TECHNISCHE UNIVERSITÄT WIEN
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Master´s Thesis

The Impact of Building Certificates in regard to the implementation of relevant SDGs

using the example of Austrian Office Buildings

submitted in satisfaction of the requirements
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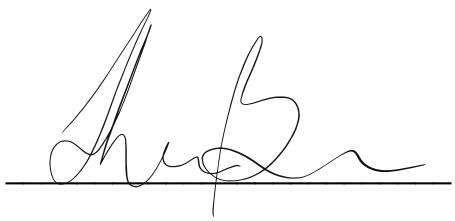

Hannah Backmeister

Prolog

Die folgende Diplomarbeit ist auf Grundlage des einjährigen Design Innovation Course an der Standford Universität entstanden. Für die tolle Zusammenarbeit, Unterstützung und Förderung danke ich daher dem gesamten ME310 Teaching Team, insbesondere Herrn Professor Alexander Redlein für die Betreuung und das Vertrauen. Überdies gilt mein besonderer Dank Teodora, Jan und Sophia, die die zahllosen Stunden zur Findung und Umsetzung der Prototypen freudvoll machten.

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Abstract

In light of this years´ 30th anniversary of the adoption of the United Nations Framework Convention on Climate Change, the world still faces a critical decade for climate action. Therefore, the Conference of the Parties (COP 27) deliberated on further initiatives to cut global emissions. (UN, 2022) Given the complexity where threats of climate change equally affect the "welfare, prosperity and integrity of people and the planet", COP27 promoted the 2030 Agenda once more. (EN, 2021, p. 3) Therefore, the thesis at hand focuses on interlinkages and interdependencies of relevant Sustainable Development Goals (SDGs), providing particular reference to the Austrian real estate sector. Hence, the compliance of two selected building certificates, ÖNGI and WELL, are elaborated, presenting their added value for all parties involved. In this regard, building certificates not only provide performance indicators (PIs) of a building's operation but also benefit the corporates' identity by highlight additional effort of businesses and developers. However, the ME310 prototype demonstrated once more that merely technical solutions do not achieve-long term sustainability if tenant´s intentions regarding sustainability have not been changed. (Biggio & Cortese, 2013) Discussing therefore the attitude-behavior gap, the contribution of green leases is also raised. Yet, the implementation of the 17 SDGs not only requires horizontal demand, but also vertical legislation. (Frantz, 2016) Therefore, the thesis finally considers Austrian legislation and European policy revisions by discussing ESG alignment of the theoretical comparison of GBS and the 2030 Agenda.

Key Words: SDG, 2030 Agenda, Austrian Legislation, Building Sector, Building Certificates, Sustainability, Health and Comfort, Workplace, Economy, Productivity

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1. Introduction

Stanford University's Design Innovation Course 2020 (ME310) introduced students with technical backgrounds to analytical limitations of Big Data. (Leifer, et al., 2018) Therefore, the yearlong ME310 project addressed strategic prototyping and the process of Design Thinking for broad industry challenges, empathizing various techniques for creative prompt solutions. (Domingo, et al., 2020) In this context, the Austrian Real Estate Consortium (AREC) asked for innovative approaches to the urgent topic of sustainability. Following the 2030 Agenda adopted by the United Nations (UN) in 2015, AREC identified three of the 17 Sustainable Development Goals (SDGs) to be particularly relevant in order to “ensure sustainable office buildings that prevent both environment and civil health” (Figure 1). In this context, the project requirement for energy-efficient buildings exceeds the obvious economic aspects of developers and integrates a high level of user comfort. (IFM, 2020)

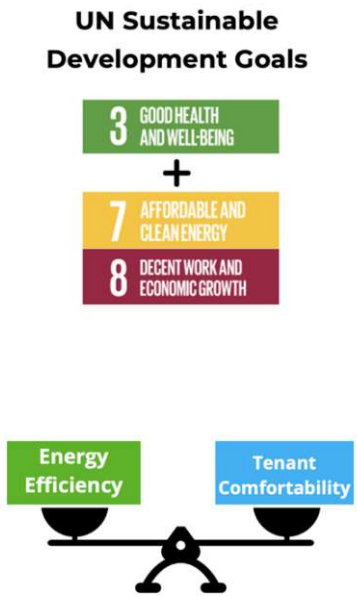


Figure 1: Two-folded project prompt of ME310, Team AREC (IFM, 2020)

Soon in the benchmarking and need finding process, however, the vast number of individuals and their different needs and work-related habits were recognized. Combining these individual interests with the interdependencies of environmental, economic and sociocultural sustainability, the complexity longed for an inclusive rather than dictating solution. (Biggio & Cortese, 2013) Accordingly, finance-led laws and policies (e.g., control mechanisms like tax adjustments) do not achieve long-term commitment of stakeholders, but cause social resistance and inertia. (UNEP, 2006) Therefore, economic models must rather incentivize intrinsic motivation and promote added value of adjusted behavior. Hence, all 193 UN member states adopted the so-called mainstreaming approach for the 2030 Agenda, which aims to achieve behavioral change through increased awareness and societal support (Jorgensen, 2022)

However, ME310 prototyping (see Chapter 3.4) reinforced once more that incentives only work for specific time frames. If habits are not changed within this period, old patterns exceed the “effect of the unknown and exciting” and invalidate intentions. Understanding therefore this causal chain of "laws are imposed" and "motivation is lost", the approach of the 2030 Agenda – to leave the implementation strategy to each country itself - safeguards national adaptions to the diverse conditions of European land and people but misses its binding leverage effect. (Breuer, et al., 2019)

1.1. Motivation

Considering the ME310 class assignment, research reinforced once more that the topic of sustainability is the most critical challenge our generation faces. Thereto, experts at the World Economic Forum 2019 questioned the anthropocentric dogma of the industrial mind (Kern, 2020, p. 132):

“I want you to act like the house is on fire,
because it is.” Greta Thunberg

Accordingly, human behavior is still the most poorly understood aspect of the climate change system. (Gifford, 2014) In this regard, literature addresses the attitude-behavior gap which decouples stated intentions and actual behavior. Findings therefor suggest that the more people form an intention to adopt to new resolutions, the more likely society actually implements long-term behavior change. (Claudy, et al., 2013) Hans Kern therefore connotes the “challenge of global warming” to “opportunities of global swarming”, promoting behavioral understanding of society´s underlying believes that have inherently caused the problem of climate change. (Kern, 2020, p. 1) In this context, the 2030 Agenda embodies the joint attempt to achieve what individual nations have not been able to do: the transformation to trifold sustainability and viability of its interdependencies.

In regard to the building sector, increased quality of building materials and construction regulations already halved the primary energy demand of Austrian buildings over the last half century. (Erber, 2020) However, the building sector still ranks the world´s biggest carbon dioxide emitter. (European Commission, 2020) Therefore, planner and developer must also increase their focus on user´s need rather than forcing behavior thru framework conditions. (Raab, 2015) Only if built structure enables environmental behavior that also ensures individual habits and comfort, long-term improvements may be achieved in a building´s operation. (Biggio & Cortese, 2013)

1.2. Problem Statement

The implementation strategy of the 17 SDGs follows the so-called mainstreaming approach where the objectives of the 2030 Agenda are anchored as broadly as possible among all stakeholders. However, there are no binding regulations in primary law on how the relevant SDGs are to be implemented in the respective sectors. Instead, the Austrian government relies on personal responsibilities, reinforced by the mainstreaming of sustainability and climate disaster. (Obrovsky, 2018)

1.2.1. Research Question

Therefore, this paper aims to determine whether the certification of buildings can contribute to meeting the relevant SDGs and thus provide guidance for the construction sector. However, as already stated in the problem definition, the interest of building owners in certifying their projects must first be aroused, followed by the involvement of building users. The following three research questions therefore outline the work:

1) To what extend do the selected building standards ÖGNI and WELL cover relevant SDGs for the building sector?
2) How do we motivate stakeholders to certify office buildings?
3) How do we safeguard long-term behavior change?

1.3. Structure

The thesis at hand examines the added value of two selected building certificates in regard to the implementation of relevant SDG in the construction sector. To do so, the work is split into four parts.

The first part compiles the basis. Therefore, chapter 2 introduces the 2030 Agenda. As this universal climate agreement comprises 17 SDGs on national, regional and global levels, inherent interdependencies are discussed. The focus of chapter 2, however, is on a selection of three SDG which were found most relevant for the construction sector. Chapter 3 thereto addresses the Austrian implementation strategy of the 2030 Agenda. Learning the mainstreaming approach which bases the implementation on personal responsibility, chapter 3 also presents stakeholder´s motives and incentives for implementing the SDGs. Therefore, findings of our study group´s physical prototype are put into context.

Chapter 4 comprises the second part of the work, elaborating the characteristics of the two selected building certificates ÖGNI and WELL. Furthermore, the contributions of both certificates with regard to the implementation of the selected SDGs are evaluated, weighting the assessment of the respective certificate expert.

The third part, however, complements findings of chapter 3 which evaluated incentives that cannot directly be linked to an intention. Accordingly, chapter 5 covers the European legislation and discusses legal incentives such as subsidies and tax benefits.

Building on all the above, chapter 6 discusses points raised by this rather political, thus emotional problem. Chapter 7 finally concludes the most important findings of the work.

1.4. Methodology

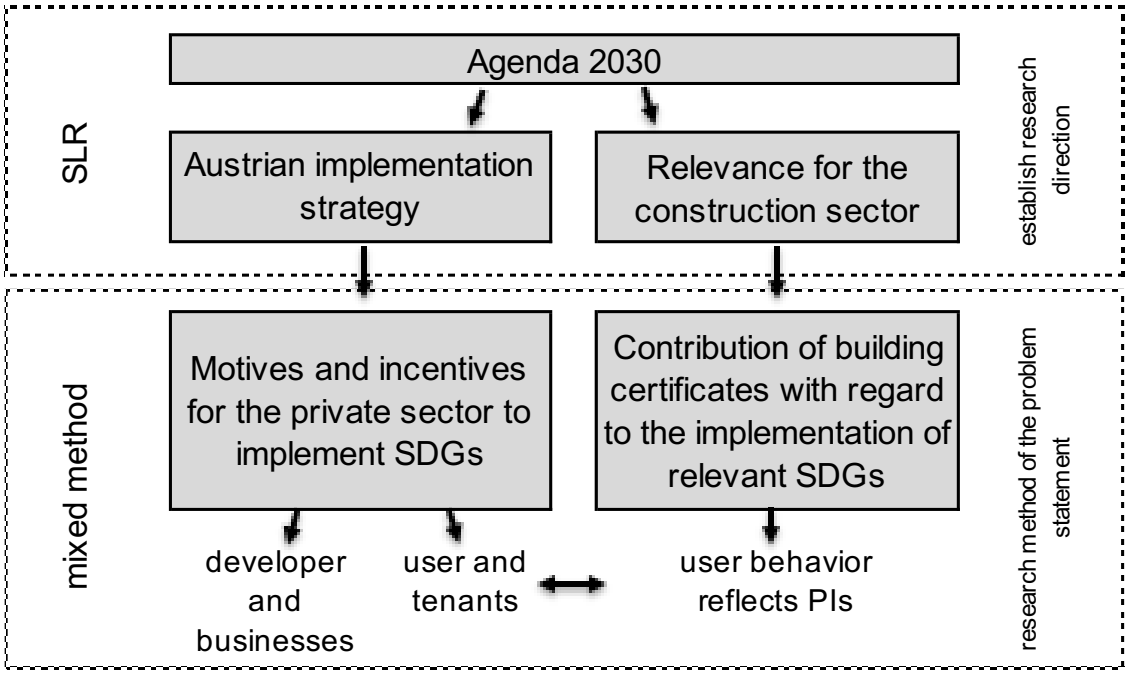


Figure 2: Methodology of the thesis

1.4.1. Literature Research

Plan: In order to define the thesis´s research question as precisely as possible, the initial keywords had to be narrow but also enable a comprehensive coverage of related subject areas. (Denyer & Tranfield, 2009) To ensure the scientific nature of the thesis, the Systematic Literature Research (SLR) based on databases like the TU´s CatalogPlus, ScienceDirect and ResearchGate. In addition to these journal articles, monographs and collective works, gray literature like white papers, conference reports and documents of public administration were also considered. Chapter 4 furthermore consulted interned documents such as official building standard catalogues. Legal regulations and commentaries on laws were also accessed for Chapter 2 and 5.

Review: In order to comply with the SLR requirements, all keywords were protocolled. Hence, the initial keywords and their synonyms include: SDG, 2030 Agenda, Austrian

Legislation, European Legislation, Building Sector, Building Certificates, ÖGNI, WELL, Sustainability, Health and Comfort, Workplace, Economy, Productivity.

The resulting collection of papers was thereafter filtered on the basis of their abstracts. Subsequently, the remaining papers were reviewed individually for quality.

Report: On this basis, the most relevant findings were compiled in the final phase. Accordingly, core statements were filtered out and presented in a compact, consistent form.

1.4.2. Mixed Method

As shown in Figure 2, the mixed research method was used to answer the research questions posed. Therefore, the following two traditional research disciplines were combined to maximize their synergies (Maxwell & Raybold, 2015):

Quantitative research typically processes data to numerical form in order to compare and generalize predefined hypotheses. Accordingly, traditional definition often refers to “external validity” as the study´s results apply to a wider range of settings than actually studied.

Qualitative research, however, seeks to understand processes rather than showing certain features of a setting. In this context, not data collection but data analysis is most distinctive for qualitative research. In addition, the research subject is explicitly included in the study to understand the specific context of the research. Accordingly, it is important to understand that qualitative results are inevitably interpretive.

In order to address meaning, context and process of the problem statement, a symbiose of both research methods, the qualitatively driven mixed method, was chosen. Therefore, the qualitative part comprises findings of the SLR with insights of the physical prototype, providing a naturally existing setting for the study of human perception of sustainability at the workplace. The quantitative part, however, evaluates the components of both criteria catalogues. To examine causal relationships between the building certifications and relevant SDGs, the respective contributions were weighted in a model to provide quantitative assumptions. The evaluation is therefore based on the assessments of the respective experts, received from their official criteria catalogs. In order to make the different descriptions comparable, however, the assessments were weighted using a self-selected key (see chapter 4.3).

2. Sustainable Development Goals

Considering Austria, consequences of the global climate crisis are already being felt due to the increasing frequency of floods, droughts or storms. However, global warming does not stop at our boarders and we are just as affected by climate actions of our neighboring countries as they are by ours. Yet, inequalities between different social groups are growing, as sustainability threats effect areas and livelihoods in different ways, not following any (human) law. The complex challenge of sustainability is therefore no longer a private, national matter of fact but requires joint, holistic approaches. (UniNEtZ, 2021) In this regard, Europe also enhanced it´s understanding for global development, expanding the range and depth of topics associated with sustainability. Compared to binary goals like the socio-cultural Millennium Development Goals (MDGs) or the Rio+20 process on Sustainable Development, sustainable development thereafter encompassed economic, social and environmental aspects. (Breuer, et al., 2019)

From 2012 to 2015, the 193 member states of the United Nation (UN) therefore developed 17 Sustainable Development Goals (SDGs), setting the common goal of "promoting sustainability for all". (Kraker, 2018) Achieving such integration, the challenge of sustainability no longer only addressed environmental aspects associated to climate change but enhanced a focus on social inequalities and tension from dissatisfaction. (UniNEtZ, 2021) On January 1st, 2016, all UN member states adopted the "2030 Agenda for Sustainable Development" (2030 Agenda) at the UN Summit on Sustainable Development in New York, entering force of the 17 SDGs for the next 15 years. (Kraker, 2018)

Figure 3: UN´s 17 Sustainable Development Goals (Bundeskanzleramt, 2015)

Regarding Figure 3, the sectorial scope of the 2030 Agenda is universal in nature. Thus, including areas such as migration, industrialization and energy ensure the adaption of the three pillars of sustainable development. Thereof, socio-cultural goals such SDG 11 which aims to reduce inequality between and within states, or the "comprehensively standalone goal" SDG 5 were included to empower all, also women. (Lerch, 2015, p. 5) Other goals, like SDG12 focus on environmental sustainability, targeting the careful use of resources and responsibility of consumption and production patterns. (Bundeskanzleramt, 2015) Furthermore, as the 2030 Agenda is adopted by a diverse range of developing countries with different priorities, two further critical dimensions were added to the three pillars of sustainability, creating the "5Ps" people, prosperity, planet, partnership and peace (Figure 4). (UNSSC, 2017)

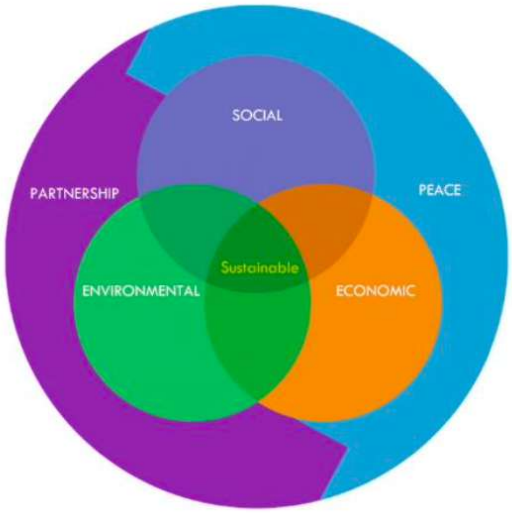


Figure 4: Three pillars of sustainability extended by two further critical dimensions to the "5Ps of the 2030 Agenda" (UNSSC, 2017)

Other sustainable agreements such as the European Green Deal (see Chapter 5) also connect an equitable society to a flourishing planet. Their focus, however, is on the ecological sustainability of economic regulations. In practice, the goals achieved are similar to the 2030 Agenda but less indivisibility as the European Green Deal formally follows economic aspects. The 2030 Agenda, however, incorporates social, economic and ecologic measures equally. As chapter 2.2 discusses in more detail, these integration challenges entail grate policy coherence. (Breuer, et al., 2019)

2.1. Relevance for the Construction Sector

Taking into account that the construction sector is responsible for 40% of our energy consumption and almost just as much of greenhouse gas emissions, the importance of further promoting sustainable construction measures is indistinctive. (European Commission, 2020) Therefore, to create a world in which both- people and planet - can thrive, governments, citizens and businesses must equally do their part. Whereas

building regulations and relevant literature use to focus on prescriptive methods and ensure material properties and construction details, performance-based methods raise due to innovation and collaboration. In order to highlight and reward additional efforts of citizens and businesses, the introduction of voluntary certifications and their performance-based assessments seem obvious. (IWBI, 2022) Binding standards, however, require lead and testing time, thus must be implemented slowly. In contrast, sustainable building certificates already cover the whole life cycle of a building. Starting from the project development and planning through construction, also the operation, maintenance and deconstruction is considered in the evaluation. Especially for the phase of building operation, however, the exclusive guarantee of good structural substance must be accompanied by flexible performance indicators (PI). Thereby, user-applicable boundaries are provided and safeguarded. (Geze, 2022).

Accordingly, the Energy Institute of Economics evaluated benchmark values for relevant energy consumptions (per users and floor area) in 2015. Hence, relevant main consumers of SME businesses were assessed, presenting their energy efficiency and estimated savings potential (Figure 5).

