with people from the creative industries, which is the target group. Tenants come from the creative sector and they have accepted that there is no air conditioning. The building is not highly insulated, but it has high ceilings. Essentially, heat rises quickly to the ceiling. In the summer, tenants must ventilate their room in the morning to cool the room, which works well. The building is popular and fully rented out.

Low-tech building SC-A2 is also in the area popular with people from the creative industries. It is relatively raw and simple. It appears a bit industrial, which fits the surroundings. It is also oriented toward tenants who come from the creative sector. Natural materials were used, and the building has the label Minergie P ECO. Although it is a ventilated-cooled building, it functions with a lower level of technology. Many components are standardized, and therefore they are readily replaceable. For example, radiators are out in the open and easy to maintain. Window sashes can be opened, which

allows for natural ventilation, and ventilation control is not pushed to its limits but, rather, is optimized.

The main advantages of low-tech buildings are easy control of their operations, easier maintenance and lower maintenance costs. There were no special challenges encountered with low-tech buildings; however, there is no experience with radical low-tech buildings.

A target group is defined by the location of the building and rent prices. The expectation is that the price level is lower: “A low-tech building has to be built relatively simple and affordable, so that one can offer a low rent.” Low-tech does not appeal to a broad tenant clientele. There are other factors to consider, such as surroundings, outside areas and green spaces.

The advantage of the positive image of low-tech buildings is recognized in terms of finding tenants and with shareholders.

Key Economic Figures

The aim is to reduce additional costs so that net rent can be increased. However, one part of what is gained from reduction of additional costs is passed to the tenant. Therefore, both sides profit from lower additional costs. The net rent is approximately 5–8% higher. The costs are lower compared to the rental income, which leads to slightly higher returns on investment of about 0.2%.

Life-cycle costs and usage costs are lower, due to the lower level of technical infrastructure. Renewal measures are less frequent and not comprehensive. It was difficult to estimate the value of the reduction of these costs.

Low-tech buildings are better appraised, because of their longevity, due to stretched renovation cycles, which ultimately places a higher value of low-tech buildings.

It is more expensive to build and renovate a low-tech building, because of the development of optimized technology with planners. However, the savings are obtained later in operation, therefore there is a willingness to invest more in the planning phase of low-tech buildings.

Tenants are willing to pay more for basic rent and the building’s image, but less for maintenance costs. In general, rental potential is better because marketing is better.

3.3.4 Bank B

The interview with the fund manager was conducted on July 30, 2020. The bank's portfolio consists of mostly newly constructed buildings.

Basic Information on Strategy and Investment

There is a sustainability strategy that was, at the time of the fund's creation, based on the Minergie label and today includes standard for sustainable building in Switzerland (SNBS), leadership in energy and environmental design (LEED) and others. There is no explicit strategy for low-tech buildings, but an investment in low-tech buildings would be in accordance with the existing sustainability strategy. Low-tech buildings are understood to be radically low-tech like 2226.
An investment in low-tech buildings has not yet been realized. One reason is that, as a publicly traded real estate fund, they can enter such a project only if it has a legally binding building permit, at which point it has already been decided if the building will be low-tech or not. However, developers are not offering projects with low-tech buildings, probably because by investing in low-tech buildings they would narrow potential buyers. Moreover, there are simply no low-tech buildings on the transaction market for institutional investors, which makes these investments impossible to execute. If that was not the case, Bank B would invest in them, depending on the usage. When investing in a commercial property, it would be necessary to have a tenant with a (for example) ten-year lease, because there is uncertainty when investing in a special building. Therefore, if the question of a tenant is solved, it would reduce the risk of not renting it. Residential use is less risky, so investing in it would be easier.

Many aspects are considered in the decision-making process. One is monetary; Bank B cannot buy at a higher value than the estimation allows. Sustainability aspects are examined. Generally Bank B removes the need for fossil fuels and adds photovoltaics. Other important elements are the location and connection to public transportation, as well as construction methods for the building (which should have a sustainable approach) and social aspects in the form of mixed use.

The main reasons for investing in low-tech buildings would be to save energy. In general, there is an opinion that one needs to try to get by with less technical equipment. The bank is currently approaching an investment in low-tech buildings in a broad way: "We are generally looking for interesting investments. […] We are looking for sustainable real estate projects, and that includes low-tech buildings."

The Potential and Challenges of Low-Tech Buildings

The bank has no experience in investing in low-tech buildings. The advantage of low-tech buildings is seen in lower operating costs, both in consumption and maintenance, as well as higher net rent. There were no encountered challenges in radically low-tech buildings. However, in renovation there could be technical problems; for example, sometimes radiators and oil heating cannot be exchanged with a heating pump. In renovations, social problems also occur when newly renovated houses are more expensive and difficult for the tenants to afford.

Key Economic Figures

There is no experience to determine the gross rent for low-tech buildings. However, it is assumed that net rent could be higher, because tenants pay the same gross rent and additional costs are reduced. According to a study from Wüest Partner AG, there is a willingness to pay more for Minergie buildings. There is a distinction between residential and commercial tenants. Residential tenants expect that a new building is sustainable, but there is no willingness to pay for it. Large corporations, however, prefer sustainable buildings. In the portfolio, Bank B has a building occupied by international company that is LEED certified. The lable is beneficial for the public image and marketing purposes, but generally the location must be right and the rent must not be too high.