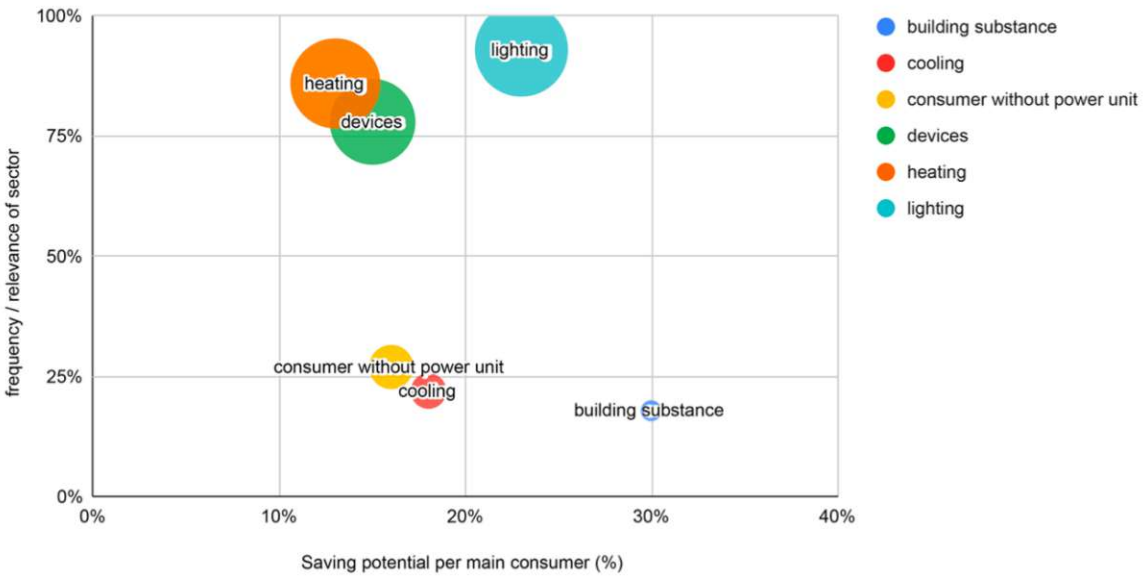


Figure 5: Saving potential of energy consumers in office buildings (Jandrokovic, et al., 2012, p. 14)

By plotting the frequency on the ordinate, Figure 5 illustrates how often a main consumer was identified as a potential sector for savings. The estimated mean value of energy that can be saved is represented on the abscissa. Therefore, the figure quickly identifies major consumers with high savings relevance. In this regard, almost all companies (95 percent) were found to hold an average of 23 percent of saving potential in lighting. Heating and office equipment were identified for slightly lower savings potentials, but a similar occurrence (applicable for more than three-quarters of SME businesses). The highest saving potential, however, was expected in optimization

of the structural substance. Yet, only 17 percent of businesses were found to target the structural sector – mainly due to the high number of office space leases where tenants avoid long-term investments. (Jandrokovic, et al., 2012) In this regard, the upgrade to intelligent systems allows low-impact maintenance of specific, preset criteria. Furthermore, preset temperature, humidity or light configurations are less intrusive and structurally invasive and can easily be adopted to existing structures. Although the Internet of Things (IoT) already collects and analyzes the data on user presence, foot traffic, and tenant´s preferences, human perception is still difficult to fully understand. (Wehrberger, 2022) Therefore, main energy consumers of a building should no longer be approached by the built structure itself, but in respect to people´s habits and comfort. Merely technical solutions will neither promote individual well-being, nor achieve long-term success as it requires individual willingness which is further based on personal objectives and goals. (Biggio & Cortese, 2013)

Considering thereto that 90 percent of life is spent in the built environment, buildings are of great importance to our well-being. (Sobchak, 2015). Although average working hours are slowly declining (Figure 6), work has shifted to rather sedentary activities. As today's technology allows almost any meeting and instruction to be made remotely, physical relocations and on-site services are less common and increase effective time in office buildings - sitting. (WHO, 2015) Accordingly, societal demands for the work environment are rising in conjunction to the increasing time employees spend in the office. (Morton, 2015) Hence, Arch. Dipl. Ing. Stephan Rindler put office layouts and designs to a new level in this years´ Office Market Report (Homm & Granabetter, 2022, p. 9):

“It's more about an attitude toward life and less about work. The task of companies in the future will be to map individual life dreams and meet employees there.” Stephan Rindler

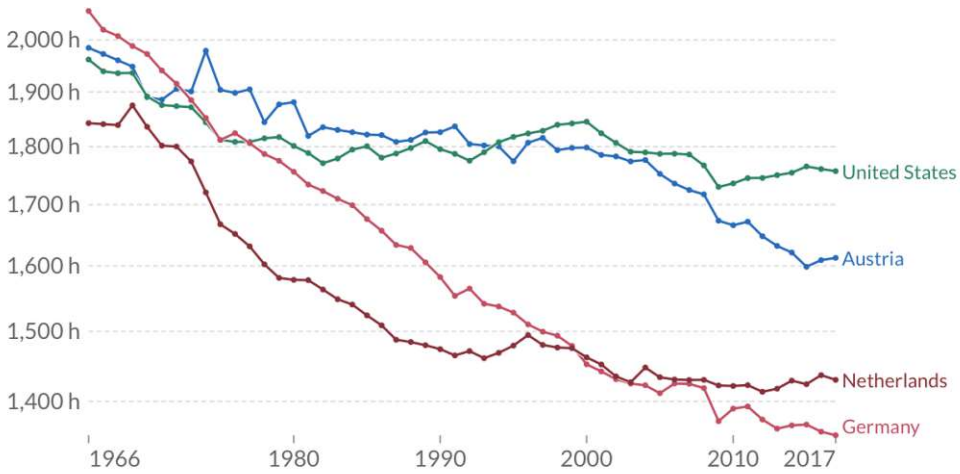


Figure 6: Average working hours per worker and year (Giattino, et al., 2020)

Therefore, understanding interactions and synergies of internal and external stressors and integrating soft factors (such as excessive stress, dissatisfaction or poor communication) into sick building syndrome (SBS) is no longer a private matter, but increasingly receiving attention in the professional work environment. Hence, office structures – much more than any other built environment – need to understand their tenant´s different behavioral tendencies in order to improve the experience of all stakeholders. (Gifford & McCunn, 2011) To do so, building professionals and authorities may no longer limit their building evaluation on environmental impacts (like energy, water or waste) and the avoidance of health hazards, but increasingly take socioeconomic aspects into account and promote well-being. (Alker, et al., 2014) As Chapter 3.3 (Figure 16) explains in more detail, promoting well-being reduces stress and absenteeism, improves comfort and ultimately increases occupant productivity. (Olson, 2015) However, standardizing individual comfort remains much more difficult than defining physical limits and providing external conditions from above. Work-related motivators are more likely to be influenced from below and depend on individual behavior and cultural characteristics such as respect and purpose. (Biggio & Cortese, 2013)

2.2. SDG Interdependencies

By implication, the complexity of a joint attempt to globally align to the climate challenge is given. The most outstanding principle of the 2030 Agenda, however, is its unprecedented indivisibility. (Breuer, et al., 2019) Ensuring environmental protection and social inclusion for human well-being while also balancing economic development and prosperity already implied that there is no single approach. Thus, the UN member states understood the compilation of the 2030 Agenda much like a traditional clockwork: only a system of synergistic reinforcement (e.g., interlinking goals and targets) would be able to radically address the global three folded challenge of sustainability. (Pradhan, et al., 2017) Against the background that each of the SDGs resulted from a “protracted process of several years of multi-stakeholder consultations and intergovernmental negotiations”, targets of different SDGs may overlap, reinforce or contradict each other. (Breuer, et al., 2019, p. 2) Thereto, so-called trade-offs refer to situations in which achievements on one goal have negative effects on another goal or target. Synergies, in contrast, denote the amplification effect, where achievements in one goal also reinforce the progress of another one. (Renaud, et al., 2022)

Mid-way through the implementation period of the 2030 Agenda, however, literature still lacks a definitive framework that fully understands the integrated synergies and trade-offs. (Pradhan, et al., 2017) Although multiple experts already conducted different empirical studies to identify interdependencies within the SDGs, there is still no universal method. Thereof compiled literature reviews, such as (Renaud, et al., 2022) or (Breuer, et al., 2019), agree on the already discussed hypothesis that complex

problem prompts (sustainability) require complex solutions (2030 Agenda). Additionally, the different boundary conditions of various (national and international) communes further challenge the preparation of one universal, robust assessment methodology. (Renaud, et al., 2022) Furthermore, dynamic factors like governance, geographical context, resource endowments or time horizons must find (re-) consideration in order to provide a comprehensive reflection of all stakeholder´s needs. (Nilsson, et al., 2018) However, having multiple, tested models and tools available allow content and case specific adaptions and interlinkages of methods available. Therefore, further collection of data and knowledge will resolve current limitations. Eventually, the combination of all different approaches will lead to one generic method. (Renaud, et al., 2022)

Given the predominance of interlinkages shown in Figure 7, empirical analyses are a sound basis to identify SDG synergies and trade-offs. Building upon, operationalized models must further consider exploitation. (Pradhan, et al., 2017) Only if interdependencies are proactively approached, capacities may be channeled and resources saved. (Breuer, et al., 2019) Furthermore, not all 17 SDG equal in significance but are divided into so-called “finalistic” goals and “means”. Similar to considerations already given, the latter goals are not explicit end-goals. SDG 7 for example, is not longing for clean energy for energy reasons itself, but as “means” to final goals like SDG 3, our ultimate health and well-being. (UNSSC, 2017)

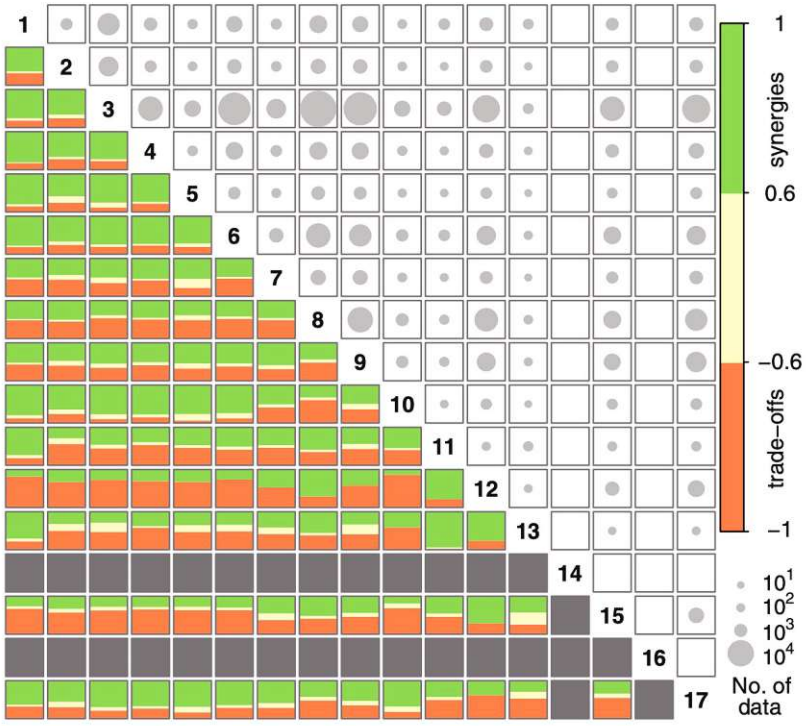


Figure 7: Interdependencies between the 17 SDGs with indication of data pairs (Pradhan, et al., 2017, p. 5)

Depending on the scope, level of consideration and conceptual approach chosen, the analysis reveals different findings for frequency and scope of interlinkages (Figure 7). However, studies found that most UN member states typically show more synergies than tradeoffs – indicating a strong, successful implementation of the 2030 Agenda. (Pradhan, et al., 2017) In addition, human-centric SDGs (1-3) were found to be more likely to be targeted than environmental related SDGs (13-15). (Renaud, et al., 2022) Similar findings were made by the analysis of (Pradhan, et al., 2017). According to Figure 8, the global pattern distribution of interdependency pairs, SDG3 was found to have the highest number of shares of synergies. This indicates a paradigm shift of "good health and well-being" in most country-scales. Interesting fact if one considers Austria's synergy pair which links "good health and well-being" to "affordable clean energy" as this might reinforce and relabel SDG7. Regarding the lower plot of Figure 8 (b), SDG3 was found part of the top four global trade-off patterns. Conclusive, if one links better healthcare with population size, material footprint and sealed floor area. However, the historical dependency of SDG3 and SDG12 must get recontextualized in order to avoid a lock-in-effect where identified countries will have to choose between "good health" and "production".

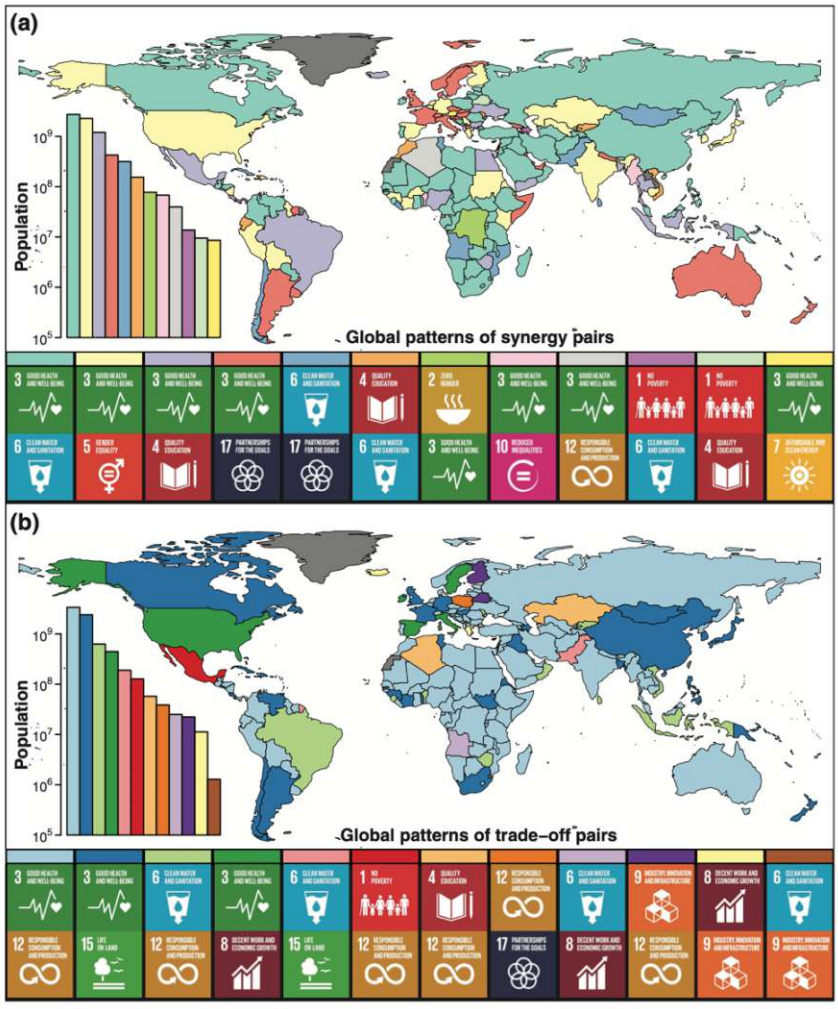


Figure 8: Global pattern distribution of interdependency pairs (Pradhan, et al., 2017, p. 1176)

Furthermore, literature stresses the indirect correlation and mapping of causalities. Although human-centric SDGs do not initially contradict ecological SDGs, their synergies with economic SDGs do. Accordingly, target 3.2 (see Chapter 2.3) reinforces a growing population of consumers for example. Subsequently, ecological SDGs are contradicted by the exploitation of natural resources, driven by SDG8. In conclusion, however, one should not hinder human-centric goals, but increase significance of alternative interdependencies like target 8.4 (see Chapter 2.5) which decouples economic growth from environmental degradation. (Katila, et al., 2020)

In this context, the following chapters take a closer look at three SDGs that are relevant for the construction sector. The selection is based on the ME310 project specification and contains one category for each of the three pillars of sustainability. (IFM, 2020)

2.3. Goal Three: Good Health and Well-Being

In 1948, the newly formed World Health Organization (WHO) defined human health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. (WHO, 2020, p. 1) However, the SDG3 slogan “well-being for all by 2030” which was proclaimed at the New York Conference in 2015 is rather an aspiration than a task to achieve. Thereto, even the definition of well-being itself is vast and shows that the term is contested and context dependent. While the WHO defines well-being as part of health, the Millennium Ecosystem Assessment (MA) considers health the other way round, as one of five components of well-being (Figure 9). Either way, the sole input of air, water and food will not be sufficient in order for people to thrive. Other aspects, such as social connections, self-determination and safety are vital to foster physical, mental and social well-being. (Katila, et al., 2020)

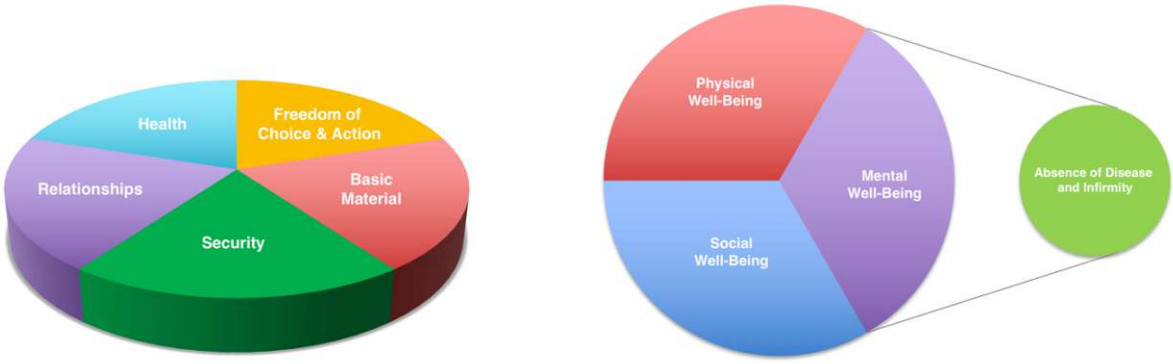


Figure 9: Definition of Health and Well-Being, left: MA Definition for Well-Being (MA, 2005), right: WHO Definition for Health (WHO, 2020)

Similar synergies apply to mental health as it is also not simply the absence of mental health condition, but rather a state of well-being. Accordingly, individuals are not able to live to their fullest potential, cope everyday stress, work productively or contribute to their community if mental health has not been adequately cared for. The complex

relation between mind and body is thereto determined by a range of socioeconomic, biological and environmental factors. Given the high prevalence of mental health conditions among the working population – over 30% of adults will experience a mental health condition during their lifetime, of which approximately two-thirds are employed – the workplace obtains importance to promote, prevent and intervene mental health. (IWBI, 2022, p. mind)

Table 1: SDG3 targets, highlighting those particularly pertinent to built structure and their tenants (dark grey: obvious goals, light grey: synergies which are further elaborated)

Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development SDG indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, in accordance with the Fundamental Principles of Official Statistics.		
	Goals and targets	*Indicators*
Good Health and Well Being	**Goal 3. Ensure healthy lives and promote well-being for all at all ages**	
	3.1 By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births.	3.1.1 Maternal mortality ratio 3.1.2 Proportion of births attended by skilled health personnel
	3.2 By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births.	3.2.1 Under-5 mortality rate 3.2.2 Neonatal mortality rate
	3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.	3.3.1 Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations 3.3.2 Tuberculosis incidence per 100,000 population 3.3.3 Malaria incidence per 1,000 population 3.3.4 Hepatitis B incidence per 100,000 population 3.3.5 Number of people requiring interventions against neglected tropical diseases
	3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.	3.4.1 Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease 3.4.2 Suizide mortality rate
	3.5 Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol.	3.5.1 Coverage of treatment interventions (pharmacological, psychosocial and rehabilitation and aftercare services) for substance use disorders 3.5.2 Alcohol per capita consumption (aged 15 years and older) within a calendar year in liters of pure alcohol
	3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents.	3.6.1 Death rate due to road traffic injuries
	3.7 By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the	3.7.1 Proportion of women of reproductive age (aged 15–49 years) who have their need for family planning satisfied with modern methods

integration of reproductive health into national strategies and programs.	3.7.2 Adolescent birth rate (aged 10–14 years; aged 15–19 years) per 1,000 women in that age group
3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.	3.8.1 Coverage of essential health services 3.8.2 Proportion of population with large household expenditures on health as a share of total household expenditure or income
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.	3.9.1 Mortality rate attributed to household and ambient air pollution 3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services) 3.9.3 Mortality rate attributed to unintentional poisoning
3.a Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate.	3.a.1 Age-standardized prevalence of current tobacco use among persons aged 15 years and older
3.b Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all.	3.b.1 Proportion of the target population covered by all vaccines included in their national programs 3.b.2 Total net official development assistance to medical research and basic health sectors 3.b.3 Proportion of health facilities that have a core set of relevant essential medicines available and affordable on a sustainable basis
3.c Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States.	3.c.1 Health worker density and distribution
3.d Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.	3.d.1 International Health Regulations (IHR) capacity and health emergency preparedness 3.d.2 Percentage of bloodstream infections due to selected antimicrobial-resistant organisms

While the sustainable factor of buildings - both construction and operation (e.g., air and water quality) - is increasingly being considered, social design and growing concern for physical and mental health are also becoming priorities in building design. Thereto, the building sector contributes to the achievement of the SDG3 targets (Table 1) by (IWBI, 2022):

- measuring the operation of the building (air quality, light intensity, etc.),
- providing access to resources and services that support the mental health of employees,
- supporting circadian and psychological health through indoor daylight exposure and outdoor nature views,
- promoting physical activity thru policies, design and implemented programming,

- selecting low-emitting materials and products to minimize volatile organic compounds (VOCs).

Moreover, the built environment serves a powerful tool to mitigate adverse mental health outcomes by policies, programs and design. Thereto, mental health and substance use conditions are collectively accounting for 13 percent of the global burden, leading to increased attention for SDG3 targets like 3.5, 3.a and 3.d. Furthermore, the access to mental health, substance use and addictions services will allow early treatment and can prevent the conditioning of harmful substitute behaviors (at work). Considering thereto that depression is the largest cause of disability worldwide and accounts for 4 percent of the global burden disease alone, the impact of mental health in the workplace is profound. Depression and anxiety cost the global economy an estimated $1 trillion due to lost productivity. Thus, mental health promotion is directly linked to target 3.8, the release of (medical) resources. (IWBI, 2022, p. mind)

Additionally, physical activity is not only helping to reduce stress, anxiety and depressive symptoms (Esi van der Zwan, et al., 2015) but also promotes individual fitness. Therefore, a wide range of alternative transport options may be also linked to SDG3. Furthermore, the Centers for Disease Control and Prevention reports that 68 percent of the American workforce has at least one chronic health condition. If obesity is added to that list, almost nine out of ten workers must be assigned to this group. (Lister, 2018) European figures are not quite as drastic, but still alarming, considering that the average worker spends around 7.7 hours each day sitting. In addition, muscular degeneration, disorders of the back, neck and leg, and even some types of cancer are linked to poor activity. (Olson, 2015, p. 26) As safety is - by definition of MA (Figure 9) - also part of well-being, target 3.6 must also find consideration. Good connectivity to transportation networks, sidewalks, and thoughtful special planning will not only incentivize individual (preferably non-motorized) movement, but also promote road safety. A well-balanced urban development – where the use of private cars shifts towards public transport, walking and cycling - will lead to economic, social and environmental considerations where true costs of transportation are opposed. (Racioppi, et al., 2004)

To conclude this chapter, the Sick Building Syndrome (SBS) should also be noted as it summarizes effects that are difficult to influence individually. Accordingly, symptoms like headache, lethargy, nausea, dizziness, lack of concentration, irritability, and irritation of eyes, throat, nose and skin. (Heerwagen, 2000). However, SBS awareness is already well established through structural measures and complies with Austrian building laws.

2.4. Goal Seven: Affordable and Clean Energy

As the world's population continues to grow, the trend toward urbanization is also likely to continue. According to the World Bank, the urban population will more than double to 6 billion people by 2050, meaning that 7 out of 10 people will live in cities at that point. To provide basic services, infrastructure and affordable housing needed by the growing population, the expansion of urban land use will exceed population growth by up to 50 percent, demanding another 1.2 million square kilometers of new built-up area worldwide. (Sivaraman, 2020) However, over the past 50 years net gains in human well-being and economic development increased more rapidly and extensively than in any other period of time in human history. Degradation of many ecosystem services, increased risk of nonlinear change and exacerbation of poverty of specific groups of people are among the costs we (and generations to come) pay. (MA, 2005). As the urban lifestyle is already responsible for two thirds of global energy consumption and for more than 70% of greenhouse gas emissions, the energy consumption of cities has to be kept within limits. Therefore, in order to preserve (benefits that derive from) the ecosystem, strict land use patterns and fixed, compressed forms must be enforced. (Sivaraman, 2020) However, population growth and distribution are more of an ethical question this thesis does not presume to answer Moreover, the share of renewable energies must be increased in order to still reach an emission-free future. Therefore, the construction sector (which, again, is responsible for 36 percent of the EU´s energy consumption) needs to strive for greater energy efficiency. The overall energy consumption of buildings during construction and operation needs to be reduced as well as a building's resource management targeted. Furthermore, the use of new environmental technologies will provide knowledge that will benefit future building projects and enable the phasing out of fossil fuels. (BIG, 2022) In this regard, the World Economic Forum connected five out of the top-ten threats to humanity (Figure 10) as a result of climate crisis in 2020. (Hölzl, 2020)

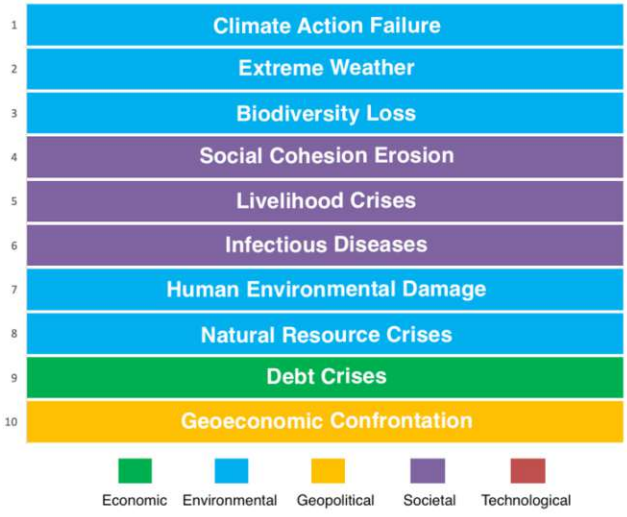


Figure 10: Top 10 Global Risks by Severity over the next 10 years (Markovitz, 2022)

Regarding the ambitious goal of EUs climate neutrality by 2050 (EC, 2020), the latest report on the trajectory of the climate crisis, issued early 2022 by the Intergovernmental Panel on Climate Change (IPCC), is less optimistic. The urgent recommendation for further actions on climate protection and its warning of creating an “uninhabitable planet” if not doing so, sets the European Green Deal to far distance. (Pörtner, et al., 2022)

Table 2: SDG7 targets, highlighting those particularly pertinent to built structure and their tenants (dark grey: obvious goals, light grey: synergies which are further elaborated)

Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development SDG indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, in accordance with the Fundamental Principles of Official Statistics.		
	Goals and targets (from the 2030 Agenda)	*Indicators*
Affordable and Clean Energy	**Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all**	
	7.1 By 2030, ensure universal access to affordable, reliable and modern energy services.	7.1.1 Proportion of population with access to electricity 7.1.2 Proportion of population with primary reliance on clean fuels and technology
	7.2 By 2030, increase substantially the share of renewable energy in the global energy mix.	7.2.1 Renewable energy share in the total final energy consumption
	7.3 By 2030, double the global rate of improvement in energy efficiency.	7.3.1 Energy intensity measured in terms of primary energy and GDP
	7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.	7.a.1 International financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems
	7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programs of support.	7.b.1 Installed renewable energy-generating capacity in developing countries (in watts per capita)

However, the construction sector contributes to the 2030 Agenda by approaching SDG7 targets (Table 2) by (IWBI, 2022):

- Increasing building energy efficiency by maximizing daylight access and utilizing low-emission heating systems.
- Encouraging participation in leading green building certification programs that promote energy efficiency practices.

The energy sector, however, is currently facing a trilemma between clean energy, energy access and security and energy affordability. As energy affordability in relation to the need for cleaner energy is put in focus for the consumer-end, indulging public in the energy transition is a great way to hasten the sustainability progress. However, multidimensional strategies are required to perceive energy affordability. Not only from an individual´s perspective, but also in regard to societal aspects. In addition, the production corner needs to shift its focus from the potential economic profitability to the promotion of clean energy affordability. (Madurai Elavarasan, et al., 2021) To overcome this bias, the first major united nations conference on global environmental issues took place as early as 1972 (UN, 2018). Despite all official efforts (Figure 11), however, greenhouse gas emissions (GHG) are still rising (Conca, 2021).

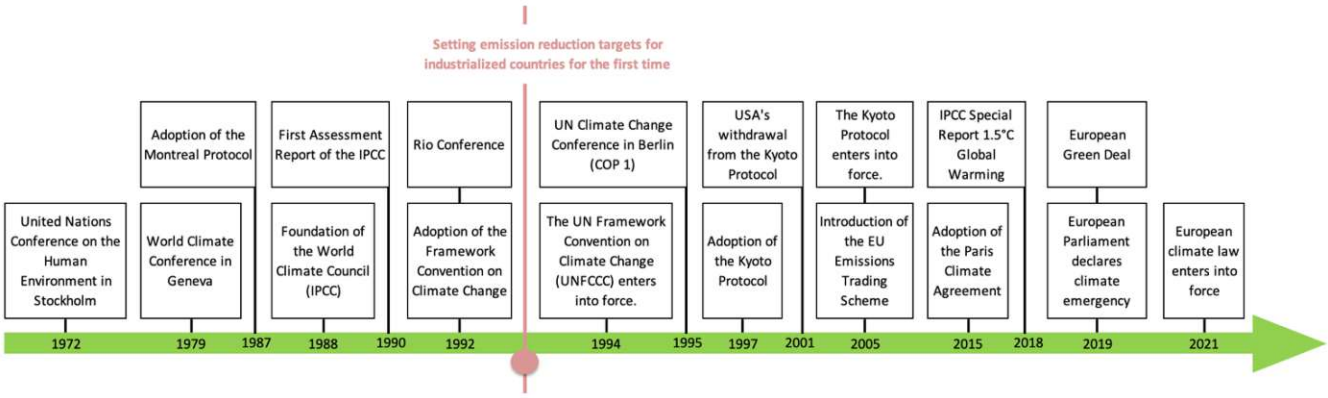


Figure 11: Overview of the climate change negotiations (UN, 2018)

In this regard, Robert Gifford, professor of psychology and environmental studies at the University of Victoria, sees environmental behavior, respectively human behavior, as the most poorly understood aspect of the climate change system. Thus, Gifford refers to the attitude-behavior gap as a promising approach to finally regress energy use. Accordingly, this long-standing problem between stated intentions and objective behavior has shown that self-reported and actual pro-environmental behavior only share about 20 percent of their variance. Hence, individual´s responsibility has to be mitigated by effective policies that focus on obstacles people face (at work). These policies and regulations, however, should no longer only be the symptomatic response to environmental impacts of our actions, but attempt to positively influence people´s behavior regarding energy efficiency and sustainability. (Gifford, 2014) To do so, social design longs for a better understanding of people's needs and ultimately links energy efficiency to well-being (SDG3).

2.5. Goal Eight: Decent Work and Economic Growth

Especially the younger generations – known as Millennials - ranked the state of the planet and environmental risks as alarming. (Hölzl, 2020) Additionally, the value of work shifted. Most Millennials do no longer strive for narrow, steep careers, but seek quality of life and meaning. (Moore, 2014) Accordingly, Russ Salzman, CEO of the Institute of Real Estate Management (IREM), defines sustainability no more as an individual matter, but as a conflict concerning society as a whole that became “an important part of everyday operations”. (Feist, 2015, p. 44) A recent survey found that social justice and environmental and climate protection were among the top three issues German citizens face. However, only 19 percent of respondents agreed that environmental and climate protection is adequate addressed and promoted by the state. (Wintschnig, 2021) Thereto, SDG 8 calls for the promotion of “sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” (Table 3). Additionally, tension in “labor rights for all” and “social reproductive work” are highlighted. Yet, the focus remains on narrow economic metrics of growth, such as GDP per employed person. However, targets 8.5 or 8.8 also address the subsequent gender shift and number of working (migrant) women in the formal and informal sector, thus reinforces the value of unpaid care and domestic work (SDG5). (Rai, et al., 2019)

Table 3. SDG8 targets, highlighting those particularly pertinent to built structure and their tenants (dark grey: obvious goals, light grey: synergies which are further elaborated)

Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development SDG indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, in accordance with the Fundamental Principles of Official Statistics.	
Goals and targets (from the 2030 Agenda)	*Indicators*
Decent Work and Economic Growth	**Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all**
8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries.	8.1.1 Annual growth rate of real GDP per capita
8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value added and labor-intensive sectors.	8.2.1 Annual growth rate of real GDP per employed person
8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services.	8.3.1 Proportion of informal employment in total employment, by sector and sex
8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavor to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programs on Sustainable Consumption and Production, with developed countries taking the lead.	8.4.1 Material footprint, material footprint per capita, and material footprint per GDP 8.4.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP
8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.	8.5.1 Average hourly earnings of employees, by sex, age, occupation and persons with disabilities 8.5.2 Unemployment rate, by sex, age and persons with disabilities
8.6 By 2020, substantially reduce the proportion of youth not in employment, education or training.	8.6.1 Proportion of youth (aged 15–24 years) not in education, employment or training
8.7 Take immediate and effective measures to eradicate forced labor, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labor, including recruitment and use of child soldiers, and by 2025 end child labor in all its forms.	8.7.1 Proportion and number of children aged 5–17 years engaged in child labor, by sex and age
8.8 Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment.	8.8.1 Fatal and non-fatal occupational injuries per 100,000 workers, by sex and migrant status 8.8.2 Level of national compliance with labor rights (freedom of association and collective bargaining) based on International Labor Organization (ILO) textual sources and national legislation, by sex and migrant status
8.9 By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products.	8.9.1 Tourism direct GDP as a proportion of total GDP and in growth rate

	8.10 Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all.	8.10.1 (*a*) Number of commercial bank branches per 100,000 adults and (*b*) number of automated teller machines (ATMs) per 100,000 adults 8.10.2 Proportion of adults (15 years and older) with an account at a bank or other financial institution or with a mobile-money-service provider
	8.a Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-related Technical Assistance to Least Developed Countries.	8.a.1 Aid for Trade commitments and disbursements
	8.b By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labor Organization.	8.b.1 Existence of a developed and operationalized national strategy for youth employment, as a distinct strategy or as part of a national employment strategy

Therefore, to achieve the 2030 Agenda, the building sector targets SDG8 (Table 3) by (IWBI, 2022):

- the implementation of a robust diversity, equity and inclusion program that promotes “diversity in the workplace and supports fair and equitable treatment of employees no matter their identity, location, background or level of ability”.
- aiming for organizational commitment to responsible labor practices that address modern slavery risks in the supply chain.
- Increasing the availability and access to support services, resources and care for victims of domestic violence.

Furthermore, SDG8 determines an attractive working environment with fair and socially equitable working conditions as the uppermost premise of one´s corporate code. Ethical standards for fairness, transparency and appreciation are demanded to reflect the corporate´s governance. Internally, by living up to the office culture itself. Externally, by regional value creation and future-oriented investments that shape sustainable business relationships and promote healthy economic growth. (BIG, 2022)

3. Implementation of the 2030 Agenda

Considering the different positions, conditions and priorities of all the 193 member states of the United Nation, the implementation approach of self-management is obvious. (Kraker, 2018) Therefore, each country committed to safeguards its national implementation measures of the 2030 Agenda in 2015. (UniNEtZ, 2021) Seven years later, mid-way through the implementation period, this year´ UN SDG Report is disappointing. Hence, global threats and conflicts such as COVID-19 and the war in Ukraine are crisis multiplier as they exacerbate existing challenge. In this context, poverty, hunger and instability override the climate emergency and have recently diverted focus. (Jensen, 2022)

3.1. Performance Reviews

Analyzing implementation strategies of the UN´s member states, the Organization for Economic Cooperation and Development (OECD) is one of the leading sources of data and international standards. Thus, the OECD-Action-Plan highly contributes to shape the 2030 Agenda and controls national success. (BKA, 2017) In this context, Douglas Frantz, former Deputy Secretary-General of the OECD, emphasizes the inherent responsibility for national contributions:

> *"This is not about the North dictating to the South. That conversation is dead. Rather, success requires partnerships with national governments and regional organizations, with the United Nations and other international bodies, with philanthropies, civil society and the business community. More than enough work exists to go around. It will get done through co-operation, not competition." (Frantz, 2016)*

Using OECD Data, the UN Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) thus developed a global indicator framework to monitor the level of SDG compliance by 231 unique indicators. Thereof, the UN annually publishes the "Sustainable Development Goals Report", presenting average progress made regarding each of the 17 SDGs in a global matter. (UN, 2022).

In 2016, the Eurostat Working Group "Sustainable Development and Europe 2020 Indicators" identified 83 of the 231 IAEG-SDGs indicators to be "widely available" in the European Statistical System. Another 47 SDG indicators were rated "not relevant for the EU" and 64 indicators "contain information that does not correspond to data in the statistical sense". Presenting thereof the first report on European progress toward SDG compliance, Eurostat was able to evaluate 51 indicator measures. (BKA, 2017) Six years later, the 2022 report measures progress by using 101 target indicators. Subtracting the multiple shares of 31 multi-purpose indicators included, progress has

already been made in regular monitoring. Thus, the informative value of the reviews is constantly increasing. (Sabadash, et al., 2022).

Report	Sustainable Development Goals Report	Sustainable Development in the European Union
Consideration	global	EU
Working Group	UN Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs)	Eurostat Working Group "Sustainable Development and Europe 2020 Indicators"
Unique Indicators	231	70
Survey Period	yearly	yearly
Publisher	United Nations	European Commission

Figure 12: Comparison of SDG Monitoring Reports

The Eurostat Report presents – analogous to the global UN Report – the European measurement values annually. To quantify progress made, recent data values are compared to their previous measurement values. The evaluation is visualized by descending or ascending arrows which follow long and/or short-term developments, depending on data availability (five, respectively 15-year periods). Furthermore, the OECD provides benchmark-values for 22 indicators. Targets affected by these benchmark values are therefore not only assessed in terms of their relative progress, but also in terms of absolute SDG achievement. (Eurostat, 2022)

Additionally, the 2030 Agenda obligates each UN member state to submit at least two Voluntary National Reviews to the High-Level Political Forum on Sustainable Development (HLPF) until 2030. (BKA, 2017) Although most member states have already reported on their national progress towards SDG compliance, independent non-governmental organizations such as SDG Watch Austria question the validity and significance of voluntary self-reporting. In this context, SDG Watch calls for independent, foreign experts to submit HLPF reports that provide raw data on which follow-up reports can be built. (Ökobüro, 2020)

3.2. Austrian Strategy

The Austrian Court of Audit (RH) reviewed the Austrian implementation of the 2030 Agenda for the first time from June to September 2016. Therefore, the federal government commissioned a management report of each federal ministry beginning of 2016. However, these summary reports submitted for audit lacked common thread, critical potential analyses and further implementation strategies. Furthermore, Austria did not prepare any other report up to this point in 2018. In comparison, 24 of the 28 UN member states already presented their first national progress report to the HLPF. (Ökobüro, 2019)

The 2018 audit of the RH, however, criticized the government program. Although it was adopted in 2017, it did not engage any commitment to the 2030 Agenda. Furthermore, general lack of an organizational unit or dedicated institution was highlighted. Therefore, the “mainstreaming approach” was dismissed as a phrase where the Austrian government delegated full responsibilities to its federal ministries. Accordingly, the Austrian legislation was found to neither politically prioritize the 2030 Agenda, nor implement a coherent, central control body. (Kraker, 2018) However, the RH audit was considered “an important first impulse” (Parlamentsdirektion, 2020) that inspired the formation of an Interministerial Working Group (IMAG), instructed to increase transparency and actual awareness of the 2030 Agenda in Austria.

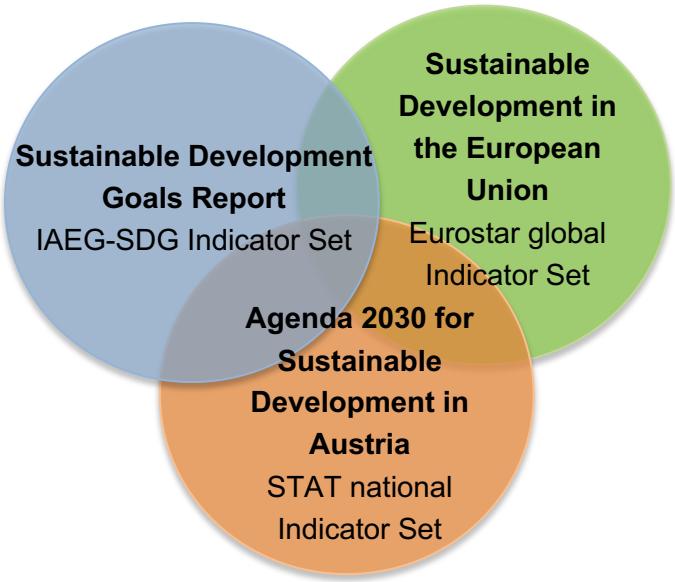


Figure 13: Comparison of Indicator Sets (Kraker, 2022, p. 32)

In July 2020, the "Agenda 2030 for Sustainable Development in Austria - SDG Indicator Report", conducted by the Austrian statistical office Statistik Austria (STAT), was presented at the HLPF in New York (Figure 13). Additionally, the RH assessed the implementation status of the recommendations from the 2018 report from January to March 2021. The follow-up review thereby noted progress in reporting and a more active involvement of civil society. However, the audit still lacked an implementation strategy and schedule for the 2030 Agenda. Thus, in February 2021, a steering group was established and instructed to submit annual implementation strategies to IMAG. (Kraker, 2022) Furthermore, the 2022 work program includes the implementation of the second SDG Dialogue Forum 2022 as a central dialogue and cooperation mechanism of IMAG. (Bundeskanzleramt, 2022) In this context, SDG Watch was founded in 2017 and already serves a platform for more than 220 members, increasing the visibility of sustainable activities in Austria. To do so, the non-governmental initiative works in close coordination with IMAG and plans events like the SDG Dialogue Forum. (SDG Watch, 2022) Similarly, 14 Austrian universities founded UniNEtZ - a platform that aims to safeguard sustainable development - in 2012. Hence,

300 scientists developed 950 measures for the implementation of around 150 options. (Ökobüro, 2022) However, the 2021 presented option-report does not provide direct recommendations for actions but identifies future-oriented solution paths and their respective consequences. Referring to Chapter 2.2, the 17 SDGs are fundamentally interdependent, thus seek transdisciplinary implementation approaches. Accordingly, the broad university alliance bundled know-how from social and natural science, technology as well as art and music. Furthermore, UniNEtZ and the Austrian parliament launched a cooperation in September 2022 where each SDG (and according results of the option-paper) is presented at the monthly plenum of the National Council. (UniNEtZ, 2021) Yet, the construction sector still lacks vertical legislation as building law and regulation only reflect the current state of the art. (Redlein & Hax-Noske, 2016) Therefore, the following Chapter debates reasons and motives for individuals and businesses to pay more consideration for SDGs in the work environment.