It was difficult to assess the return on investment, but it is expected to be the same as for a standard building. Life-cycle costs and usage costs are expected to be lower. Operating costs of a low-tech building that does not require much building technology (or practically none) would have to be noticeably lower.

There are no references to determine if investment in low-tech buildings is higher or lower compared to standard building. Investment decisions are based on the life-cycle costs. There is a willingness to pay more for planning and construction if the building is inexpensive in the long term.

For a vacancy rate and market absorption, low-tech is not as important as other criteria such as location.

3.3.5 Pension Fund A

The interview with the head of real estate was conducted on August 12, 2020. The pension fund's portfolio is focused on residential buildings.

Basic Information on Strategy and Investment

Pensions fund A is working on its sustainability strategy, which will be published in 2021. Although there is no fixed strategy, the question of sustainability is always present in their investments. Low-tech is considered a very interesting topic. The new strategy will answer the question of what standards and requirements will be put on the building in general and for low-tech. One of the important points that is in the revision is the earliest possible time to enter an investment. Currently, the pension fund invests in a project that already has a legally binding building permit, which is seen as quite late. Developers also appreciate it if an investor can start earlier in the project and thus also take a part of the risk.

Pension fund A has never made an investment in a low-tech building because there are no such buildings on the market for institutional investors and no new project developments have been offered to them. However, such an investment is a possibility in the future under the condition that the pension fund enter a project sooner or if low-tech buildings become accessible in the market.

An approach to investment is made from a long-term point of view. A building must maintain its value in the long term, which is expected if sustainable and economic requirements are met. The aim is to invest in a building that is durable, has low operating costs and has sustainable energy sources.

The Potential and Challenges of Low-Tech Buildings

The pension fund lacks experience in the implementation of low-tech buildings; however, recognized advantages includes lower maintenance and operating costs, as well as stable property value.

The pension fund invests mostly in residential real estate, whose tenants are the target group. Some tenants are sensitive to sustainability, while others do not put value in it. However, an advantage for everyone is a property with lower additional costs.

The advantage of the positive image of investments in sustainable and low-tech buildings was not recognized, but neither were the disadvantages. For Pension Fund A, this is a question of attitude; they want to invest in low-tech buildings out of conviction:

> “Of course, if we can still collect plus points for our image, all the better. First and foremost, it is a question of attitude, and for us this means that

> we have stable earnings over the long term and correspondingly stable performance. And low maintenance and operating costs. That is the goal. And then everyone wins: we and the environment."

Key Economic Figures

Return on investment is expected to be lower, and gross rent is expected to be at the level of the market rent. The advantage is seen in lower additional costs. Considering that for the tenant the gross rent is decisive, which is in relation to the market environment, lower additional costs would give an investor additional room to increase their net income.

It is assumed that it is expensive to invest in low-tech buildings in the planning phase because planners are not yet established. There is pioneering work with a great deal of time and effort invested, which leads to additional costs in the planning phase. In the implementation phase, one would also have to consider higher costs. They would be willing to accept higher costs for the planning and construction phase. The benefit would be in lower life-cycle costs and usage costs.

A difference in the vacancy rate in the low-tech buildings is not expected because this depends on the rent level. It is expected that, for the first time letting and re-letting is needed longer period of time, because tenants of low-tech buildings need additional explanations in how the buildings are used.

3.3.6 Shareholder Company B

The interview with the head of development was conducted on August 24, 2020. The company's portfolio is focused on office and commercial properties.

Basic Information on Strategy and Investment

There is a strategy to invest into sustainable buildings, which is guided by the criteria of the SNBS, based on which they made object-specific requirements. This applies to new buildings. In renovations, special attention is placed on the reduction of CO_2 emissions.

There is no special strategy to invest in low-tech buildings. Those investments are made intuitively at the building level. In the future, the company plans to define a standard that will be incorporated into overall project requirements. Currently, they are gathering experience with two low-tech systems to understand them better, to see what functions better and if they can take something from both and merge them into one.

When investing in low-tech buildings, aside from location, the condition of the building, rent and usage, fit-out is taken into consideration. A correlation between basic and tenant fit-out is one of the most important criteria because it helps to formulate the product according to market conditions.

The company invests in low-tech buildings because then they are more flexible in terms of the building and noticeable changes. In comparison to other buildings, here one can adjust during operation at a later date according to tenants' needs. This is one reason to invest in low-tech; the other reason is to keep life-cycle costs and operating costs as low as possible.

The Potential and Challenges of Low-Tech Buildings

Shareholder Company B has two low-tech buildings in its portfolio, which are named here low-tech building SC-B1 and radical low-tech building SC-B2.

In the low-tech building SC-B1, only what is necessary for a building to function was built in. It has an industrial design with a conventional façade and a heating system with a heating pump and district heating. However, the installation's type of ventilation systems (tempered room ventilation, which serves as cooling) is used only if certain parameters are right. There is also a separation between installations and the load-bearing structure of the building. Therefore, maintenance is much easier and cheaper. SC-B1 is a flexible building. A tenant can be flexible with the ground floor and in the height. One can create a false floor and thus have a mezzanine in case of increased space requirements.

The other low-tech building, SC-B2, belongs to the radical system, meaning there is no heating, cooling or forced ventilation. It is currently in a planning stage. SC-B2 is not as flexible as SC-B1, it is comparable to standard buildings. The ground floor is prepared for small, medium and large tenants with a good layout and conventional interior fir-out.