3.3. Motives for Private Sector

Even though Austria implementation of the 2030 Agenda has been slow, annual reports and events such as the SDG Dialogue Forum show a positive trend. However, domestic policies do not yet align with the global 2030 Agenda. (Frantz, 2016) Political coherence - whether at the construction level or in tax control - requires a lot of time and resources, as Chapter 2.1 already discusses. Therefore, this chapter emphasizes SME motives which align business related investments to the 2030 Agenda. Accordingly, not only mandatory regulations shift the status of “nice to have” add-ons to “must have” options, but also social pressure and demand do. (Steurer & Streibl, 2022) In this regard, vertical legislation may be overruled by horizontal demand and image cultivation. Incentives that hare directly linked to a nation’s legal situation (subsidies, tax benefits, etc.) are, however, not of interest for this chapter. Yet, Chapter 5 refers to European contributions such as the EU Taxonomy, CSR Directive and ESG Reporting.

Coming back to the “reinvention of the new normal”, Silicon Valley companies like Google recognized the benefits of emphasizing their headquarters design already in the early 2000s. In this context, Google Design and Construction Integrator Andreas Gyr explained their put-the-user-first attitude by increased performance measures. Continuous research and testing of work environments thus led to the establishment of important indoor environmental quality (IEQ) criteria. These, however, no longer only included basic construction indicators (IAQ, light, sound, etc.) but also soft parameters that promote employee health, satisfaction and productivity. (Alker, et al., 2014) Kate Lister, coauthor of several studies which examine the correlation of well-being in the workplace, made the business case clear: “it is in an organization’s own best interests to invest in employee well-being.” (Lister & Harnish, 2016, p. 134) Accordingly, there

are several extrapolations which illustrate the return of investment of happy people. Although literature is not congruent in the absolute amount, the World Green Building Council (WorldGBC) agrees that salary expenses account for 90 percent of typical business operating expenses (Figure 14). Space rent and operational cost account for another nine percent, whereas energy costs only cover one percent. (Alker, et al., 2014)

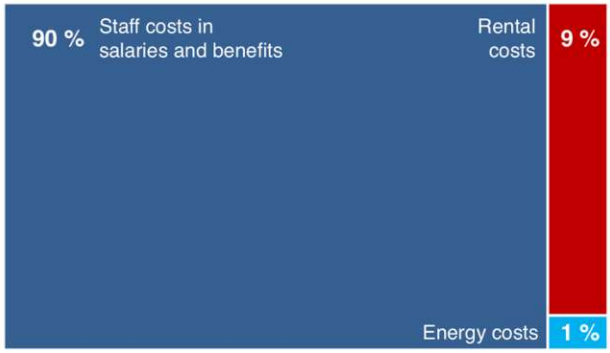


Figure 14: Typical Business operating Costs, (Alker, et al., 2014, p. 6)

Accordingly, also small percentages of increased employee productivity result in considerable savings if multiplied by the total staff number. Global Workplace Analytics therefore captured, that employees in finance sector produce six times their salary, resulting in eight minutes of work a day which cover office costs (Figure 15). (Lister & Harnish, 2016)

Figure 15: Occupancy Costs vs. Employee Productivity (Lister & Harnish, 2016, p. 136)

However, the definition of a healthy workplace which separates wellness and well-being (Figure 16) is quite young: Herzberg's two factor-theory of job satisfaction first appeared in the Harvard Business Review in 2003. (Lister & Harnish, 2016)

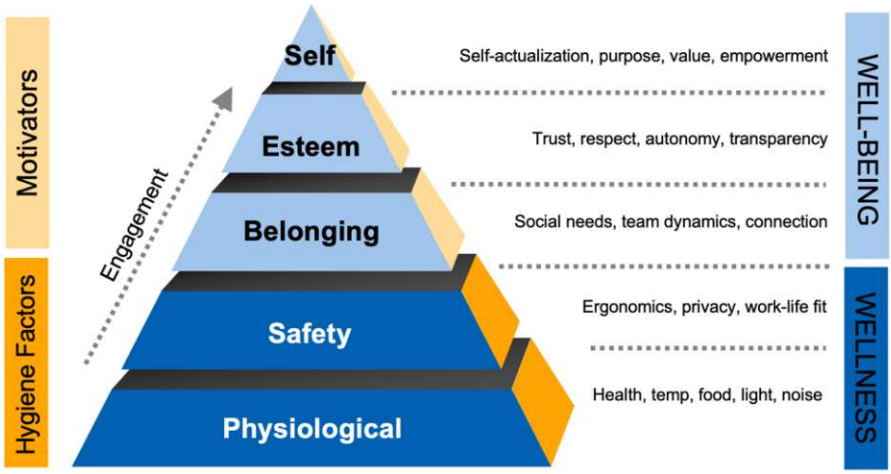


Figure 16: Mapping Wellness, Well-Being and Engagement to Maslow & Herzberg´s Work (Lister & Harnish, 2016, p. 140)

In this regard, wellness - also referred to as hygiene factors - mostly approaches locomotive health (e.g., ergonomics and physical characteristics of the work environment). Well-being, however, focuses on psychological aspects such as worker engagement, work-life balance or freedom of choice. (Lister, 2014) In this regard, Herzberg's theory indicates that a lack of hygiene factors at the workplace automatically implies job dissatisfaction. The reverse conclusion, however, is not inherently true: The mere fulfillment of basic wellness factors does not automatically increase employee satisfaction. Employee well-being much rather longs for motivators like team culture, trust, interpersonal respect and empowerment. (Lister & Harnish, 2016). In this regard, industry agrees that poor workplace conditions cause people to stay away from work. (Leaman, 2009) Research additionally shows that presenteeism - the fact of being at work physically but not doing your best due to poor health or well-being - substantially exceeds the cost of medical care and absenteeism by 2.6, respectively 10.5 times. If the work environment therefore performs according to Maslow & Herzberg´s Work (Figure 16), employee engagement may be raised. However, industry focus still remains on physical symptoms rather than mental health considerations. Considering thus that more than 30 percent of adults – whereof two thirds are in a permanent employment relationship – are suffering from anxiety disorders, depression or substance abuse during their lifetime, office management must further promote a general understanding of (mental) health. (IWBI, 2022, p. mind)

In this context, the relevance to organizational success was elaborated in a meta-study. Cate Lister found that employees associated to the highest quartile of engagement found to be 37 percent less absent, 21 percent more productive and less likely to have work-related accidents or change job. (Lister & Harnish, 2016) Therefore, to create a high-performance culture, WorldGBC compiled a four-quadrant schematic which separates the outcome metrics by ease of measurement and impact on business (Figure 17).

In this regard, the process identified seven targets (in the first quadrant) to be the most effective input metric (Alker, et al., 2014):

1. Absenteeism
2. Staff Turnover / Retention
3. Revenue breakdown
4. Medical cost
5. Medical complaints
6. Physical complaints
7. Self-perceptions as determined by a survey.

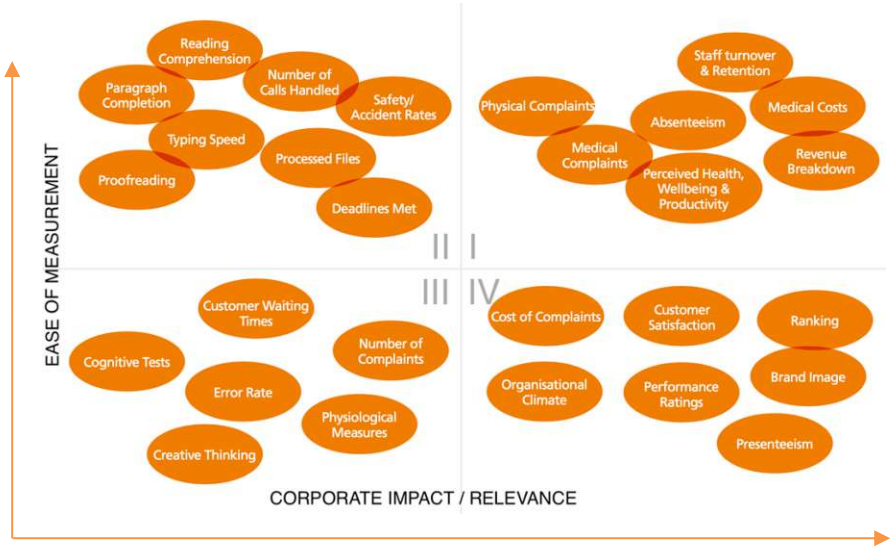


Figure 17: Schematic input relevance from metric results (Alker, et al., 2014, p. 61)

Furthermore, metrics of the 4th quadrant are most difficult to control, but of great relevance to the organizational success. In this respect, building certificates are a great mechanism as they are recognized to improve corporate image, allowing higher market opportunities and increase the rental income of a property. (Heerwagen, 2000). Furthermore, the capital market analysis found economic criteria to be most strongly associated with the topic of sustainability (Figure 18). Accordingly, almost half of all German assets were linked to sustainability criteria in 2018 (Volksbank & Union, 2018) European numbers are even higher: 80 percent of GenZ consumers factor ESG into investing decisions. (Struharova, 2021)

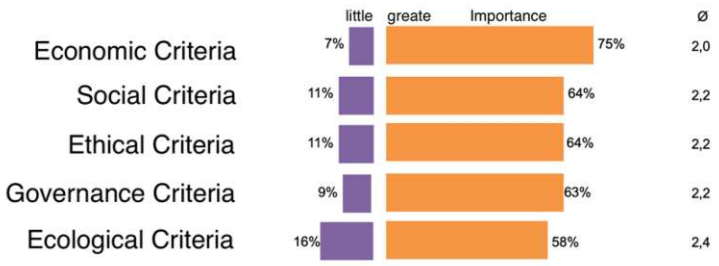


Figure 18: Criteria related to the topic of sustainability, German Survey (Volksbank & Union, 2018, p. 5)

3.4. Physical Prototype

As stated in the introduction, it was our student´s challenge prompt to save energy, without compromising tenant´s comfortability. Therefore, the academic structure and schedule of the ME310 course encouraged us to test “the most ambiguous or challenging element” of the complex system first (orange column, Figure 19). Easier subsystems should be iterated accordingly thereafter. (Domingo, et al., 2020) Soon in the benchmarking and need finding process, our project team identified intrinsic motivation as the crucial part to be triggered. Sustainable long-term results were found to require actual habit change rather than incentives for actions that do not align with employees' intuitive motivation. (Callinan, et al., 2021)

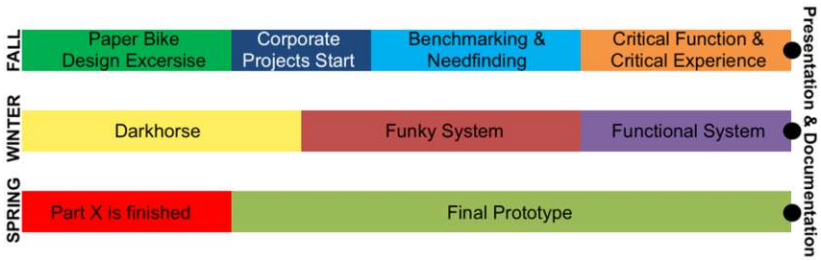


Figure 19: Caricature of the ME310 design project timeline (Domingo, et al., 2020)

Therefore, our Critical Function Prototype (CFP) (Appendix I) aimed to achieve energy savings in the workplace by encouraging sustainable tenant behaviors. To do so, gamified incentives were provided. First, information and explicit examples for improved energy efficiency ensured increase consciousness and a common base. In addition, intermediate group statuses were sent out to stimulate the ambition of the participants every other day. Thereto, one participant (the so-called secret influencer) was instructed to actively promote sustainable behavior among his group members, setting new standards and goals to reach in the next group status. Finally, a selection of prizes was announced in order to further ensure gamification and competitiveness.

As part of the competition, five desks were equipped with measuring devices in each of the three participating departments. The set-up recorded the energy consumption of selected work equipment and the department´s room settings over a period of 4 weeks. To obtain reference values, one week of lead and follow-up measurement was added to the evaluation of the actual competition period. Measurement data and effective energy saving evaluations, however, are not of interest for this thesis but are part of the final, collaborate ME310 document. (Callinan, et al., 2021) Yet, the CFP highlighted various important elements to further iterate and revise in the prototyping process. (Domingo, et al., 2020) Yet, some of them are also of great interest for the research question of the paper at hand. One finding, for example, derived from the measurements of a secretly sampled, additional worktable:

> *"Sales Department Table 6" was not knowing its energy consumption was measured too, thus did not save energy to any significant extent (Appendix I, p. 3)*

Accordingly, we were able to determine that consciousness - without intentional engagement - does not change behavior, as the person associated to Sales Department table 6 was genuinely involved in the running of the competition. Thereto, Robert Gifford, professor of Psychology and Environmental Studies at the University of Victoria, conducted a meta-analysis on barriers to climate change mitigation behavior in 2014. Accordingly, self-reported and actual pro-environmental behavior only share about 20 percent of their variance. Given the high consumer´s favorability to the concept of sustainability (see Chapter 3.3), Gifford relates the significant discrepancy to "imperfect memory", "social desirability bias" and "lack of opportunity to observe others' behavior". (Gifford, 2014, p. 552) Furthermore, implicit behavior (such as stereotypes towards sustainable products) must be overridden by explicit attitudes (such as communication efforts and corporate activities) in order to close the gap of the two attitudes people can hold simultaneously about one and the same object. (Wintschnig, 2021) In regard to recycling, for example, one is more likely to separate waste if one believes that it is common to do so (Gifford, 2014). Team AREC observed similar effects for energy savings in the CFP. As one team member of Group C was therefore (secretly) instructed to positively influence his team members 'attitude towards sustainable behavior:

> *Competition Group A and B maintained their comfort room temperature without sustainable modifications proposed whereas Group C - which included an instructed influencer - lowered room temperature.* (Appendix I, p. 3)

Influencing the participants' attitudes, values or intentions, the whole group was willing to act accordingly. Thus, psychological processing of adoption intentions was created by the semblance of "the new normal". (Claudy, et al., 2013)

Learning those empirical elements, compliance of regulations and green building re-certification highly depend on all stakeholders involved. In this respect, so-called green leases offer property managers a powerful tool to avoid ESG and climate change-related risks of their building operation best. (Leduc, 2022) Accordingly, green leases establish and deepen the relationships between building owners and tenants as they collaborate to reach voluntary agreements. Following templates of contracts and memorandums of understanding (MOU), focus is therefore set on energy and water usage, waste generation and occupant´s comfort. (JGBC, 2016) In this regard, both parties agree to mutually implement their MOU, preventing the attitude-behavior gap and re-emphasizing their common objective of holistic sustainability.

Accordingly, the attorney Stuart Kaplow defines a “green lease, at concept, what happens after a Green Building is delivered by the builder”. (Kaplow, 2009) Hence, green leases do not replace building certificates but combine binding obligations to simple effort commitments of potential tenants. In return, the owner pays for the capital improvements to reduce energy use and ensures motivators that come with incorporated SDGs (see Chapter 3.3).

4. Building Certificates

Looking at the construction sector - as most developer do - from an economic point of view, it seems obvious to stick to the state of the art. Complying statutory regulations and mandatory standards are already a good piece of work and thus cost a lot of time and money. Meanwhile, government, as well as relevant businesses drive the application of building certifications worldwide. Therefore, the first Green Building Standard (GBS) was developed in the United Kingdom more than three decades ago and still certifies, thus promotes energy-efficient buildings. Ever since, other GBSs have followed and help diminish the single largest energy consumer sector, the construction sector by enhancing sustainable designs. (Ebert, et al., 2010)

Benefits like increased resource efficiency and pollution prevention (Heerwagen, 2000), as well as increased market values and improvements to corporate images (Eichholz, et al., 2009) have already been achieved. Understanding climate change furthermore a global problem, one joint, binding standard seems obvious. Yet, different climate zones and characteristics as well as various economic, social and ecological developments of a country aim for individual adaptions. (Raab, 2015) However, the introduction of BREEAM enabled companies for the first time to attract potential tenants based on their sustainable performance and certified offices. Subsequently, other GBS have emerged (Figure 20) and provide evidence-based, transparent classifications of built structure. Yet, new construction projects which are non-certified are no longer marketable. (Homm & Granabetter, 2022)

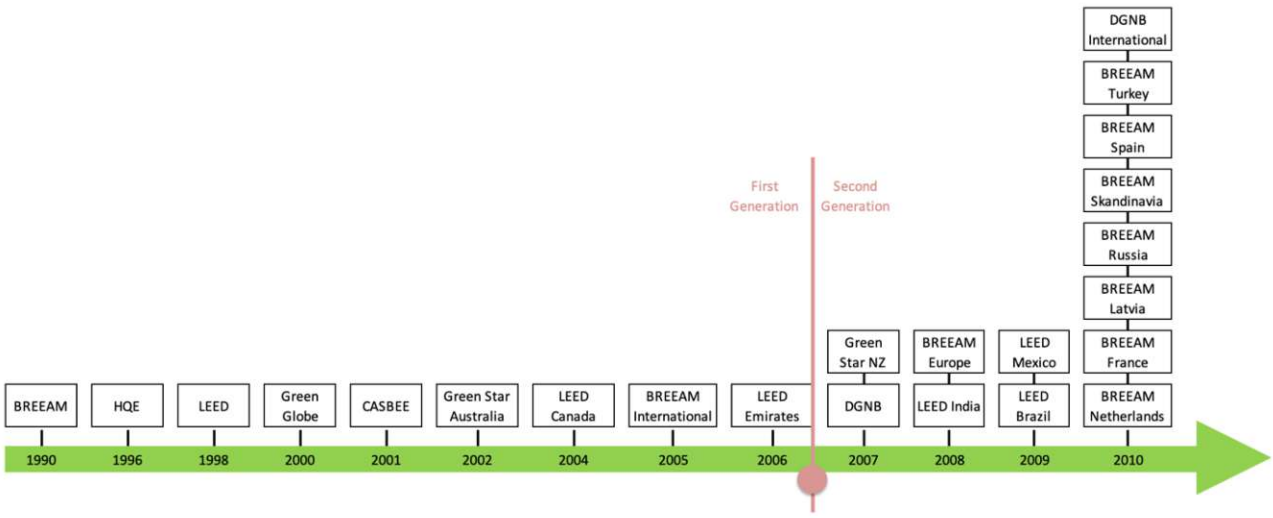


Figure 20: Timeline for sustainable building quality assessment systems and methods (Ebert, et al., 2010, p. 26)

However, the variety of certifications (Figure 20) directly reflect the number of rating systems as they not only differ their weighting and points, but also in their criteria selection. In this context, it is not the aim of this thesis to compare GBS with each

other. A large number of publications (such as (Raab, 2015) and (Traufratzhofer, 2015)) have already dealt with this in detail. This work therefore remains with their reference. However, Green Buildings do no longer only classify sustainable construction (first generation) but consider the entire life cycle of a building (second generation). (Geze, 2022) Moreover, operational conditions of Green Buildings standardize also societal demands, introducing the term “Blue Building”. In this regard, Blue Buildings emphasizes additional empathy for socio-cultural aspects in Green Buildings and increase demand for well-trained building managers that are able to incorporate collected PI measures. (ÖGNI, 2022) Although digitization simplified these data analyses and supports cost-effective evaluations, the implementation process and maintaining the value of comfortable real estate requires human expertise and conflict management (see Chapter 4.1.1). (Wehrberger, 2022).

4.1. ÖGNI Certificate

In 2009, the Austrian Society for Sustainable Real Estate (ÖGNI) was founded by 125 industry members, striving to strengthen Austria´s transfer of know-how between theory and practice of sustainable development. By joining the WorldGBC (World Green Building Councils), the non-profit association develops - as the only Austrian Council - solutions for sustainable approaches. Furthermore, ÖGNI raises awareness by following the 3Ps: products (real estate and building materials), (internal) processes and people. To do so, ÖGNI certifies building projects according to the DGNB system which is one of the most reputable European certification systems. Therefore, DGNB allows comparison of real estates on a national and international level (Figure 20). (ÖGNI, 2022) By adapting to the German DGNB system, ÖGNI ensures ecologic, economic and socio-cultural equity of sustainability (Figure 21) for Austria. (Kaufmann & Lechner, 2013) Thus, ÖGNI (pre-)certification assesses a buildings cumulative costs over the entire life cycle in regard to adequate national state of the art and interpersonal standards. (ÖGNI, 2022)

Figure 21: Basic structure of the DNGB system for new construction (ÖGNI, 2022)

4.1.1. Certification System

Based on the precise criteria selection, DGNB can be adapted to different building types and user-specific requirements (Figure 22). In addition, developers may also pre-certify their new construction project. Therefore, the award of independent auditors is recognized as a quality mark and attracts potential developers. Furthermore, planning according to DGNB criteria ensures optimal, holistic planning and increases success in office space leasing. (ÖGNI, 2022)

Building Types	new construction	existing & renovation	building in operation (GIB)
Education Building	x		x
Office and Administration Buildings	x	x	x
Commercial Buildings	x	x	x
Health Care Facilities	x		x
Hotel Buildings	x	x	x
Logistics Buildings	x	x	x
Production Facilities	x	x	x
Laboratory Buildings	x		
Residential Buildings > 6 units	x		
Small residential buildings ≤ 6 units	x		
Mixed Use	x	x	x
Multiple and Serial Certification	x		

Figure 22: ÖGNI types of certification (ÖGNI, 2022)

Regardless of the construction type chosen, the certification system defines clear target values. Depending on the degree of fulfillment of one criterion, the auditor rates the points (with a maximum score of 10 points). The points achieved per topic field are further combined to a partial degree of fulfillment. As shown in Figure 21, the partial fulfillment level of the three pillars “ecological quality, economic quality and socio-cultural & functional quality” are each weighted with 22.5 percent in the overall evaluation of certification. “Process quality, technical criteria and quality of location” weight accordingly less. However, regardless of the award achieved, a minimum level of fulfillment ensures the high level of quality (Figure 23). (ÖGNI, 2022)

Performance Level	Minimum Compliance	Award
≥ 35 %	-	Bronze*
≥ 50 %	35%	Silver
≥ 65 %	50%	Gold
≥ 80 %	65%	Platin
*this award only applies for existing buildings		

Figure 23: DGNB Criteria Weighting (ÖGNI, 2022)

Additionally, the DGNB system includes all environmental goals of the EU Taxonomy Regulation. Therefore, the evaluation of the EU taxonomy requirements is already included (see Chapter 5) in the case of certification according to ÖGNI. Similar applies

to the 2030 Agenda, as DGNB inherently supports the SDG goals. Thus, ÖGNI encourages the Austrian mainstreaming approach by highlighting concrete SDG contributions (see Chapter 4.3). However, to simplify the examination of the added value of ÖGNI-certified office buildings in regard to the achievement of the predefined SDGs, the following evaluation will solely reference to buildings in operation (GIB). In this regard, the GIB criteria catalog was favored for two reasons. First, because GIB covers the vast majority of office buildings in Austria, as it also includes buildings that have been in operation for only one year. Second, GIB has to be recertified at three-year intervals, which ensures repeated data collection. (ÖGNI, 2022)

4.1.1. Data Collection

The basic structure of the DNGB system for buildings in operation (GIB) is based on a three-pillar model (Figure 24) which splits holistic sustainability into three key aspects. Each of which is assessed by three further criteria (ÖGNI, 2022):

- Ecological Quality, which enables an assessment of global end local effects of buildings on the environment as well as resource use and waste generation:

ENV1 Climate protection and energy

ENV2 Water

ENV3 Waste management

- Economic Quality, which is used to assess long-term profitability and value development:

ECO1 Operating costs

ECO2 Risk management and value preservation

ECO3 Procurement and management

- Socio-cultural and Functional Quality, whereby buildings are assessed in terms of indoor comfort, user satisfaction, health, and key aspects of mobility options:

SOC1 Indoor comfort

SOC2 User satisfaction

SOC3 Mobility

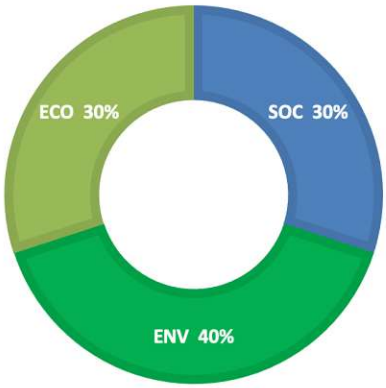


Figure 24: Three-pillars of sustainability of GIB (ÖGNI, 2022)

Accordingly, Blue Buildings comprise environmental, ecological and sociocultural indicators which are either initially assessed or monitored by performance data, using the Plan-Do-Check-Act (PDCA) structure (ÖGNI, 2022):

- Plan: Target agreement (internal data basis or comparable model building)
- Do: Data collection (evaluation according to periodicity and tool)
- Check: Data analysis and processing
- Act: Implementation of measures that improve operating

Figure 25: Life cycle costs of a building (Wehrberger, 2022)

However, excessive use of technology may even increase the total energy consumption. Yet, almost 80 percent of a building´s life cycle costs are incurred during its years of operation (Figure 25), indicating the highest improvement potential. Therefore, ÖGNI supports the idea of intelligent architecture and promotes Facility Management 4.0 (FM 4.0) which integrates operative functionality (people + space) into processes and technology (Figure 26). (Wehrberger, 2022)

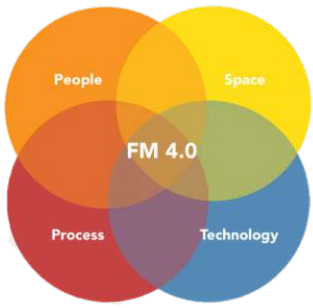


Figure 26: Facility Management 4.0 Modell, (Wehrberger, 2022)

Accordingly, GIB certification enhances performance validation for criteria which obtain performance data: ENV1 Climate protection and energy (ENV1), Water (ENV2), Waste management (ENV3), Operating Costs (ECO1) and Indoor Comfort (SOC1). Firstly, to cut down operating costs, but foremost to ensure that Blue Buildings are certified according to real-time operating data rather than plans and benchmark values. Therefore, according to ÖGNI compliance staff Florian Wehrberger, facility manager will remain crucial. Regardless of the level of automation, change processes will remain customer oriented. Therefore, a holistic approach requires (human) conflict-management to further ensure the sustainable embedding of the PDCA cycle. (Wehrberger, 2022)

4.1.2. Criteria Assessment

Table 4: Criteria Catalogue (ÖGNI, 2020)

ÖGNI v2020	Building in Operation - Criteria	Points MAX ADD
ENV1: Climate Protection and Energy		100
Intent	**Move the building toward a carbon-neutral building operation.**	
Value	By operating a building in a climate-neutral manner, the user can actively contribute to reducing greenhouse gases and thus to climate protection. Active management of energy consumption can reveal optimization potential, which leads to cost savings.	
Rating	The contribution to climate protection and the reduction of energy consumption in building operation are evaluated in both management and performance. A process is established in collaboration with all relevant stakeholders to determine the building's greenhouse gas (GHG) emissions and agree on new target values. As a result, the property is subject to a continuous improvement process.	
2030 Agenda	**Life cycle assessment of the construction: calculated GHG emissions of the building construction correspond to the balance framework "Bilanzrahmen Konstruktion".**	**10**
	Climate neutrality in building operation according to the "Framework for climate-neutral buildings and sites".	**30**
ENV2: Water		100
Intent	**The aim is to preserve the natural water cycle and minimize drinking water consumption.**	
Value	Reducing drinking water consumption lowers ongoing costs. The use of gray water and rainwater enables independence from price fluctuations and availability.	
Rating	The aim of water management is to determine and evaluate the drinking water consumption of a project. In cooperation with all stakeholders, a new target value is set which establishes the continuous improvement process.	
Circular Economy	Closed water circuit to ensure that only minimal natural fresh water is drawn for the buildings´ water requirements.	**10**
ENV3: Recycling Management		100
Intent	**The aim is to increase the recycling rate of the waste generated in a building. In addition, the total amount of waste is to be minimized and closed cycles of recyclable materials are to be maintained.**	
Value	Reducing the amount of waste generated lowers ongoing costs. Furthermore, greater fractionation of generated waste enables higher recovery/recycling rates and is associated with cost savings.	
Rating	Waste management establishes a process that evaluates the recycling rate and residual waste generation of a building in operation. Thereof, the stakeholders involved agree on new target values which further ensure continuous improvements regarding the building's management of recyclable materials.	
Circular Economy	Circular economy ensures that no waste is generated for disposal in building operations (100% recycling rate)	**10**

ECO1: Operating Costs		100
Intent	**The aim is to continuously review the distribution of financial expenditures in building operation. At the same time, the intended holistic consideration of economic, ecological and social aspects may identify the most economical way for future changes in building operation.**	
Value	In addition to manufacturing, maintenance and repair costs, operating costs represent a significant proportion of total lifecycle costs. Economic asset management requires continuous optimization of the use of economic resources. However, the future viability and value of real estate will be determined by the societal challenge of mitigating climate change and adapting our buildings to its consequences. This will require structural and operational changes, and it is necessary to develop processes and change roadmaps that identify the most cost-effective way to implement these changes.	
Rating	Operating cost management establishes a process that determines the building's operating costs and compiles new target values which continuously improves the operating process of the property.	
2030 Agenda	**Dual assessment of operating cost performance (additional assessment according to an external target value).**	**10**
Circular Economy	Cost neutrality: Due to an existing climate-neutral operation, closed water cycle or closed recyclable material cycle, the total costs for energy, water or waste are neutral.	**10**
ECO2: Risk Management and Value Preservation		100
Intent	**The goal is forward-looking management and the future viability of the property. To ensure long-term value retention, necessary building-operation related decisions must be made according to the maximum building information.**	
Value	Information on building condition, user needs, environmental risks at the site, and a potential analysis for the creation of a climate protection roadmap form an important basis for decision-making, on the one hand for active damage and cost risk management, and on the other hand as a basis for the development of cost-optimized change processes and roadmaps.	
Rating	The assessment of the building's condition and external environmental risks, as well as a survey of user needs are the basis of an action and financial plan. The potential analysis further compiles an individual climate protection roadmap.	
Innovation Space	In addition, positive evaluation of implemented alternative measures that demonstrably help to carry out forward-looking risk management and secure the value retention of the building in the long term.	analog PDCA
ECO3: Procurement and Management		100
Intent	**The aim is to reduce or avoid products and materials that are harmful to the environment and health and pose a risk in sustainable procurement and management, to promote the use of products and services with recognized environmental and social standards, and to contribute to the preservation of biodiversity in the adjacent outdoor areas.**	
Value	The value and development of a property is significantly influenced by decisions in procurement and management. Every new acquisition involves opportunities and risks for the fulfillment of the sustainability goals pursued in building operation and, as a result, for the development of the value of the property. With the help of guidelines for procurement and management, intended minimum qualities are ensured and their implementation is continuously monitored.	
Rating	In order to assess sustainability in procurement and management, guidelines for maintenance and expansion are considered. In addition, the existence of technical monitoring for the building operation cycle under consideration is examined and whether sustainable management has been demonstrably implemented.	
Circular Economy	Life cycle assessments for expansion and maintenance measures (life cycle assessment for alternative variants compared).	**5**
Innovation Space	In addition, positive evaluation of implemented alternative measures that demonstrably help to manage the building sustainably and avoid harmful products and materials.	analog PDCA

SOC1: Interior Comfort		100
Intent	**To ensure adequate indoor conditions for the activity of building users at any time of day and year.**	
Value	High air quality and pleasant room temperatures increase the well-being and performance of building occupants. A positive indoor climate with a high level of satisfaction among building users has a positive impact on the occupancy rate and marketability of the property and reduces potential cost and health risks.	
Rating	In cooperation with all stakeholders, target values are formulated to ensure thermal comfort and air quality in the interior. A complaint management system is in place to register complaints about indoor comfort. In the event of complaints about indoor comfort, a process is established to record thermal comfort and air quality by means of indoor monitoring and to demonstrably comply with the agreed target value for the property.	
2030 Agenda	**Random measurement of comfort parameters.**	**12**
SOC2: User Satisfaction		100
Intent	**The goal is to create a living and working environment that meets the demands of our diverse society and to provide offerings for building users that promote their satisfaction and well-being.**	
Value	Through a variety of offers and measures, building owners can increasingly contribute with solutions to the compatibility of work and family as well as to the topics of inclusion and health protection. Social interaction and exchange are strengthened, user satisfaction and well-being are increased, and the attractiveness of the building is decisively improved.	
Rating	In order to increase the satisfaction and well-being of the user, it is evaluated whether suitable socio-cultural offers are provided, communication and interaction between different actors is promoted and measures to promote well-being are implemented. For this purpose, the existing offers should be regularly reviewed in the company with regard to their use and need and, if necessary, further or other measures should be made available.	
2030 Agenda	**Non-smoker protection.**	**5**
Innovation Space	Additionally, positive evaluation of implemented alternative measures that have been shown to increase user satisfaction for building occupants.	analog PDCA
SOC3: Mobility		100
Intent	**Our goal is to conserve natural resources, create livable neighborhoods and spaces, reduce transportation-related emissions to air, water, soil, and increase user comfort by promoting sustainable mobility.**	
Value	The quality of mobility offers is an important location factor for the users of a building. The availability of various mobility alternatives enables an individual choice of the appropriate means of transport for different routes and thus opens up the possibility of a gradual switch to sustainable mobility in the environmental network. If the prerequisites for using a variety of mobility options are created at the building, an increase in the quality of the environment and a reduction in the negative effects of individual motorized transport can be assumed. Furthermore, the satisfaction of the users is increased, affordable mobility is expanded, and the health-promoting bicycle and pedestrian traffic is strengthened.	
Rating	Mobility is centrally linked to the building and its infrastructure as a starting point and destination. In addition to the structural condition and parking facilities for means of transport, this also involves the promotion of alternative modes of transport. For this purpose, the existing offers should be checked in the operation in the considered cycle and, if necessary, further or other measures should be made available.	
2030 Agenda	**Mobility at the building - strategy for Modal Split.**	**10**
Innovation Space	Additionally, positive evaluation of implemented alternative measures that have been shown to encourage building occupants to make extensive and frequent use of environmental transportation (non-motorized modes, public transit, or rental systems) to reach the building.	analog PDCA

4.2. WELL Certificate

Starting again with the idea of Building Certificates, GBS are built upon on the idea of environmental sustainability where the human factor only finds little consideration. (Redlein & Hax-Noske, 2016). Yet, the second generation of GBS expanded the social and economic criteria to the entire life cycle of construction projects. However, the emphasis remained rather on costs than on benefits and added value for its tenants. (Heerwagen, 2000) Rick Fedrizzi, IWBI chairman and CEO, nominates WELL Certification a second wave of sustainability where the health of a business is linked to the health and well-being of the people who work there. Hence, he refers to the six-year elaboration of WELL, which was launched in October 2014, as a movement that finally focuses on the most precious resource, the human resource. Accordingly, WELL certified buildings no longer merely provide its hygiene factors (see chapter 3.3). Well rather ensures individual health by implementing, validating and measuring interventions that support and advance wellness. (IWBI, 2020) This dedicated consideration for socio-structural aspects, however, does not claim to be a replacement of GBS but rather be seen as an additional standard that helps to be uppermost productive. (Sobchak, 2015)

In 2020, after two years of a pilot phase, the “pioneering foundation of the first version of the WELL Building Standard” was channeled into “a more accessible, adaptable and equitable rating system”. Thereto, WELL v2 draws expertise from more than 150 WELL concept advisors and incorporating feedback from thousands of global FM members. (IWBI, 2020, p. 1) The IWBI Governance Council therefore has proven a scalable and globally applicable feature of ten concepts (Figure 27) that fits any environment or organization that aims to improve its impact on both, people and environment. (IWBI, 2020)

Figure 27: Basic structure of the ten equally weighted WELL concepts (IWBI, 2020)

4.2.1. Certification System

The WELL standard approaches any economic and ecological building aspect from a human-centric perspective and is third-party certified by the Green Building

Certification Institute (BGCI) which also administers LEED, the American pendant to DGNB. (Morton, 2015)

The ten equally weighted concepts in Figure 27, however, are further monitored by 108 building features with distinct health intents. While each concept contains (one to four) precondition which need to be met, there is a much wider range of optional criteria (so-called optimizations). However, criteria scores are capped (Figure 28), thus allow individual focus of projects. Therefore, different pathways are provided that still ensure Gold or Platinum certification. (IWBI, 2020)

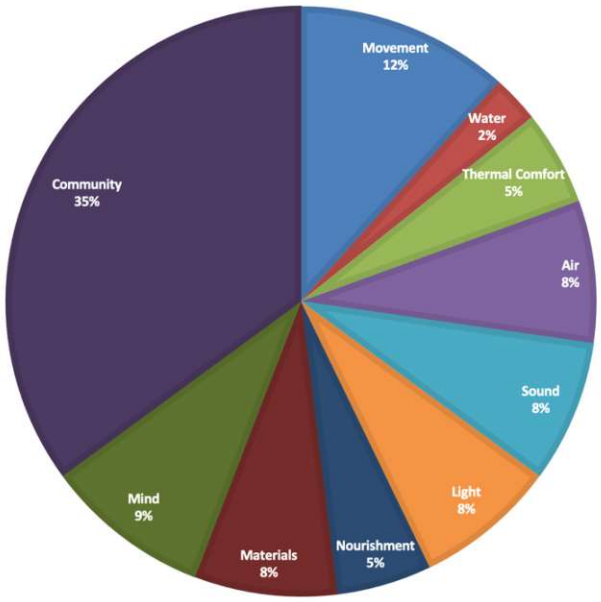


Figure 28: Point-earning potential of WELL concepts (IWBI, 2022)

Similar to the DNGB rating system (
Figure 23: DGNB Criteria Weighting

), WELL proceeds certification levels based on the number of awarded points (

Figure 29). However, each of the ten concepts may reach no more than 12 points and a total of 100 points. Additional optimization points, that exceed the twelve-point cap (Figure 28), may be submitted as innovations. Therefore, WELL provided an eleventh innovation-concept which pursues another 10 points, inclining the maximum number of points to 110. (IWBI, 2020)

Total Points Achieved	min Points per Concept	Level of Certification
40 pts	0	WELL Bronze
50 pts	1	WELL Silver
60 pts	2	WELL Gold
80 pts	3	WELL Platinum

Figure 29: Number of points for different levels of WELL Certification (IWBI, 2020)

If project owners wish to have new adaptations considered (prior to recertification), mid-cycle reviews may be submitted during any 12-month period. The project boundaries, however, need to be defined with project registration, preventing the exclusion of unreasonable building portions in order to achieve better certification. (IWBI, 2022) Ultimately, WELL Certificate distinguishes between two project types which are mostly determined by ownership (IWBI, 2020):

- "Owner-occupied" projects, that are mainly occupied by the project owner. They do not necessarily need to be the building owner but are affiliated with its regular occupants, respectively employees.
    - "Interiors" projects which represent the particular case of rentals that account for less than half of the total base building
- "WELL Core" projects, where the project owner rents most of the project space to one or more tenants. Hence, fundamental features are implemented in the core and shell of the base building and benefit all tenants.
    - Projects still under construction may achieve "precertification", using documentation based on current plans to demonstrate a projects owner´s commitment to health and well-being, thus attract potential tenants.

However, design and conditions in-place are attested for each space within a project and not the project as a whole. For example, an office building may be further specified into "regularly occupied spaces" (e.g., office rooms, dining area) and "occupiable spaces" (like balconies or storage and equipment rooms). However, space clarification ensures the inclusion of the correct criteria. (IWBI, 2020) To simplify the research question which examines the added value of WELL-certified office buildings in regard to the achievement of the predefined SDGs, the following evaluation will solely reference to owner-occupied office projects. Hence, each (Austrian) employer is able to certify its office space. Regardless whether he is the owner of the entire base building or only leasing part of it.