The main potential of SC-B1 and SC-B2 are life-cycle costs, which are considerably lower for SC-B2. For SC-B1, it was a challenge that, there was suddenly many office tenants who wanted to have air-conditioned space, therefore the building was retrofitted. The temperature in SC-B2 should not exceed 26°C, which is the highest temperature for which the system is designed because the building is completely without installations. This is also a challenge in terms of marketing and the lease agreement. If the value is

exceeded and the goal is not met from the perspective of a tenant, then it could, for example, lead to a rent reduction.

The target group is mixed. For SC-B2, demand are classic office tenants, while SC-B1 has a wide range of commercial tenants.

It creates a positive image to invest in low-tech buildings. There is an advantage in positioning in the market, which in turn contributes to the image of the company as a whole.

Key Economic Figures

Investing in a low-tech building is not more expensive. There is simply a difference in the relocation, according to the head of development: “So, if you are low-tech in your basic construction, then maybe the tenant improvements need to be more expensive.” This can be done through contribution to the tenant fit-out or an offer of a lower rent, so that the tenant's finishing work does not become too expensive.

There is a target return on investment the company wants to accomplish, which is comparable to other buildings. If the company builds inexpensively, then it creates added value for the tenant (for example, with higher fit-out allowance). Achieving an added value for the tenant is almost more important than achieving a higher return. However, there is a lower limit that the company would not cross.

The company aims for market rent, while the high of the net rent depends on the requirements of the tenant and the intersection between basic fit-out and tenant fit-out. This is quite different than in SC-B1 and SC-B2.

The forecast is that the life-cycle costs of SC-B2 are 30% lower than that of SC-B1 and 40% lower than that of standard buildings. SC-B1 is 10% cheaper than standard buildings.

The costs of the planning and building phase are the same as that for standard buildings, and there is no willingness to pay more for these phases. Costs are a result of factors such as return on investment, which depends on the costs and income, which is then dependent on the location.

It is not determinable if the low-tech buildings are better valued. The valuation is basically based on the net rent but not on the life cycle costs.

A tenant is hardly willing to pay more for a low-tech building. Tenants pay for the whole package, like very sustainable building, which is perhaps good for the company's image, and electromobility and similar.

Experience with vacancy rates is still limited. SC-B1 had good marketing, but first letting is comparable to other buildings. There is no difference due to the low-tech system. There is also effects[1] from COVID that one can see in the market; therefore, it is difficult to assume. One might even suspect that it will take longer to rent it out. Moreover, SC-B1 has very elaborate tenant fit-outs. The mezzanines are planned according to the tenant's specifications and must go through an individual approval process. There is one building application per tenant, which takes longer. In SC-B2, tenants can move in immediately, as ready-made rooms are planned. However, if the tenant wants changes, such as installing a tea kitchen, it will take a somewhat longer to move in.

3.3.7 Insurance B

The interview with the head of projects, east Switzerland, was conducted on August 26, 2020. The company's portfolio consists predominately of residential buildings.

Basic Information on Strategy and Investment

The company is working on a sustainable strategy, but there is a statement on sustainability in its annual report because capital investors fund sustainable investments. There is no strategy to invest in low-tech buildings.

There are two reasons for not investing in low-tech buildings. On the one hand, low-tech was never offered to them by any developer, and on the other hand, their own developments have not yet gone so far as to give specifications to the planner that they want a low-tech building. The company simply has not reached that point for investing. The question then is, what is a low-tech building? It would be much easier if there was a label to provide with a standard for a low-tech building.

In the decision-making process for investments, the return on investment is the key factor. The market, the project and the price are decisive when deciding for or against an investment. Low-tech per se is not a factor for or against the investment. However, the company is trying to keep operating costs low, and they are convinced that low-tech building would enable this.

[1] The COVID effect was caused by the corona virus and because of the lockdown, which affected commercial property renting.

One recognized problem with low-tech is that it is not a protected term. If there was a low-tech label, it would set a standard with binding requirements. This would describe a product, and planers could be commissioned to plan according to it. A label would also allow evaluation of the project based on given criteria and toward other buildings. A label, in general, enables the company to carry out developments in an exemplary manner and stand out from of the competition.

Potentials and Challenges of Low-Tech Buildings

There is no experience with low-tech buildings, but expected advantages are low operating costs and ecological principles. The main challenge is that tenants will not understand the principles of low-tech buildings.

Demand are those who have an understanding of this technology. Tenants need to be in an accordance with the philosophy of the building. In the commercial sector, there is a specific target group that could appreciate this innovative building. Low-tech might also be a part of a company's strategy. This would be difficult with private tenants.

Key Economic Figures

Return on investment is expected to stay the same, as well as gross rent. Additional costs should be lower, and net rent should be higher because the construction costs are expected to be higher. Planning costs are expected to be higher simply because the planning phase is more complex, and planners are less experienced. Life-cycle costs and usage costs are expected to be lower. There is a willingness to pay more for planning low-tech buildings because planning costs are calculated out of construction costs.

3.3.8 Insurance C

The interview with the head of asset management, real assets was conducted on August 26, 2020. The company's portfolio is split between residential and commercial buildings, with a focus on cities.

Basic Information on Strategy and Investment

There is a sustainability strategy to reduce CO_2 emissions to net zero by 2050. The aim is to secure the value of the properties because in the future properties that are not net zero will become illiquid. There is no current or future strategy to invest in the low-tech buildings.