4.2.2. Data Collection

As already discussed in the system description, respectively points allocation above, the basic WELL structure is based on ten concepts (Figure 27). Each of which is assessed by further criteria (IWBI, 2022):

- AIR-concept, which includes strategies for source elimination, operation and behavior interventions in order to achieve high levels of indoor air quality (IAQ) across a building's lifetime:

A01 Air Quality *	A08 AQ Monitoring and Awareness
A02 Smoke-Free Environment *	A09 Pollution Infiltration Mgmt
A03 Ventilation Design *	A10 Combustion Minimization

A04 Construction Pollution Mgmt *
A05 Enhanced Air Quality
A06 Enhanced Ventilation Design
A07 Operable Windows
A11 Source Separation
A12 Air Filtration
A13 Enhanced Supply Air
A14 Microbe and Mold Control

- WATER-concept that covers aspects of the quality, distribution and control of liquid water in a building:

W01 Water Quality Indicators *
W02 Drinking Water Quality *
W03 Basic Water Mgmt *
W04 Enhanced Water Quality
W05 Drinking Water Quality Mgmt
W06 Drinking Water Promotion
W07 Moisture Mgmt
W08 Hygiene Support
W09ß Onsite nonportable Water Reuse

- NOURISHMENT-concept encourages healthy food choices and nutritional transparency in order to establish healthy eating habits, thus occupant's health:

N01 Fruits and Vegetables *
N02 Nutritional Transparency *
N03 Refined Ingredients
N04 Food advertising
N05 Artificial Ingredients
N06 Portion Sizes
N07 Nutrition Education
N08 Mindful Eating
N09 Special Diets
N10 Food Preparation
N11 Responsible Food Sourcing
N12 Food Production
N13 Local Food Environment
N14ß Red and Processed Meat

- LIGHT-concept provides task-appropriate requirements for lighting environments which minimize visual, mental and biological health disruption:

L01 Light Exposure *
L02 Visual Lighting Design *
L03 Circadian Lighting Design
L04 Electric Light Glare Control
L05 Daylight Design Strategies
L06 Daylight Simulation
L07 Visual Balance
L08 Electric Light Quality
L09 Occupant Lighting Control

- MOVEMENT-concept ensures movement opportunities through environmental design and programs:

V01 Active Buildings & Communities *
V02 Ergonomic Workstation Design *
V03 Circulation Network
V04 Facilities for Active Occupants
V05 Site Planning Selection
V06 Physical Activity Opportunities
V07 Active Furnishings
V08 Phys. Activity Spaces & Equipment
V09 Physical Activity Promotion
V10 Self-Monitoring
V11ß Ergonomics Programming

- THERMAL COMFORT-concept which promotes human productivity by providing a maximum level of thermal comfort among all building users:

T01 Thermal Performance *
T02 Verified Thermal Comfort
T03 Thermal Zoning
T04 Individual Thermal Control
T05 Radiant Thermal Comfort
T06 Thermal Comfort Monitoring
T07 Humidity Control
T08ß Enhanced Operable Windows
T09ß Outdoor Thermal Comfort

- SOUND-concept approaches acoustical comfort parameters, thus occupant experiences in the built environment:

S01 Sound Mapping *
S02 Maximum Noise Levels
S03 Sound Barriers
S04 Reverberation Time
S05 Sound Reducing Surfaces
S06 Minimum Background Sound
S07ß Impact Noise Mgmt
S08ß Enhanced Audio Devices
S09ß Hearing Health Conservation

- MATERIALS-concept aims to reduce human exposure to materials and chemicals that may impact health:

X01 Material Restrictions *
X02 Interior Hazardous Mat. Mgmt *
X03 CCA and Lead Mgmt *
X04 Site Remediation
X05 Enhanced Material Restrictions
X06 VOC Restrictions
X07 Materials Transparency
X08 Materials Optimization
X09 Waste Mgmt
X10 Pest Mgmt & Pesticide Use
X11 Cleaning Products and Protocols
X12ß Contact Reduction

- MIND-concept addresses the diverse factors that influence cognitive and emotional well-being:

M01 Mental Health Promotion *
M02 Nature and Place *
M03 Mental Health Services
M04 Mental Health Education
M05 Stress Mgmt
M06 Restorative Opportunities
M07 Restorative Spaces
M08 Restorative Programming
M09 Enhanced Access to Nature
M10 Tobacco Cessation
M11 Substance Use Services

- COMMUNITY-concept aims to establish an engaged, diverse occupant community with an inclusive culture and health for all needs:

C01 Health and Well-Being Promotion *
C02 Integrative Design *
C03 Emergency Preparedness *
C10 Family Support
C11 Civic Engagement
C12 Diversity and Inclusion

C04 Occupant Survey *	C13 Accessibility and Universal Design
C05 Enhanced Occupant Survey	C14 Emergency Resources
C06 Health Services and Benefits	C15ß Emergency Resilience&Recovery
C07 Enhanced Health &W-B Promotion	C16ß Housing Equity
C08 New Parent Support	C17ß Responsible Labor Practices
C09 New Mother Support	C18ß Support for Victims of Dom Violence

- Additional INNOVATION-concept paves the way for additional project developments and unique strategies:

I01 Innovation WELL	I04 Gateways to Well-Being
I02 WELL Accredited Professional (AP)	I05 Green Building Rating System
I03 Experience WELL Certification	I06ß Carbon Disclosure and Reduction

The total of 122 criteria features (whereof 108 provide distinctive building operation monitoring) rather ensure diverse projects to pursue their individual strategies than complying all targets. The surplus of credit points (Figure 28) indicates the wide offer range and provides project developers with various focus options. Therefore, WELL may rather be seen as a toolbox to choose from than a checklist to work through. Apart from the asterisk-marked preconditions (see (*), list above), all targets are potential optimizations. Features adopted by an “ß”, are so-called betta strategies that require additional documentation in order to support IWBI in developing new features. (IWBI, 2022) All other features follow a performance-based system, whereby repeated performance verifications ensure the intended (high-) performance of a building. Therefore, authorized WELL agents validate the project´s documentation by completing on-site tests. Subsequently, certain criteria features require annual data reports, maintenance documentation and/ or occupancy surveys. (IWBI, 2020) However, certification is valid for three years and has to be recertified thereafter. To be eligible for recertification, projects must have met the requirements of progress monitoring and annual data submissions. Upon expiration, however, all WELL Certified plaque and other signage has to be removed and must no longer be utilized for the corporate image (see Chapter 3.3). (IWBI, 2022)

4.2.3. Criteria Assessment

Table 5: Criteria Catalogue (IWBI, 2022)

WELL v2	New and Existing Buildings - Criteria	Points MAX ADD
A: Air		12
Intent	**The concept aims to achieve high levels of indoor air quality across a building's lifetime through diverse strategies that include source elimination or reduction, active and passive building design and operation strategies and human behavior interventions.**	
Value	Achieving the goal of clean indoor air requires both professionals and building users to engage not just in the conversation but also in the implementation of adequate approaches. Although indoor air quality can be managed primarily through eliminating the sources of air pollution and through adequate design solutions and human behavior modification, some WELL features require installation of a specific treatment method or technology.	
Precondition	Air Quality, Smoke-Free Environment, Ventilation Design, Construction Pollution Management.	
Optimization	Enhanced Air Quality, Enhanced Ventilation Design, Operating Windows, Air Quality Monitoring and Awareness, Pollution Infiltration Management, Combustion Minimization, Source Separation, Air Filtration, Enhanced Supply Air, Microbe and Mold Control.	**18**
W: Water		12
Intent	**Aspects of water quality and distribution, as well as the control of liquid water in a building are covered by that concept. It includes features that address the availability and contaminant thresholds of drinking water, as well as features targeting the management of water to avoid damage to building materials and environmental conditions.**	
Value	The aim is to increase the rate of adequate hydration in building users, reduce health risks due to contaminated water and excessive moisture within buildings and provide adequate sanitation through better infrastructure design and operations coupled with awareness and maintenance of water quality.	
Precondition	Water Quality Indicators, Drinking Water Indicators, Basic Water Management.	
Optimization	Enhanced Water Quality, Drinking Water Quality Management, Drinking Water Promotion, Moisture Management, Hygiene Support, Onsite Non-Portable Water Reuse.	**14**
N: Nourishment		12
Intent	**The WELL Nourishment concept requires the availability of fruits and vegetables and nutritional transparency. It encourages the creation of food environments, where the healthiest choice is the easiest choice.**	
Value	By encouraging individuals to make healthier choices, the aim is to combat the double burden of disease currently facing the world's population: a large proportion of the population is malnourished and suffers from micronutrient deficiencies. On the other hand, overweight, obesity and non-communicable diseases are on the rise. In fact, an unhealthy diet poses a greater risk of morbidity and mortality than drug, alcohol and tobacco use combined. Further, diets inextricably link human health and environmental health and sustainability. The current global transition towards unhealthy and unsustainably produced food is threatening global food systems as food production remains one the largest contributors to global environmental change.	
Precondition	Fruits and Vegetables, Nutritional Transparency.	
Optimization	Refined Ingredients, Food advertising, Artificial Ingredients, Portion Sizes, Nutritional Education, Mindful Eating, Special Diets, Food Preparation, Responsible Food Sourcing, Food Production, Local Food Environment, Red and Processed Meats.	**16**

L: Light		12
Intent	**The criteria concept promotes exposure to light and aims to create lighting environments that promote visual, mental and biological health. The latter may be created by a lighting environment that reduces circadian phase disruption, improves sleep quality and has a positive impact on mood and productivity.**	
Value	All light - not just sunlight - can contribute to circadian photoentrainment. Given that people spend much of their waking day indoors, insufficient illumination or improper lighting design can lead to drifting of the circadian phase, especially if paired with inappropriate light exposure at night. Further, studies have shown that light exposure has an impact on the mood and reduces symptoms of depression in individuals. Currently, lighting conditions in most spaces are designed to meet the visual needs of individuals but do not take into account circadian and mental health.	
Precondition	Light Exposure, Visual Lighting Design.	
Optimization	Circadian Lighting Design, Electric Light Glare Control, Daylight Design Strategies, Daylight Simulation, Visual Balance, Electric Light Quality, Occupant Lighting Control.	**18**
V: Movement		12
Intent	**By promoting physical activity in everyday life through environmental design, policies and programs, movement opportunities are integrated into the fabric of our culture, buildings and communities to reduce time spent sitting. Thereto, sedentary behavior has been linked to poor health outcomes, including obesity, type II diabetes, cardiovascular risks and premature mortality.**	
Value	The impact of changing the global physical activity narrative is substantial. Worldwide, if physical inactivity were reduced by 10%, more than half a million deaths could be averted, while over one million deaths could be averted, if physical inactivity was reduced by 25%. Furthermore, the elimination of physical inactivity has been predicted to increase the global lifespan by an average of 0.68 years.	
Precondition	Active Buildings and Communities, Ergonomic Workstation Design.	
Optimization	Circulation Network, Facilities for Active Occupants, Site Planning Selection, Physical Activity Opportunities, Active Furnishings, Physical Activity Spaces and Equipment, Physical Activity Promotion, Self-Monitoring, Ergonomics Programming.	**21**
T: Thermal Comfort		12
Intent	**The WELL Thermal Comfort concept aims to promote human productivity and provide a maximum level of thermal comfort among all building users through improved HVAC system design and control and by meeting individual thermal preferences.**	
Value	Thermal comfort is one of the most important factors influencing the overall satisfaction of people in buildings by affecting individual levels of motivation, alertness, concentration and mood. Through its influence on the integumentary, endocrine, and respiratory systems, thermal comfort also plays a major role in our health, well-being, and productivity. Beyond its individual impact, however, the indoor thermal environment also affects a building's energy consumption, as cooling and heating account for about half of a building's energy consumption.	
Precondition	Thermal Performance.	
Optimization	Verified Thermal Comfort, Thermal Zoning, Individual Thermal Control, Radiant Thermal Comfort, Thermal Comfort Monitoring, Humidity Control, Enhanced Operable Windows, Outdoor Thermal Comfort.	**16**

S: Sound		12
Intent	**Occupant health and well-being is aimed to be bolstered through the identification and mitigation of acoustical comfort parameters that shape occupant experiences in the built environment.**	
Value	Only in recent years has it been determined that exposure to noise sources – such as traffic and transportation, but also sound within an enclosed space from sources, such as HVAC equipment, appliances and other occupants – have been shown to hinder the health and well-being of people in a number of different ways. For instance, the effects of exterior noise from transportation or industrial sources have been linked to sleep disturbance, hypertension and the reduction of mental arithmetic skills. A number of studies have also indicated that internally generated noise is a major cause of complaint and ultimately results in occupant dissatisfaction. However, consistent background sound levels can be introduced into a space using a sound masking system, thus improving the signal-to-noise ratio in favor of acoustical privacy between occupants.	
Precondition	Sound Mapping.	
Optimization	Maximum Noise Levels, Sound Barriers, Reverberation Time, Sound Reducing Surfaces, Minimum Background Sound, Impact Noise Management, Enhanced Audio Devices, Hearing Health Conservation.	**18**
X: Materials		12
Intent	**Reduction of human exposure, whether direct or through environmental contamination, to chemicals that may impact health during the construction, remodeling, furnishing and operation of buildings.**	
Value	The chemical industry played a major role in improving life expectancy and the quality of life over the past 150 years. However, the health and environmental impacts of most chemicals in circulation, despite their ubiquity, are unknown. Many of the chemicals that were ubiquitously used in the past have been found to be typically toxic, persistent and prone to bioaccumulation. Commonly used in building materials and products, these chemicals have a much longer use phase. The WELL Materials concept advances two strategies for selecting building materials and products. One is to increase literacy on materials by promoting ingredient disclosure, whereas the second is to promote the assessment and optimization of product composition in order to minimize impacts to human and environmental health. Both strategies aim to bridge data gaps in the supply chain, supporting innovation in green chemistry and advancing market transformation towards healthier and more sustainable products.	
Precondition	Material Restrictions, Interior Hazardous Materials Management, CCA and Lead Management.	
Optimization	Site Remediation, Enhanced Material Restrictions, VOC Restrictions, Materials Transparency, Materials Optimization, Waste Management, Pest Management and Pesticide Use, Cleaning Products and Protocols, Contact Reduction.	**18**
M: Mind		12
Intent	**Mental health is promoted through policy, program and design strategies that seek to address the diverse factors that influence cognitive and emotional well-being.**	
Value	Mental health is not simply the absence of a mental health condition. Rather, it is a state of well-being, in which individuals are able to live to their fullest potential, cope with the normal stresses of life, work productively and contribute to their community. Mental health is determined by a range of socio-economic, biological and environmental factors, such as work conditions, lifestyle and health behaviors.	
Precondition	Mental Health Promotion, Nature and Place.	
Optimization	Mental Health Services, Mental Health Education, Stress Management, Restorative Opportunities, Restorative Spaces, Restorative Programming, Enhanced Access to Nature, Tobacco Cessation, Substance Use Services.	**19**

C: Community		12
Intent	**The aim is to support access to essential healthcare, build a culture of health that accommodates diverse population needs and establish an inclusive, engaged occupant community.**	
Value	Promoting community well-being must begin with supporting the fundamental factors that influence individual and collective health. Providing equal and affordable access to comprehensive health services supports better individual and community health outcomes, reducing health disparities and overall healthcare costs. Health promotion programs, from immunization programs and on-demand services to paid sick leave policies and incentive-based initiatives, can improve employee job satisfaction, self-esteem and overall health, while reducing health risks.	
Precondition	Health and Well-Being Promotion, Integrative Design, Emergency Preparedness, Occupant Survey.	
Optimization	Enhanced Occupant Survey, Health Services and Benefits, Enhanced Health and Well-Being Promotion, New Parent Support, New Mother Support, Family Support, Civic Engagement, Diversity and Inclusion, Accessibility and Universal Design, Emergency Resources, Emergency Resilience and Recovery, Housing Equity, Responsible Labor Practices, Support for Victims of Domestic Violence.	**39**
I: Innovation		10
Intent	**Innovation features pave the way for projects to develop unique strategies for creating healthier environments.**	
Value	The innovation features are either a novel concept or strategies pre-approved by IWBI. Regarding the first option, a strategy that is not already included in the WELL features must follow a guideline on the requirements that must be met in order for an innovation proposal to be considered for approval.	
Precondition	-	
Optimization	Innovation WELL, WELL Accredited Professional (WELL AP) Experience WELL Certification, Gateways to Well-Being, Green Building Rating System, Carbon Disclosure and Reduction.	**28**

4.3. SDG Compliance

According to ÖGNI and WELL experts, their Building Certifications inherently support the 2030 Agenda. Following the Austrian mainstream approach, both criteria catalogues highlight concrete SDG contributions (Figure 30), thus raises awareness for holistic sustainability in the construction sector. (ÖGNI, 2022) In regard to Chapter 3.3, environmental, social and governance (ESG) investments - and their labeling - are highly valuable for the corporate identity as today´s tenants demand resilient, fair-playing businesses. (IWBI, 2022) In addition, the overall labor shortage stimulates the entire work environment to attract potential tenants and employees. In this respect, SDG compliance may be the deciding factor when it comes to choosing one company or the other. (Homm & Granabetter, 2022)

However, the aim of the thesis is to examine the “Impact of Building Certificates in regard to the implementation of relevant SDGs”. Therefore, Figure 30 identifies the dedication of both criteria catalogues regarding SDG three, seven and eight. The selection of relevant SDG, however, is already derived in the complexity of previous chapters and therefore not further discussed.

Contribution of Building Certifications to the implementation of relevant SDGs			
# 3: Good Healt and Well Being			
WELL		ÖGNI	
Air	A01, A02, A03, A04, A05, A06, A08, A09, A10, A11, A12, A13, A14	Environment	ENV 1, ENV 3
Water	W01, Wo2, W03, W05, W08, W09ß,	Ecology	ECO 2, ECO 3
Nutrition	N01, N03, N07, N12, N14ß	Sociology	SOC 1, SOC 2, SOC 3
Light	L01, L02, L03, L04, L05, L06, L07, L09		
Movement	V01, V03, V04, V05, V06, V07, V08, V09, V10		
Sound	S02, S07ß, S09ß		
Materials	X01, X02, X03, X04, X05, X06, X07, X08, X09, X10, X11, X12ß		
Mind	M01, M02, M03, M04, M05, M06, M07, M08, M09, M10, M11		
Community	C14, C115ß		
Innovation	I05		
#7 Affordable and Clean Energy			
WELL		ÖGNI	
Air	A10	Environment	ENV 1
Light	L01, L02, L05, L06		
Innovation	I05		
#8 Decent Work and Economic Growth			
WELL		ÖGNI	
Light	L02	Environment	ENV 1, ENV 2
Community	C12, C17ß, C18ß	Ecology	ECO 1, ECO 3
		Sociology	SOC 3

Figure 30: Identification of concrete SDG contributions according to official ÖGNI and WELL certification catalogues. (ÖGNI, 2020) (IWBI, 2022)

In order to allow better comparison, Figure 31 illustrates the contribution (in form of credit points) of ÖGNI targets whereas Figure 32 considers WELL criteria. A detailed description of targets and content may be found in Chapter 4.1.1 and 4.2.1, respectively their following Assessment Chapter.

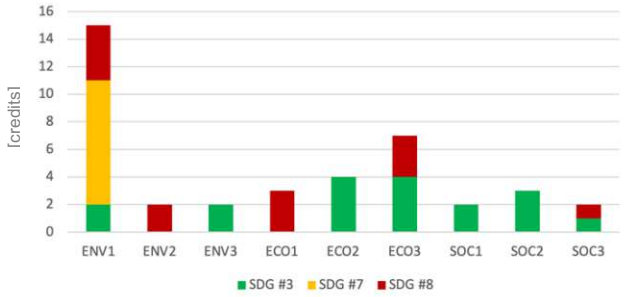


Figure 31: ÖGNI compliance with SDGs

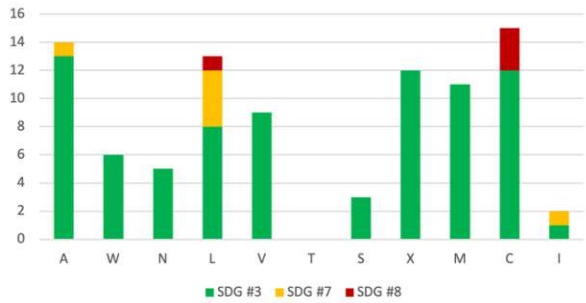


Figure 32: WELL compliance with SDGs

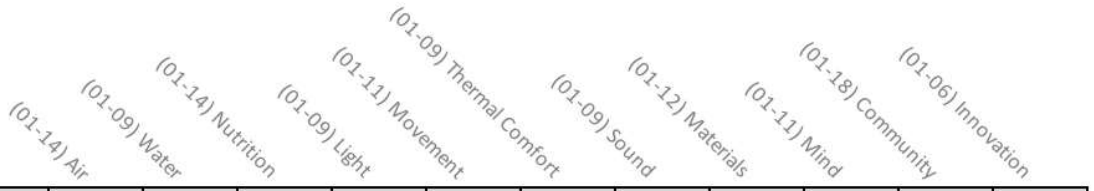
In this context, the calculation basis of ÖGNI criteria follows the assessment strategy of DGNB experts, found in their official GIB criteria catalog of 2020. Therein, target contributions were categorized into three levels: significant, moderate and minor.