When deciding on an investment, they generally check the location, the object (quality of the floor plan, apartment mix, etc.) and the energy concept. The main reason they do not invest in radically low-tech buildings is because there is simply no market for it. If there was a market and factors such as location and use would fit, they would invest in a low-tech building. The head of asset management is of the opinion that "If a low-tech building can also meet the needs of the users and is economically more attractive, also in terms of management and maintenance, then we would certainly invest in low-tech buildings." Generally, they prefer not to install too much building technology, but they build according to the wishes of the tenants. If a tenant is an international company that has a high demand for ventilation systems, then they provide it. It was pointed out that there is a comparison missing between standard and low-tech buildings to learn the advantages of low-tech, which would influence the investment decision.

The Potential and Challenges of Low-Tech Buildings

There is an opinion that the potential market for low-tech buildings is in renovation, because institutional investors have very old real estate holdings and they have to renew them, due to federal and cantonal CO_2 reduction requirements and to meet the demand of capital investors, who ask about sustainability and CO_2 emissions.

There is no experience in implementing low-tech buildings, but recognized advantages are that they are inexpensive and more sustainable because they emit less CO_2. It is expected that the management of a building also requires less effort. No challenges were encountered with radical low-tech buildings, but an anticipated challenge is to get the greatest utilization out of a plot due to tick walls and that the needs of the user could be affected, such discomfort due to temperature oscillations in an office.

The target group for low-tech buildings is the office sector in industrial areas, as well as in urban areas, if a building can provide the same comfort as other buildings. The target group approaches sustainability in various ways. Office tenants (for example, from large corporations) have their own sustainability strategies, while other tenants simply look at the additional costs. Residential tenants focus solely on gross rent. Ultimately, both tenant and landlord have nothing to gain from additional costs, and therefore both are interested in reducing it. Another substantial target group are capital investors. There is a need to invest in sustainable buildings and demonstrate this in portfolios because capital investors invest in portfolios with sustainability standards.

Key Economic Figures

A lower return on investment is expected and would be accepted because low-tech buildings meet the highest sustainability requirements and the value on the market remains more stable in the long run than that for standard buildings. It is assumed that the building quality is higher due to a high-quality building system. The purchase price would be higher if return on investment is lower.

Gross rent depends on the standard of the fit-out, as well as location and competition in the same area. With lower maintenance costs, net rent would be higher. The company already has experience with a building that has lower additional costs and higher net rent. However, tenants are probably not prepared to pay a higher gross rent for a low-tech building compared to a conventional building.

Life-cycle costs are expected to be lower, and the same is true for usage costs, due to a lower level of building technology and higher-quality materials. Planning costs should be lower due to fewer building services. Construction costs are expected to be lower because less interior work and fewer building services are needed. A willingness to pay more for the planning and construction of such a project depends on the return on investment. The market value after completion minus construction costs, financing costs and so on is decisive.

The vacancy rate depends on many factors. Market absorption is expected to be better, and therefore renting should be easier if everything meets the needs of a conventional building and the low-tech building meets the highest sustainability standards.

4. Comparative Analysis of the Results and Discussion

Institutional investors do not define low-tech buildings in a unique and unambiguous way. For three investors, for Bank A, Bank B and Insurance C, the concept of low-tech is a building without building technologies, such as 2226 in Emmenbrücke by Baumschlager Eberle Architects. For other investors, low-tech buildings are fitted with as few technical standards as possible. From the interviewed institutional investors, two shareholder companies have low-tech buildings with a minimal level of building technology, and one company is planning a radical low-tech building.

4.1 Comparative Analysis of General Information on Strategy and Investment

Inst. Invest.	Sustainability strategy	Low-tech building strategy	Future plans to invest in low-tech building
BA-A	yes	no	Yes. They want to learn more about it through their experience
IN-A	yes	no	There are no specific plans to invest in low-tech buildings, but if the product is in accordance with the target group, then they would invest
SC-A	yes	no	Yes, depending on the location, tenant's needs and the building
BA-B	yes	no	Yes. If there were such buildings available on the market, depending on the use, then they would invest in it
PF-A	coming in 2021	no	Yes, if they enter the project in the development stage or if it becomes available on the market
SC-B	yes	no	Yes. They will define certain standards that will enter the project requirements
IN-B	work in progress	no	There are no specific plans to invest in low-tech buildings
IN-C	yes	no	Yes, if there was a market for it and if other criteria such as economical aspects and user needs are meet

Table 3: Comparison of strategy and future investment plans

All institutional investors, except two, have a sustainability strategy to address a net-zero target. They want to reduce CO_2 emissions by 2050 according to Swiss climate policy and the CO_2 Act. The focus is to remove fossil fuel heating and to use renewable energy sources in buildings. Two investors who have no sustainability strategy are working on developing their strategies and are currently intuitively investing in sustainable buildings. It was pointed out that a larger problem than new buildings are old buildings that need to be renewed to meet sustainability demands and CO_2 emission reductions. All institutional investors, except Insurance B whose representative lacked the experience to make a judgment, recognized low-tech buildings as adequate to addressing the problem of climate change.

Aside from national policy to reduce CO_2 emissions, an argument in favor of investment in sustainable buildings is that capital investors are increasingly looking for opportunities to invest in sustainable portfolios. Labels help to make portfolios more transparent and easier to compare to one another. Some companies, especially international companies, have internal sustainability strategies that result in a desire to rent a building with a label. Such companies are willing to pay more to be in such a building. Labels also define a certain building standard. Three of the interviewed investors, those from Bank B, Insurance A and Insurance B, have a strong label strategy.

Table 3 shows the main criteria for the decision-making process when deciding on an investment. The main criteria are economic components, sustainability, as well as location and the building (usage, ground floor, condition of the building, potentials for renovating, etc.). Two investors pointed out the importance that the product must be in accordance with demand. In the opinion of the author, all investors are looking at the same elements in investment decisions; however, due to the open interview questions and the direction of the individual conversations, some differences resulted.

As shown in Table 4, among the eight investors, only two invest in low-tech buildings. Others were asked why they do not invest in low-tech building. Four investor pointed out that there are simply no such buildings on the transaction market for institutional investors. An additional problem for Bank A, Bank B and Pension Fund A is that the earliest they can enter a project is with a legally binding building permit, by which time the type of building has already been decided. Pension fund A is in the process of making their strategy, and one of the strategy's main points is determining the earliest moment they can enter an investment. They aim to have the ability to enter a project

sooner. They thus plan to share the risk with the developer and have the ability to decide on the building sooner in the process. Bank A is looking for a way to invest in low-tech through renovations and new replacement building.

Another reason not to invest in low-tech buildings is that developers do not offer them, as pointed out by four investors. There is an opinion that developers do not offer low-tech buildings because in this way they do not shrink the group of interested buyers. Basically, there are no low-tech buildings on the market and no such projects are being offered by developers.

The interviewee from Insurance B pointed that they would prefer to invest in a building with a label tor know the standard of the building and to be transparent with the tenant and capital investors. The reasons why Insurance A is not investing in low-tech is due to large group of tenants that often ask for substantial air exchange in rooms, as well as due to regulations that, for some usages, need a large air exchange.

There is also an underlying reason for not investing in low-tech buildings, which is the lack of experimentality in investments made by institutional investors, due to too many unknown aspects of such buildings.

Two investors that invested in low-tech buildings are shareholder companies that did not have any legal limitations such as those held by Bank A, Bank B and Pension Fund A. The advantages of low-tech buildings are lower costs and easier control of a building's operation. Buildings SC-A1 and SC-A2 are products developed to fit the needs of the target group.

Generally, there is a quite positive attitude toward low-tech among investors. Two shareholder companies will continue to invest in low-tech buildings: one depending on the location and users' needs, and the other depending on what it learns from two low-tech systems they invested in. With this later company, based on the knowledge they gain, they will define the standards for the building requirements. Bank A wants to invest in low-tech in order to learn about it from experience. However, that is only possible with renovation or by investing in new replacement building. Five investors pointed out that they would invest in low-tech if the product was available on the market and if other criteria are meet, most of all if the product is in accordance with their target groups. Among these five, three showed more interest in investing in low-tech buildings. One insurance investor has no specific plans to invest in low-tech

buildings; he would prefer to know more about them and have a label so that low-tech could be standardized and more approachable for those with a strong label strategy.

Inst. Inves.	Realized low-tech buildings	Main elements in decision-making process	Main reasons for current investment in low-tech buildings
BA-A	no	• economic components • sustainability • product in accordance with demand	• lack of low-tech buildings in the transaction market for institutional investors • lack of low-tech projects offered by developers
IN-A	no	• economic components • sustainability • location and object	• majority of tenants need large air exchange (office and commercial tenants) • regulations that say that, for example, a restaurant needs a certain amount of air
SC-A	SC-A1 SC-A2	• economic components • sustainability • location and according to demand	• low maintenance costs • easy control of operation • product fit location and target group
BA-B	no	• economic components • sustainability • location and object (user mix)	• lack of low-tech buildings in the transaction market for institutional investors • lack of low-tech projects offered by developers
PF-A	no	• economic components • sustainability	• lack of low-tech buildings in the transaction market for institutional investors • lack of low-tech projects offered by developers
SC-B	SC-B1 SC-B2	• economic components • location and object • correlation between basic and tenant fit-out	• in the case of SC-B1, flexibility of building and in terms of needs • low life-cycle costs
IN-B	no	• economic components market and project	• lack of low-tech projects offered by developers • lack of experimentality in investment • prefer a label
IN-C	no	• sustainability • location and object	• lack of radically low-tech buildings in the transaction market for institutional investors

Table 4: Comparison of current investment approach to low-tech buildings

4.2 Comparative Analysis of Potential and Challenges

Investor	Experience	Potential	Challenges
BA-A	no	• expected lower costs • sustainability • higher net rent	• to learn more about low-tech and find ways to invest in it
IN-A	no	• expected lower costs • sustainability	• none encountered, but tenants (offices and commercial) in cities pay high rents if they rent in a building with many building technologies • tenant restrictions – low-tech buildings are not perceived as comfortable • regulation for certain usage (for example, restaurants)
SC-A	yes	• lower costs • higher net rent • easy control of operation of the building • positive image helps finding tenants and in front of investors	• nothing spatial in comparison to other projects • (there is no experience with radically low-tech buildings)
BA-B	no	• expected lower costs • higher net rent	• none encountered, but in renovation there could be technical problems when changing heating systems • certain segments of commercial tenants are not suitable for such buildings (for example, laboratories)
PF-A	no	• expected lower costs • higher net rent • keeping the value of the property stable	• in renovation, there could be technical problems
SC-B	yes	• lower life-cycle costs	• sudden need for air conditioning
IN-B	no	• expected lower costs • sustainability	• tenant will not understand the principles of the building
IN-C	no	• expected lower costs • sustainability	• greatest utilization out of a plot • needs of user – temperature comfort

Table 5: Comparison of potential and challenges of low-tech buildings

Table 5 shows that the main potential of low-tech buildings is sustainability and expected lower costs. Three investors expect higher net rent as well. One shareholder company that has experience with low-tech sees the main advantage as being lower life-cycle costs. Meanwhile, another company with experience recognizes multiple benefits: lower costs and easy control of the operation of the building, higher net rent and a positive image, which is beneficial when finding tenants and when attracting company's shareholders.