(ÖGNI, 2020) In order to obtain a comparable weighting of the two certificates, ÖGNI targets that contribute significantly to the achievement of the SDGs under consideration were weighted with three credit points. Moderate contribution with two credits and minor contributions correspondingly with one credit point. Hence, the following distribution of credit points (Figure 33) resulted in the cumulative representation of Figure 31.

[credits]	SDG Relevance	Environment			Ecology			Societal		
		ENV 1	ENV 2	EVN 3	ECO 1	ECO 2	ECO 3	SOC 1	SOC 2	SOC 3
3	significant	7.1, 7.2, 7.3, 8.4	-	--	8.4	-	-	-	3.4	-
2	moderate	-	8.4	3.9	-	3.4, 3.9	3.4, 3.9, 8.4	3.4	-	-
1	minor	3.4, 3.9, 8.2	-	-	-	-	8.7	-	-	3.4, 8.4
Σ		15	2	2	3	4	7	2	3	2

Figure 33: Contribution of ÖGNI target criteria to relevant SDGs

The WELL criteria score, on the other hand, derived from the frequency and number of WELL targets assigned to each of the three SDGs in the official WELL catalogue. (IWBI, 2022) For example, WELL experts linked 13 of the 14 AIR concept goals to SDG3 (Figure 34). Therefore, 13 credit points were distributed to SDG3 in Figure 32. Respectively, WELL experts assigned one AIR target also to SDG7 whereas none was allocated to SDG8, adding an additional credit point to the AIR concept for SDG7. Overall, 80 percent of WELL features were found to be in line with at least one of the 17 SDGs.



SDG Relevance	A	W	N	L	V	T	S	X	M	C	I
#3	13	6	5	8	9	-	3	12	11	12	1
#7	1	-	-	4	-	-	-	-	-	-	1
#8	-	-	-	1	-	-	-	-	-	3	-

Figure 34: Number of WELL indicators related to relevant SDGs

5. European Green Deal

The European Green Deal, unveiled by the European Commission (EC) in late 2019, aims to create the first carbon-neutral continent by 2050. Therefore, the EC adopted a set of proposals in order “to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions”. Hence, all 27 EU Member States pledged to reduce emissions by at least 55% (from 1990 levels) by 2030. (EC, 2022) In July 2021, the European Climate Change Act (Regulation 2021/1119/EU) entered into force. Consequently, the European Commission compiled the "Fit for 55" package of “reformed and new EU directives” to achieve updated 2030 targets. (EC, 2022) In this context, the Renewable Energy Directive, for example, was revised in 2018. It´s legal obligation entered force in June 2021. Additionally, the European Commission's Directorate-General for Climate Policy is currently proposing to increase the share of renewables by a further 8 percentage points (to 40 percent by 2030). (EC, 2022) Likewise, most measures of “Fit for 55” are constantly balanced and revised in order to further ensure market-driven revolutions. In this respect, the following examples are intended to give an impression of the nature of revisions (EN, 2022):

- The revision of the Energy Taxation Directive aims to ensure taxation of fuels according to their energy content and environmental performance rather than volume. Maximum rate taxation of fossil fuels (oil, gasoline, etc.) will help businesses and consumers to make climate-friendly choices and secures green tax revenues for member states.
- The implementation of a Carbon Boarder Adjustment Mechanism (CBAM) will prevent the undermining of European climate objectives. As corresponding carbon certificates put a price on imports of carbon-intensive products, international partners are also encouraged to reduce global production emissions.
- The revision of the Energy Performance of Buildings Directive (EPBD) aims to implement an Energy Performance Certificate (EPC) for new and existing buildings. Hence, EPBD complements the zero-emission directive for new construction by increasing the renovation rate of existing buildings. Since the vast majority of existing buildings have poor energy performance, promoting renovations has a high savings potential.

Hence, revisions and expansions of the legal framework follow precautionary and “polluter-pays” principles. Accordingly, European companies remain both, sustainable and economic competitive at the global market - regardless whether they are subject to the EU Emission Trading System (ETS) or not. (EN, 2021)

However, understanding developer´s inducement to align with the UN´s 2030 Agenda is most relevant for this thesis. Therefore, correspondent investment funds incorporate

environmental, social, and governance (ESG) data and services into individual project strategies. Furthermore, these ESG-aligned activities ensure standardized, comparable and reliable quality standards that provide leadership advantage in corporate identity. However, ESG information was found to be misused by different methodologies and initiatives. Accordingly, the EU Taxonomy aims to increase transparency and accountability by integrating the European Classification of Economic Activities (NACE) into EU legislation. (EC, 2022)

5.1. EU Taxonomy

In 2020, the Technical Expert Group on Sustainable Finance (TEG) was set up as part of the European Green Deal, aiming to redirect money towards sustainable projects to further improve Europe´s economic, business, and social resilience to climate change. (EC, 2022). In order to enhances ESG transparency and comparability, TEG developed an Action Plan for financing sustainable growth. Creating a list of economic activities that are considered environmentally sustainable, the EU Taxonomy (Regulation 2021/2139/EU) was among the first measures of the action plan and set out a framework for a common classification system (Figure 35). (de Gier, et al., 2022) However, the Taxonomy does not require full compliance of all six objectives but follows the principle of doing no significant harm (DNSH principle). Accordingly, not all principles must be achieved but none of them may be negatively affected by a simultaneous target action. (TEG, 2020)

Figure 35: Six Environmental Objectives of the EU Taxonomy, following the DNSH principle (TEG, 2020, p. 2)

Yet, the Taxonomy entered force on July 4th, 2020, supplementing Regulation 2020/852/EU. Ever since, the EU Taxonomy provides large companies (which fall under the scope of the Non-financial Disclosure, see Chapter 5.2), investors and policymaker with appropriate definitions for which economic activities can be considered environmentally sustainable. (EC, 2022) Furthermore, the regulation refers to the inclusion of ESG factors and initiates environmental, social and legal benchmark considerations to foster sustainable long-term activities. (WKO, 2022) The European Green Deal and it´s EU Taxonomy, however, are as much of an ongoing process as

the 17 SDGs and UN´s 2030 Agenda. Therefore, this paper refrains from comparing the Technical Screening Criteria (TSC) of economic activities in more detail but refers to the TEG´s table of “substantial contribution to climate change mitigation” (TEG, 2020, p. 56) However, the EU Taxonomy only provides voluntary objective criteria and does not impose binding requirements for economic activities of companies. Accordingly, TSC encourage the transition towards sustainability by increasing the reputation of green financial products and prestige for investors (see also Chapter 3.3). (EC, 2021) Furthermore, the creation of an official certification system protects private investors from greenwashing. Common funds elaborate a better understanding for climate-friendly activities a company may target. (EC, 2022) Thus, the classification system is “highly relevant for companies that aim to obtain investments through green bonds and EU level loans”. (Ecobio, 2022)

5.2. Sustainability Reporting

In December 2016, the National Sustainability and Diversity Improvement Act (NaDiVeG) implemented the Non-Financial Reporting Directive (NFRD) (Regulation 2014/95/EU) into Austrian law. Thus, "non-financial and diversity-related information" have been included in the annual financial statements of relevant capital market-oriented companies (PIE). (WKO, 2017) In April 2021, the NFRD was revised and published in the Corporate Sustainability Reporting Directive (CSRD) draft in June 2022 (Figure 36). The preliminary plenary session for the final vote on the provisional political agreement between the European Council and Parliament, however, was postponed until end of 2022. (Braun & Melde, 2022)

EU Revision	Non-Financial Reporting Directive (NFRD)	Corporate Sustainability Reporting Directive (CSRD)
Adoption	adopted by the European Commission (EC) in 2004	adopted by the EC in 2021, applicable from 2024
Directive´s Goal	strengthening companies’ accountability towards stakeholders on ESG topics	providing more verifiable, accessible, coherent non-financial data while ensuring alignment between (non-) financial standards
Reporting Entities	applies mainly to large public companies with more than 500 employees	companies that meet one or more criteria: €40 million in net turnover, €20 million on the balance sheet, 250 or more employees
Framework	based on a set of non-mandatory guidelines	based on a set of mandatory EU Sustainability Reporting Standards
Compulsoriness	ESG information reported shall integrate within companies´ annual reports	companies must assess how their strategy and business model aligns with and impacts ESG matters

Figure 36: Revision from NFRD to CSRD (Struharova, 2021, p. 1)

Yet, the proposed CSR Directive significantly expands the group of companies which are subject to the reporting framework. Accordingly, the implementation for reporting entities follows the layered model shown in Figure 37. (Braun & Melde, 2022)

Figure 37: Timeline for the reporting entities (Struharova, 2021, p. 3)

Furthermore, the revision of NFRD expands the materiality principles for application and introduces a dual materiality assessment. Hence, items are classified “material” if they contribute to either one of the following:

- the financial success of a company
- environmental, respectively social matters

Up to now, both factors had to be met which is why only a little number of companies had to conduct annual non-financial reports. Therefore, Austrian legislation remained with the recommendation of reporting according to the global GRI standard to meet the requirements of the NaDiVeG. (Braun & Melde, 2022) Yet, the CSRD proposal also revises the European Sustainability Reporting Standard (ESRS) in order to provide “relevant, faithful, comparable and reliable information”. With the expected effective date of January 1, 2024, the ESRS will thus combine financial and non-financial information. Hence, both end users and stakeholders which are affected by the material sustainability impacts of the reporting company will be informed about the reporting entity's sustainability objectives, position and performance. Furthermore, the distinction between sector-specific, sector-independent and company-specific disclosures (following the GRI framework) limits the current autonomy of companies in determining the content of their (random) sustainability reports, further preventing greenwashing. (Baumüller & Sopp, 2022)

5.3. ESG Compliance of Building Certificates

Understanding that the development of non-financial to sustainability reports is not only about the terminology used but the perceived lack of consensus on the form and content of corporate ESG reporting, ESRS requirements will put sustainability reporting on an equal basis with financial reporting. (Baumüller & Sopp, 2022) In this context, the current variety of existing frameworks and the unclear legal status of reporting guidelines reports induced reports that are neither disclosed comprehensively nor provide detailed ESG. (Machado, et al., 2021) Although studies connect differences

in the extend and style of reporting to respective cultural and socioeconomic environments, no regularity could be attributed to the focus of reporting or the application of standards. (Fifka & Drabble, 2012) That is where CSRD comes in with the prescription of ESRS application. However, ESRS architecture is not yet fully subject to public consultation. (Hartmann & Kühle, 2022) Therefore, this thesis does not compare or evaluate the contribution of building certificates in regard to CSRD compliance. Rather, respective references of ÖGNI and WELL experts towards ESG compliance (Figure 35) are compiled in this chapter.

On that note, green building certifications are already market standards and an important competitive advantage for developers. (Meshcheryakova, 2021) As the Taxonomy´s transition to a green economy unfolds, however, their ESG compliance becomes more important. (Leduc, 2022) Hence, regardless whether a business is subject to the disclosure requirement or not, ESG represents a solid and provable basis for banks and eventual investors. (ÖGNI, 2022) For this reason, ÖGNI also offers support through its Taxonomy Advisors, who check buildings for Taxonomy compliance or define possible improvement measures if needed. (ÖGNI, 2021) Considering thereto that eight European green building panels (including DGNB and ÖGNI) collaborate on the TSCs and proposed Circular Economy Directive (DGNB, et al., 2022), ÖGNI experts try to ensure that buildings certified under the DGNB system include all TSC data. Accordingly, ÖGNI certification automatically co-evaluates Taxonomy compliance. (ÖGNI, 2022) Yet, ESG reporting is to be conducted in the annual financial statement report of businesses in order to obtain quality and comparability. (Braun & Melde, 2022) ÖGNI certificates, however, pass three-year periods, which requires technical compliance testing to be repeated twice in the building's recertification cycle. However, data infrastructure and collection should be ensured. (ÖGNI, 2022)

The American WELL standard, however, does not claim EU Taxonomy compliance but provides a dedicated “method for measuring and reporting on human and social capital metrics”. Therefore, standardized disclosure is transparently embedded in the corporate´s culture and IWBI aims to build its own identity. (IWBI, 2022) In this regard, the research team developed the so-called 12 Competences to “better define, track and measure their human and social capital strategies within their ESG, CSR, sustainability and regulatory disclosures and reporting”. (IWBI, 2022, p. 2) The recent framework hence provides businesses with measurable ESG targets and forms universally accepted corporate strategies to approach, thus promote human and social capital measures. (Figure 38). Furthermore, the twelve competencies identified track multiple metrics over time and ensure a common language for a new industry standard. Accordingly, current health measures, for example, are limited to illness and injury indicators rather than benchmark values which also map (in)direct impacts of investments on tenant health and well-being. (IWBI, 2022)

	12 Competences	Measurement Categories
Individual	Health and Well-Being	Physical and mental health, resilience and behaviors
	Thriving	Work-life balance, role strain, purpose, energy, ability to recharge
	Performance Energy and Performance Motivation	Employee thriving, work structure and relationships, engagement, perceived core and support
	Employee Effectiveness	Perceived focus, attention and performance, job satisfaction
Organizational	Organizational Performance	Organizational, leadership and employee effectiveness, financial well-being
	Organizational Culture and Engagement	Organizational strategy and execution, structure, relationships and communication, talent management, engagement
	Risk Management	Diversity, equity and inclusion, emergency preparedness, health and safety, asset and organizational resilience
	Environment of Care and Support	Workplace and leadership, actual and perceived support of well-being, collective well-being
Environment.	Ambient Environmental Quality	Performance testing on light, air quality, thermal comfort, acoustics, water quality
	Occupant and Market Perceptions of Indoor Quality	Perceived satisfaction, indoor environmental quality, health and safety, aesthetics and design, inclusive design, design for sense of place
Comm.	Community and Stakeholder Engagement	Community engagement policies and initiatives, shared/ collective values and practices, location and amenities, equity and historical acknowledgement
Global	ESG Transparency and Reporting	ESG, CSR, UN SDGs, carbon reporting, green building standards, natural capital, biodiversity impact reporting

Figure 38: The 12 Competencies and supporting measurement categories (IWBI, 2022)

6. Discussion

The first major united nations conference on global environmental issues took place as early as 1972 (UN, 2018). Greenhouse gas (GHG) emissions, however, are still rising, fueled by globally moving tilt effects (Conca, 2021). Thereto, national GHG concentration (measured in ppm, for those who still wonder about the most important indicator of our generation) increased faster and stronger over the last ten years than ever before. Devastating result for Austrian climate policy, considering that only five other European nations have failed to reduce their carbon emissions. Reinhard Steurer, political scientist at the University of Natural Resources and Applied Life Sciences in Vienna thus holds the political and social distortion of the climate crisis responsible. Additionally, the complex and delayed consequences of the climate system cause displacement and denial of the crisis itself as there are no immediate occurrences to our individual actions. Moreover, people like to believe that long-term impacts will be solved in far future by descendants of the homo superior. This dismissal of the climate “challenge”, however, is highly dangerous. Coming back to the fact that nine tilt effects are already in motion, reaching the actual tilt point of only one of them will trigger all other 14 effects and incite uncontrollable self-running mechanisms. (Steurer & Streibl, 2022) Yet, the Austrian mainstreaming approach still shifts the federal responsibility to individuals, promoting voluntary climate protection. (BKA, et al., 2017)

6.1. Generation Awareness Raising

The historian Rutger Bregman, who dismissed the Davos-Elite in 2019, also criticizes today´s understanding of activism as we confuse awareness-raising with real actions. (Bregman, 2022) Thereto, Chapter 3.4 introduced the attitude-behavior-gap where behavioral dynamics pose the problem of “self-reports don't change behavior” (Gifford, 2014, p. 547) Accordingly, the Austrian mainstreaming approach of the 2030 Agenda had its initial justification but was neither implemented accordingly, nor followed by serious attempts such as legislative proposals in parliament. (Bregman, 2022) Hence, the lack of legal adoptions to the SDGs highlights the Austrian illusion of human prevalence on the climate system once more. Furthermore, the absence of legislative measures sets us in far distance to the scientific excursion which longs for an objective discourse and climate reality. Indeed, Sustainable Development Reports (see Chapter 3.1) show positive trends. Their pace, however, is simply too slow. Returning thus to the statement of Greta Thunberg which was stated in the thesis´s introduction, one would not be calmed about the fire truck going the right direction, when his speed only lets him arrive when everything has already burned down. (Steurer & Streibl, 2022)

6.2. Structural Reinvention

According to the relatively new behavioral reasoning theory (BRT) which examines the interlinkages between beliefs, reasons, motives, intentions, and behavior, ME310 prototyping (see Chapter 3.4) also indicated that once-voiced attitudes not always match future actions. As implicit behavior is highly influenced by individuals´ assumptions of the norm, BRT experts link habits and sustainability vices to structural conditions and available infrastructure. (Wintschnig, 2021) Therefore, structural barriers and their dampening influence on individual motivation is important to understand. More important, however, is the mitigation of individual responsibility through effective laws. (Gifford, 2014) In this context, people often hold two attitudes simultaneously about complex objects. In order to retrieve full capacity of explicit attitudes, one attitude towards an object must be consolidated. Therefore, domestic policies must follow and internalize adequate societal norms. (Wintschnig, 2021) As sustainability is predestined for this discrepancy, all 193 UN member states committed to the implementation of the 2030 Agenda in 2015. Austria, however, did neither adjust its legislative nor establish a systematic implementation strategy. (Obrovsky, 2018) Much rather, national politicians set further ambitious goals, pretending climate action as they do not dare to take action against the powerful business lobby. (Koch, 2019) Yet, available data already suggest that Austria will miss its climate targets for 2030. (Steurer & Streibl, 2022) In this context, the capitalist world prevails pseudo climate protection as we persistently hold on to the idea of growth - pledging more profit, more jobs, more money. (Schieritz, 2020)

The construction sector, however, already links sustainable consideration to quality features that attract prospective tenants and users. Accordingly, the Austrian Office Marked Report 2022 considers the implementation of Green Building Certificates as a matter of course, representing the corporate image and ESG placements. (Homm & Granabetter, 2022) In this regard, eight European Green Building Councils already tested the upcoming Technical Screening Criteria (TSC) of the proposed Circular Economy directive. Although the consortium´s final report will not be available until early 2023, the interim feedback already provides the transition from a technical proposal to functioning system for Europe. Furthermore, the study consortium embraced and welcomed the taxonomies´ high ambitions for Circular Economy. However, they also questioned the different efforts needed for TSC alignment of various taxonomy objectives (Figure 35) where only one needs to be fulfilled and no other significantly harmed (DNSH principle). As other objectives like the protection of water or the protection of biodiversity were found to be less challenging, the consortium warns about cherry-picking. (DGNB, et al., 2022)

In addition, the upcoming revision of non-financial reporting will also increase the demand for building certificates due to the simple dependence of the rising number of

CSRD reporting entities. (Struharova, 2021) Therefore, the consortium´s intermediate project report emphasizes the importance of further strengthening existing certifications, labels and methods. In this way, the scope for interpretation is limited and problems in data collection can be avoided. (DGNB, et al., 2022)

6.3. Paradigm Shift

Considering GenZ´s shifting values and attitudes towards sustainability, decent work environments have become “must haves” rather than “nice to have”. Accordingly, modern office buildings adopted the sustainable lifestyle of its tenants in order to compete on the demand-regulated marked. Hence, the utopia of Silicon Valley headquarters like Google has become more accessible. (Homm & Granabetter, 2022) However, these (voluntarily certifiable) adoptions of the built environment are rather easy to implement. Not only technically but also in society as they do not restrict our lifestyle but add personal value and well-being. Yet, global inequalities rise and climate activists call for joint renunciation, joint revolt and joint demand for structural change. (Schieritz, 2020) To this end, most reports - especially semi-scientific articles which inherently form society’s understanding of the climate crisis -portray the destruction of planet Earth as the result of human activity. This, however, fades the liability of our ultimate actions as we subjectively value events close in time fundamentally different than those of far distance. The technical term “hyperbolic discounting” therefore holds psychology responsible for bad decision making if effects of actions are intangible for individuals. (Teufl, 2018) Accordingly, humankind should not focus on the ultimate end scenario, but on immediate changes that have impacts on us and people we (will) know. In this context, climate crisis needs to be reframed to increase societal pressure. Hence, structures will only change once the pressure of democracy is so high that politicians lose elections if they just pretend climate protection. (Steurer & Streibl, 2022) In this respect, construction law could instantly introduce mandatory green building certificates without greater obstacles. Moreover, the lower limit of sustainability would be raised for the entire life cycle of buildings with immediate effect. (ÖGNI, 2022) However, this legislative act would demand unpopular responsibilities of Austrian governance.