Among the expected challenges are concerns that in the renovations there could be problems when implementing low-tech systems on existing building technologies and building types; however, the greatest concerns are with tenants. Some usages that have a high need for building technologies (for example, laboratories) are recognized as not suitable for low-tech buildings. Office tenants in city centers are renting buildings with a high level of air conditioning, and therefore, such buildings must be equipped with substantial building technologies. Low-tech buildings are not perceived as comfortable, and thus demand is restricted. There is also concern that radically low-tech buildings do not get the greatest utilization out of each plot and that tenants simply will not understand the principles of the building. In SC-B1, a challenge arose with the sudden need for air conditioning, which resulted in the retrofitting of the building. Shareholder Company A did not encounter any specific challenges with low-tech buildings.

Demand is recognized by four investors as originating from those with an affinity for sustainability. The interviewee from Insurance B pointed out that prospective tenants should understand the philosophy and how building functions. The interviewee from Insurance A described a tenant as one who is flexible and accepts that it might be somewhat warm in summer and cold in winter. The interviewee from Bank B sees urban audience as a source of demand. The interviewee from Pension Fund A sees demanding originating from residential tenants, and the interviewee from Insurance C sees a demand for offices. The interviewee from Insurance B sees a narrow target group within the commercial sector but thinks it would be difficult with a residential tenant. There is a great variety in potential demand. Shareholder Company A allow the location of a building and rent prices to define demand. In their case, that are people form creative field, who are flexible in regard to temperature in the building and have lower gross rent. Shareholder Company B has in SC-B1 a wide range of commercial tenants, while for SC-B2, classic office tenants are expected. Shareholder Company B aims to achieve a market rent.

According to investors who have no experience with low-tech buildings, a vacancy rate would not be affected in any way by low-tech buildings. Vacancy rate depends on location, connection to public transportation, competitors in the area and other factors. Market absorption, according to three investors, also depends on other criteria. Two investors expect longer market absorption, while one would expect better and easier renting. The interviewee from Shareholder Company B still does not have enough experience to judge. Building SC-B1 had effective marketing, but there is no difference in comparison with other buildings, and currently there is the COVID-effect, which slowed everything down. SC-B1 might take longer to rent due to elaborate tenant fit-outs that partially need to go through an individual approval process. In SC-B2, tenants will be able to move in immediately. The experience of Shareholder Company A is that vacancy rate and rental potential are both better in low-tech buildings.

4.3 Comparative Analysis of Key Economic Figures

On the question of whether low-tech buildings are better appraised, five investors replied that low-tech buildings are either not better appraised or that this is not possible to determine. Among those is Shareholder Company B. One investor thinks that the appraisal could be higher due to lower costs and greater demand for sustainable buildings in the future. Another investor thinks that low-tech building should have lower returns on investment and thus an automatically higher appraisal value. The interviewee from Shareholder Company A said that low-tech buildings are better appraised because of longevity, which enters the renovation cycles, considering they are stretched that ultimately values a low-tech building higher.

Table 6 shows the comparison of key economic figures. On the question of whether higher returns on investment can be expected, two investors replied that they cannot assess this, two expected returns to stay the same and two expected returns to be lower. One investor with experience said that returns on investment are comparable to other buildings. Another had a slightly higher return on investment.

Five investors without experience expect gross rent to stay the same, and Shareholder Company B is with their low-tech buildings aiming for market rent. One investor with no experience expects lower gross rent, which Shareholder Company A found in its experience. All investors expect lower additional costs, but only four investors would expect a higher net rent, while one investor would expect lower net rent and one thinks it depends on the location. Shareholder Company A has had experience with a higher net rent by about 5–8%, and Shareholder Company B could not give a percentage

Inst. investor	Return on investment	Rent	Life-cycles costs	Planning and const. costs	Usage costs
BA-A	cannot be assessed	gross rent is the same; additional costs lower; net rent higher	expected to be lower	no experience, but constr. costs could be higher	expected to be lower
IN-A	cannot be assessed	gross rent is lower; additional costs lower; net rent depends on location	expected to be lower	expected to be lower	expected to be lower
SC-A	slightly higher, ca. 0.2%	gross rent is lower; additional costs lower; net rent is ca. 5-8% higher	lower	higher	lower
BA-B	expected to be the same	gross rent is the same; additional costs lower; net rent higher	expected to be lower	planning costs are the same	expected to be lower
PF-A	expected to be lower	gross rent is the same; additional costs lower; net rent higher	expected to be lower	expected to be higher	expected to be lower
SC-B	comparable to other buildings	aim is market rent for gross rent; net rent depends on the requirements of the tenant and the intersection between the basic fit-out and tenant fit-out	Yond 10% lower than standard building JED 2 40% lower than standard building	remain the same	lower
IN-B	expected to be the same	gross rent is the same; additional costs lower; net rent lower	expected to be lower	expected to be higher	expected to be lower
IN-C	expected to be lower	gross rent is the same; additional costs lower; net rent higher	expected to be lower	expected to be lower	expected to be lower

Table 6: Comparison of key economic figures

because it depends on the tenant and the intersection between the basic fit-out and tenant fit-out.

When it comes to expectations for life-cycle costs and usage costs, investors are unanimous and expect lower costs, which is the experience of Shareholder Company A and Shareholder Company B. Shareholder Company A could not provide an accurate percentage, but Shareholder Company B expects 10% lower life-cycle costs for SC-B1 and 40% lower life-cycle costs for radically low-tech bundling SC-B2 compared to standard buildings. Three investors expect higher planning and construction costs, two expect lower costs and one expects the costs to stay the same. The experience of Shareholder Company B is that costs are the same, while Shareholder Company A had higher planning and construction costs.

On the question of whether investors are willing to accept higher costs for planning and construction, two investors replied positively, that they would invest more if the building were cheaper in the life-cycle costs. For two investors, this depends on the return on investment. If planning and construction costs are higher, then there should be a balance with higher rent. Shareholder Company B was not willing to pay more for the planning and construction phase, while Shareholder Company A was willing to invest more.

5. Conclusion

The aim of this research was to understand the potential and challenges of low-tech buildings from the perspective of institutional investors, as well as offer a deeper understanding of the motives behind investment in low-tech buildings and of strategies for the future. This thesis provides answers to all research questions.

5.1 Discussion

Definition of Low-Tech Buildings

Institutional investors do not define low-tech buildings in a unique and unambiguous way. According to Haselsteiner et al., a sustainable low-tech building is a building that uses a low level of technology over its entire life cycle. It needs ecological, economic, social and cultural aspects in sufficient and balanced proportion to each other. Buildings are analyzed individually to examine low-tech elements.

There is a substantial difference between low-tech buildings with a low level of technology and those completely without heating, cooling and ventilation. This seems to be a point of confusion for institutional investors. Some understand low-tech as simply indicating a lower level of building technology, use of renewable energy and easy operation of the building, while for others, it is clear that low-tech buildings use a radically low-tech system, such as 2226 from Baumschalger Eberle Architects.

There is a need for categorization of low-tech buildings, which would provide a common base for discussion. Research has shown that there is a need for a low-tech label, which is another reason for categorizing low-tech buildings. A label could provide building standards and transparency for tenants and for capital investors; they are recognized as substantial demand as they increasingly invest in sustainable portfolios.

Strategy for Sustainable and Low-Tech Buildings

Institutional investors have sustainability strategies to address net-zero targets or they are intuitively investing in sustainable buildings. Furthermore, all investors, except one who lacked the experience to make a judgment, recognized low-tech buildings as adequate to contribute to tackling climate change.

The main criteria in the decision-making process are economic components, sustainability, location and the building, as well as a product that is in accordance with demand. Furthermore, the acknowledged potential of low-tech buildings is

sustainability, expected lower costs and higher net rent, basically the same advantages as pointed to by Ritter, Haselsteiner et al., Pelzeter and others. Given these advantages, the next logical question is, why do institutional investors not invest in low-tech buildings?

From the interviewed investors, only two have experience with low-tech, who pointed out that low-tech buildings have lower costs and are easier to control through their operation. Investors who do not invest in low-tech buildings identified as a main reason that there are no such buildings on the transaction market for institutional investors and no such projects are being offered by developers. Other mentioned reasons were a lack of labels and target group that just do not fit low-tech buildings.

There is also an underlying reason for not investing in low-tech buildings. It seems that private individuals, cooperatives and municipalities are more prone to invest in what is often called an experimental project. There are too many unknown aspects of such buildings from the perspective of an institutional investor.

The Potential and Challenges of Low-Tech Buildings

The main challenge, according to investors with no experience, is demand. Low-tech buildings are recognized as not adequate for usages that require a great deal of building technologies, which shrinks the target group. For radical low-tech, it was pointed out that it might not be understood by tenants. Demand is recognized as originating from those who have an affinity with sustainability and those who are flexible and can accept that it might be somewhat warm in summer and cold in winter. Investors with experience witnessed a multiplicity of commercial tenants, classic office tenants and those from the creative sector were identified by one investor.

In low-tech buildings, the temperature does fluctuate during the year. In 2226, the temperature is between 22°C and 26 °C, while in Gewerbehaus Gasser in Chur, the temperature was measured at a maximum of 28.0°C (for winter, there is pellet stove). These buildings do not have the same inner temperature during the whole year. However, the investor of Gewerbehaus Gasser pointed out that main advantages of the building are a pleasant indoor climate, very low operating costs and an easy construction process. To some extent, this statement corresponds to the recognized main potential of low-tech buildings from the perspective of institutional investors, which are sustainability, lower costs and higher net rent. Yet this also highlights that one should be ready to accept that there is a temperature fluctuation during the year.

Key Economic Figures

Investors without experience had a different view of the expected return on investment, but those who have experience with low-tech have had a return on investment comparable to that of other buildings.

Gross and net rent are not viewed the same by all investors, but all expect lower additional costs. One investor involved in low-tech has lower gross rent, but higher net rent by about 5–8%, due to lower additional costs. While another investor expects market rent, he could not identify the difference in net rent because this depends on the tenant and the intersection between basic fit-outs and tenant fit-outs. If the basic fit-out is minimalistic, they add up in other ways, for example, contribution to the tenant's fit-out.

There was a variety of opinions about return on investment and rent, but when it comes to costs, investors are of the same opinion, with exception of planning and construction costs.

All investors expect lower life-cycle costs and usage costs, which is the experience of Shareholder Company A and Shareholder Company B. Shareholder Company A could not provide an accurate percentage, but Shareholder Company B expects 40% lower life-cycle costs for SC-B2 and 10% lower costs for SC-B1 compared to standard building.

Lower costs have results in Gewerbehaus Gasser, the residential building with ateliers in Basel and in 2226. Pelzeter calculated 43% lower life-cycle costs for a massive building based on the 2226 principles in comparison to a standard building with a thermal insulation composite system façade.

The difference in planning and construction costs is expected quite differently. The experience of Shareholder Company B is that costs are the same, while Shareholder Company A had higher planning and construction costs, as demonstrated in Ritter's research. On the question of whether investors are willing to accept higher planning and construction costs, investors that are looking at benefits from lower life-cycle costs were willing to accept higher planning and construction costs, while those for whom return on investment is decisive were not so convinced.

When asked about vacancy rate, investors without experience expect that it would not be affected by low-tech. Regarding market absorption, opinions were quite different.

Shareholder Company B still does not have enough experience to judge, but Shareholder Company A experienced a better vacancy rate and rental potential.

Summary of Experience of Institutional Investors with Low-Tech Buildings

Shareholder Company B invested in two different low-tech systems with the aim to learn from them. They set return on investment as comparable to that of other buildings. They are aiming at market rent, and planning and construction costs stayed the same. At the same time, usage costs are expected to be lower and life-cycle costs are expected to be 10% lower for low-tech building and 40% lower for radically low-tech building. Furthermore, there is no limitation with the demand.

Shareholder Company A developed a product that perfectly fits the target group. As a result, buildings are popular and fully rented out. The location of the building defined the target group, and the product was developed. Shareholder Company A is profiting from a net rent 5–8% higher and lower usage life-cycle costs. Planning and construction costs were higher than those for standard buildings. Similarly, the residential building with ateliers in Basel was developed for a specific target group, which resulted in great popularity for the building. Although it is not possible to compare these buildings completely, because the aim of the cooperative is not profit, both cases argue in favor of developing a product for a specific group, even a small one.

5.2 Prospects for Implementation of Low-Tech Buildings

Research has showed that both the scientific community and institutional investors perceive low-tech buildings as sustainable and inexpensive throughout their life cycles. For these reasons, there is a quite positive attitude toward low-tech buildings among investors. Two shareholder companies will continue to invest in low-tech buildings, one investment fund is eager to find a way to invest in low-tech and four other investors pointed out that they would invest if the product was available on the market and if it fit their target groups. One investor has no specific plans to invest in low-tech buildings; they would prefer a label for a standardize building.

Currently, there is very limited experience with implementation of low-tech buildings among institutional investors, but the results of this research suggest an increase in implementing low-tech buildings in the near- to medium-term future.

5.3 Future Research

This research is first of its kind and it opened some questions which could be the basis for future research:

- Institutional investors do not have much experience in the implementation of low-tech buildings, but they have much interest in investing in such buildings. It would be interesting to conduct the same research in 5–10 years simply to see what will have changed in the market and what will have been experienced by Shareholder Company B with radically low-tech building.
- This research has shown the need for the low-tech label, which should be based on the categorization of low-tech buildings. This would also help to reduce confusion about what low-tech buildings are.
- During the research, it became clear that institutional investors perceive low-tech buildings as experimental buildings. It would be interesting to examine what have been the experience of other experimental buildings and systems and how did they enter the mainstream.

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6. Appendix 1

Interview Questions

General Information

Do you have a strategy to invest in sustainable buildings? Do you have a strategy considering Net-Zero Objectives?
Do you have a strategy to invest in low-tech buildings? What do you consider a low-tech building to be?
Why you do / didn't you make such investments?
What is considered in the decision-making process?
What are the main reasons in favor / against of acquiring / building / reconstructing a low-tech building?
How do you currently approach the realization of low-tech buildings and what are strategies for the future?

Potential and Challenges

What experience do you have in implementation of low-tech buildings?
What are the benefits?
What challenges did you encounter?
Who is the target group?
Is there an advantage in building low-tech buildings, regarding sustainability and climate change?
Is there any advantage with a positive image if you build sustainable and low-tech building?
What did the marketing process look like, from research of the target group all the way to renting it out?

Economic Key Figures

Is the rent lower / higher for tenants? (gross and net rent)
Do you realize a lower / higher return on investment?
Are low-tech buildings better evaluated?
Are life-cycle costs higher or lower?
Are usage costs higher or lower?
Are planning and construction higher or lower?
Is there a willingness to pay more for planning and construction to receive a project that is not made according to mainstream criteria?
Is there a difference in the vacancy rate of low-tech buildings in comparison to other building types?
Do you need shorter/longer time to rent low-tech buildings for the first time and to rent them out afterward?

Declaration of Honor

I hereby confirm that I have personally prepared the present academic work on the topic of *The Potential and Challenges in the Implementation of Low-Tech Buildings by Institutional Real Estate Investors in Switzerland* and personally carried out the activities directly involved with it. I also confirm no resources other than those declared have been used. Every part of this thesis has been cited literally or analogously and has been clearly indicated in every single case through the indication of its source (including secondary literature).

This Thesis has not been presented in this or any similar form to any other examination Committee and has not yet been published.

Zürich, 21.09.2020

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Blanka Petrovčić