7. Conclusion

While chapter 6 discussed rather political points of the SLR such as the system´s failure to create a genuine sustainable movement in Austria, the conclusion relates to the research questions. In this regard, the thesis at hand examined two building certificates and their impact on the 2030 Agenda. As chapter 4.3 already elaborates, both ÖGNI and WELL contribute to the implementation of relevant SDGs in the construction sector. Accordingly, Figure 39 illustrates both criteria distributions, emphasizing their different focuses.

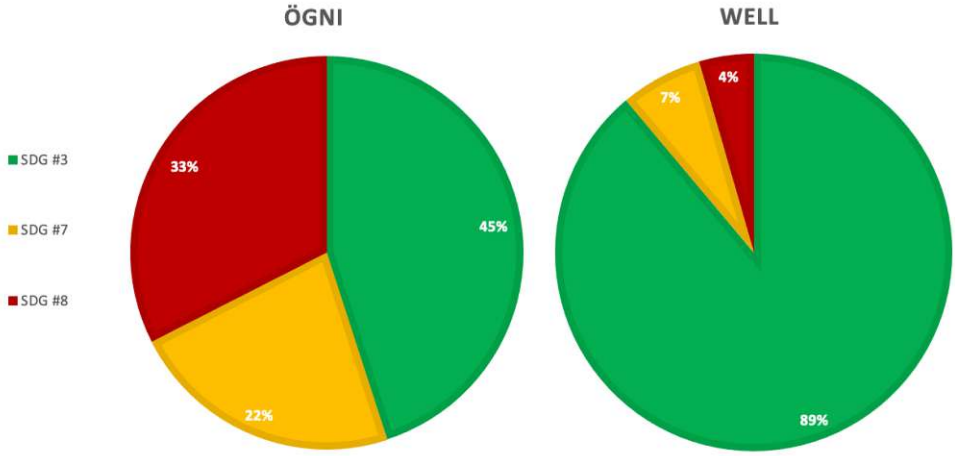


Figure 39: SDG contribution of both building certificates ÖGNI and WELL

Referring to the left-hand circle, ÖGNI contributes almost equally to all three dimensions of the 2030 Agenda´s sustainable development. The GBS catalogue thus promotes the goal of reduced energy consumption and material resources by socio-technical processes and well-balanced constraints, incorporating user dynamics and individual perception of comfort. (Meshcheryakova, 2021) In this regard, ÖGNI enables synergies of all three pillars of sustainability best.

WELL criteria, on the other hand, substantially focus on SDG3, dedicating almost 90 percent to the health and well-being of its tenants. Compared to ÖGNI, WELL projects included twice as many human centric criteria in their evaluation. Yet, user´s needs not only find better consideration in early stages of planning, but also reward tenants with new considerations for the human perception of built structure. As presented in chapter 3.3, increased comfort will lead to higher productivity and also reward companies that plan their department according to WELL criteria. Understanding that employees statistically change job every 4.2 years, soft benefits and incentives are more important than ever to attract motivated, young talents. (Bortz, 2022)

In regard to the other two dimensions, however, IBWI is well aware that its standard rather compliments GBS than replacing them. Therefore, the thesis refrains from

preferring one standard but recommends the promotion of both. Only their joint, holistic consideration may change social routines: ÖGNI ensures the sustainable and economic approach, while WELL keeps individuals engaged through increased well-being and self-actualization (see Figure 16). Yet, the CFP (Chapter 3.4) empirically showed, that stated intentions rarely ensure its implementation (attitude-behavior gap). Therefore, a genuine sustainable reduction of a building´s emissions must require full commitment of all stakeholders. (Janda, et al., 2016) In this regard, green loans currently seem to be the best instrument for realizing the full potential of certified buildings. (Kaplow, 2009) In the end, all stakeholder - not to mention the climate crisis we mitigate thereby – benefit from sustainable buildings (Figure 40).

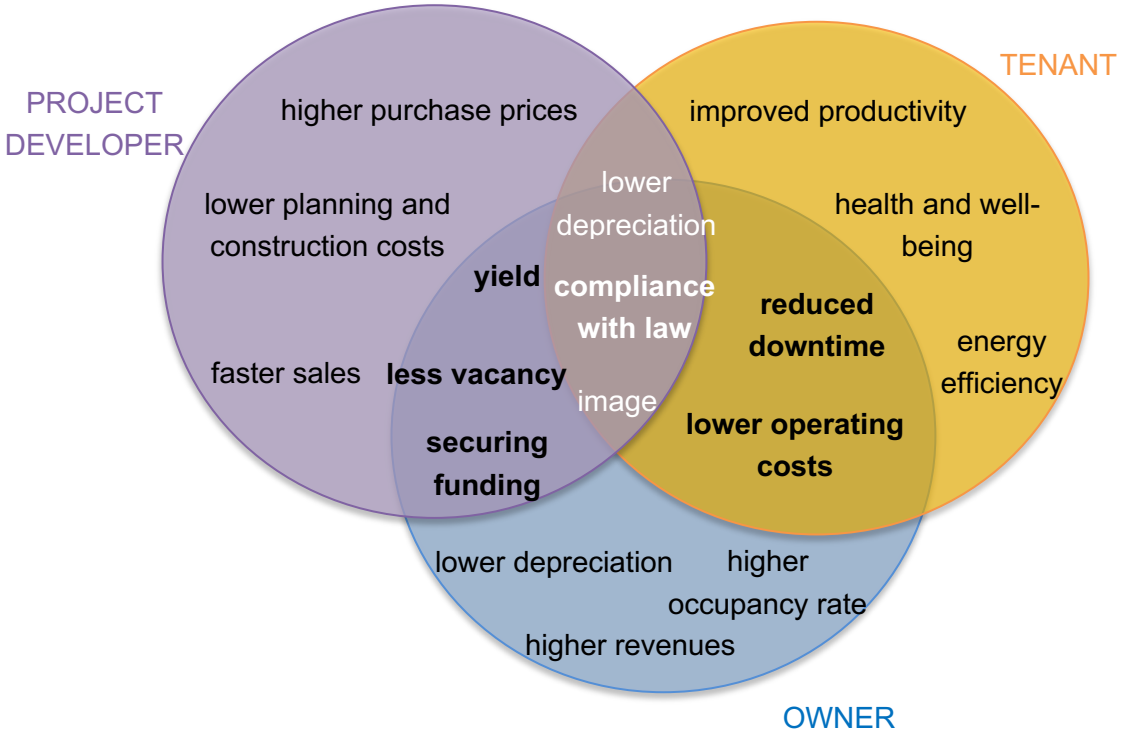


Figure 40: Respective incentives to own, rent or develop a sustainable property (Gasser, 2022)

8. Appendix

Excerpt of (Callinan, et al., 2021), concerning the CFP conducted by Team AREC:

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

IFM

Prototype #1 - Competition

Saving energy by gamification

Team AREC
Me310students@ifm.tuwien.ac.at
Date: 01.02.2021

1 Contents

2 Measurement and scoring system

2.1 Energy measurement

All competing work desks (with all their belonging devices) were prepared with smart plugs, which were linked to the app "smart life". The measured energy consumption during the competition were related to the consumption of the reference week of each participant. The scoring system itself depended further on the saving amount. The scoring system was as followed:

Energy Consumption - Smart Plugs	
Ranking	**Points**
1. Place	25 pts.
2. Place	21 pts.
3. Place	18 pts.
4. Place	15 pts.
5. Place	12 pts.
6. Place	10 pts.
7. Place	9 pts.
8. Place	8 pts.
9. Place	7 pts.
10. Place	6 pts.
11. Place	5 pts.
12. Place	4 pts.
13. Place	3 pts.
14. Place	2 pts.
15. Place	1 pts.
16. Place	0 pts.
17. Place	0 pts.
18. Place	0 pts.
19. Place	0 pts.

Figure 1.: Table of scoring system – Energy consumption

2.2 Printing History

Each Friday all printed pages of each participant were evaluated. Therefore, we set the sheets printed in black-white and the colored ones in relation. The recorded number of black-white sheets were multiplied with 0,02 [cent/sheet], whereas the colored prints were multiplied 0,14 [cent/sheet]. The team with the least prints was considered first place, whereby the scoring system was as followed:

Printing (divided)	
Ranking	**Points**
1. Place	20 pts.
2. Place	10 pts.
3. Place	5 pts.

Figure 2.: Table of scoring system – Printing

2.3 Room temperature

The room temperature was measured with preinstalled RPI´s and evaluated with the program SAP Lumira. Each week was set in comparison to their reference week measurements. The team with the biggest saving amount got 8 points, whereas the others were considered with zero points.

2.4 Creativity points

Energy saving ideas were collected daily. The amount of points variated from 15 to 0. The scoring assignments were considered internally.

3 General findings

- During the second week of the competition all team were constantly under their average value, whereas it was not that stringent the first week.
- Just the awareness of saving energy is not enough to actually start saving. Sales department Table 6 was not knowing his energy consumption was measured as well and he was not measurably saving.
- The Team C with the influencer showed more approach in gaining creativity points with sending ideas on 6 days whereas other teams only did once in the second week of the competition.
- The physical idea-box was not used at all as they preferred the more flexible way of sending emails for sharing their ideas.
- The visualization and the call for attention for the close ranking supported the engagement in participating (especially in the final week of competition).

4 General observations

- Group A was saving the most energy in total but due to not participating with creativity points and/or lowering the temperature they only got 3rd place.
- Average values for the competition were very different from the groups. Group C was already very low in energy use in general. Therefore, saving a lot of energy was not easy. They did a great job catching up with creativity points, little printing and room temperature.
- Only the group with the influencer decreased the room temperature.

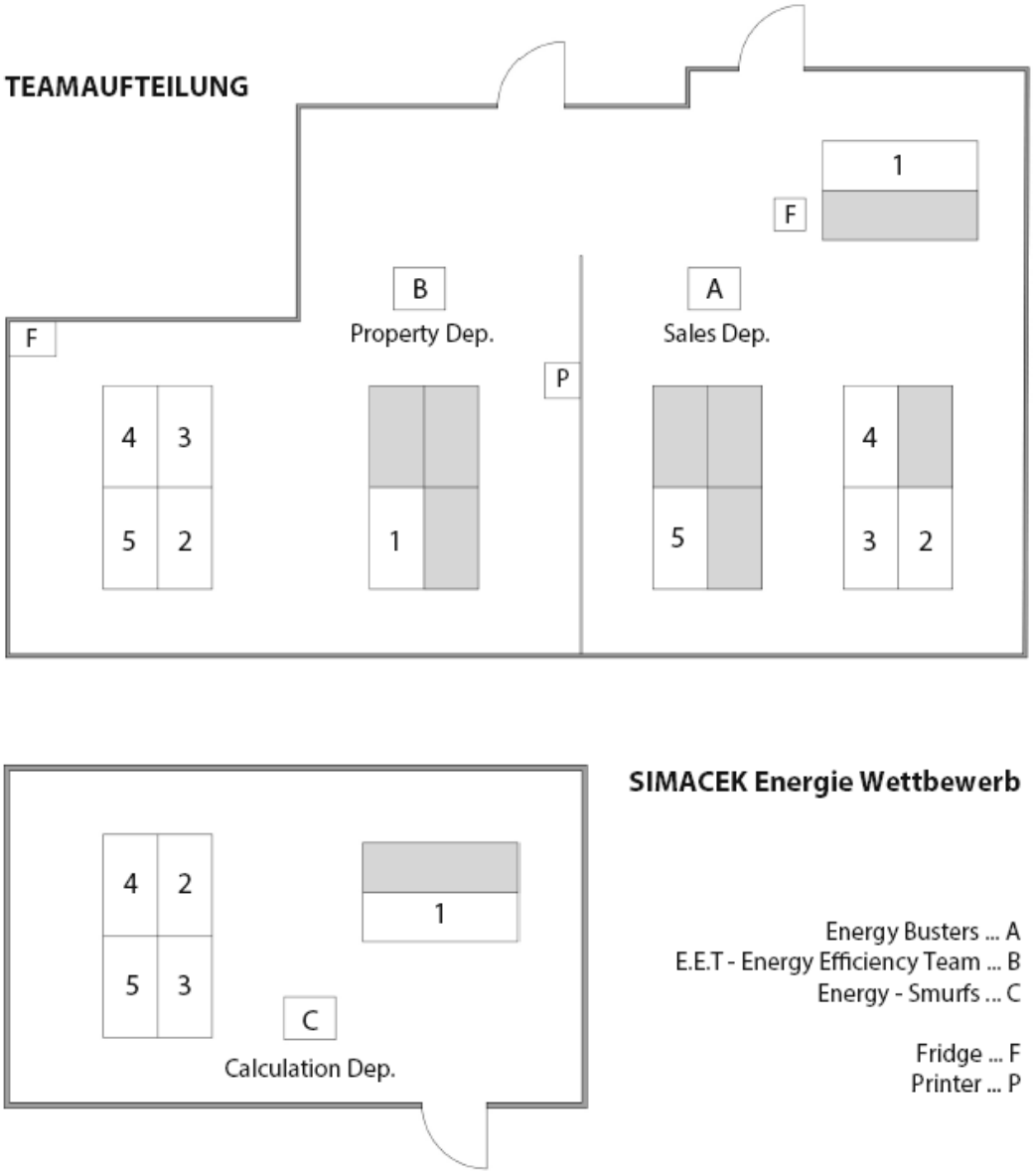
TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

Competition
SIMACEK Facility Management Group GmbH
creativity points

IFM

date	groups	points	idea
22.01.2021	group C - Calculation	10,00	Heating blankets use energy too
	Explanation of the scoring:		only Information
22.01.2021	group C - Calculation	15,00	Masterplug for whole workdesk
	Explanation of the scoring:		good idea + easy to implement
22.01.2021	group C - Calculation	15,00	more sufficient standby mode for monitores
	Explanation of the scoring:		good idea + easy to implement
22.01.2021	group C - Calculation	10,00	change all bulbs to LED
	Explanation of the scoring:		important to implement, but basic idea
22.01.2021	group C - Calculation	5,00	switch off seiling light
	Explanation of the scoring:		copied from the playbook, but indeed important
22.01.2021	group C - Calculation	5,00	reduce total number of printer
	Explanation of the scoring:		no personal effort to safe
22.01.2021	group C - Calculation	5,00	eco mode for dishwasher
	Explanation of the scoring:		holistic approach to raise awareness
22.01.2021	group C - Calculation	10,00	install motion detector
	Explanation of the scoring:		good idea, but too easy to implement
22.01.2021	group C - Calculation	5,00	maintainance of HVAC
	Explanation of the scoring:		adaptions/renewables would make a difference
22.01.2021	group C - Calculation	10,00	limit heating/cooling temp
	Explanation of the scoring:		nice strucutral, long term idea
22.01.2021	group C - Calculation	10,00	invest in new, more efficient IT
	Explanation of the scoring:		long term effect
26.01.2021	group C - Calculation	15,00	provide desklamps
	Explanation of the scoring:		good idea + easy to implement, well reserached
26.01.2021	group C - Calculation	0,00	buy new Monitores+PC
	Explanation of the scoring:		same as investing in new IT
26.01.2021	group C - Calculation	10,00	install PV + Windcraft on the roof
	Explanation of the scoring:		structural, long term effect
28.01.2021	group C - Calculation	10,00	wall and roof greening
	Explanation of the scoring:		structural, long term effect
28.01.2021	group A - Sales	15,00	switch off monitores in longer breaks and after work
	Explanation of the scoring:		good idea + easy to implement
28.01.2021	group A - Sales	15,00	turn down temp. and switch off devices when leavin
	Explanation of the scoring:		good idea + easy to implement
28.01.2021	group A - Sales	15,00	intermittent full ventilation instead of tilting
	Explanation of the scoring:		good idea + easy to implement
28.01.2021	group A - Sales	15,00	use natural light to the fullest
	Explanation of the scoring:		good idea + easy to implement
28.01.2021	group C - Calculation	15,00	generate energy by walking (piezometer)
	Explanation of the scoring:		very creative idea
28.01.2021	group C - Calculation	10,00	convert to geothermal heating
	Explanation of the scoring:		structural, long term effect
28.01.2021	group B - Property	15,00	switch off monitores in longer breaks and after work
	Explanation of the scoring:		good idea + easy to implement
28.01.2021	group B - Property	10,00	reduce brightness of monitores
	Explanation of the scoring:		nice idea

28.01.2021	group B - Property	15,00	provide desklamps
	Explanation of the scoring:		good idea + easy to implement
28.01.2021	group B - Property	10,00	change all bulbs to LED
	Explanation of the scoring:		important to implement, but basic idea
28.01.2021	group B - Property	15,00	affix foils to the window to prevent overheating
	Explanation of the scoring:		good idea + easy to implement
28.01.2021	group B - Property	15,00	close doors to the aisle to hoald the room temp
	Explanation of the scoring:		good idea + easy to implement, raising awareness
28.01.2021	group B - Property	0,00	use curtains to prevent overheating
	Explanation of the scoring:		same idea as affixing foils
28.01.2021	group B - Property	5,00	ventilate early mornings (summer)
	Explanation of the scoring:		lack of explenation
28.01.2021	group B - Property	10,00	set temp.by a time switch
	Explanation of the scoring:		nice strucutral, long term idea
28.01.2021	group B - Property	10,00	separate offices to reduce the qm to heat/cool
	Explanation of the scoring:		nice idea
28.01.2021	group B - Property	15,00	set printing settings (eco mode)
	Explanation of the scoring:		good idea + easy to implement, raises awareness
29.01.2021	group C - Calculation	15,00	use recycled printingpaper
	Explanation of the scoring:		good idea + easy to implement, raises awareness
29.01.2021	group C - Calculation	15,00	only print how much you need
	Explanation of the scoring:		good idea + easy to implement, raises awareness
29.01.2021	group C - Calculation	0,00	participate for CO2 certificates
	Explanation of the scoring:		only Information, no idea to safe energy
29.01.2021	group C - Calculation	15,00	generate energy by pedals
	Explanation of the scoring:		very creative idea



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12. Glossary

Absenteeism annual number of days (or hours) of absence due to illness.

AREC Austrian Real Estate Consortium, consisting of Immofinanz,

Austrian Council for Sustainable Development independent non-governmental advisory board that connects representatives from academia, business, civil society and government to advance the 2030 Agenda.

Baby Boomer a person born in the years following World War II, when there was a temporary increase in the birth rate.

Benchmarking Research and information gathering in order to understand where technologies may have succeeded due to new features and markets or failed due to previous limitations in manufacturing techniques.

Biophilic design concept used within the building industry to increase occupant connectivity to the natural environment.

Blue Building term for Green Buildings which moves away from the pure energy efficiency aspect toward holistic sustainability over the entire life cycle of a building; also assessing sociocultural aspects.

Comfort a state of physical ease and freedom from pain or constraint.

Decent work employment that respects physical and mental integrity of the worker.

“Green” an eco-friendly or environmentally focused adjective that describes something as less harmful to the environment and useful for promoting awareness about environmental issues.

Green Building Certification rating system to assess a building or a construction project's performance from a sustainability and environmental perspective.

Environment the direct or indirect surroundings of an individual, this term used by itself commonly refers to the natural world in addition to human civilization.

Energy Consumption the use of energy; often used in this document in reference to a building.

Energy Efficiency using less energy (in this context electricity) to accomplish the same task; this is commonly used in a ”green” context since the majority of electricity used is made by burning fossil fuels which is detrimental to the environment.

Generation X-ers those born between 1965 and 1979/80.

GenZ those born between1997 and 2012.

Good-Health condition of the body and the extent to which it is free from illness or is able to resist illness

Home Office work model where you are working from home, especially trendy due to COVID-19

Infrastructure resources required to support a system or organization; in this context it refers to physical resources that support the working environment such as office spaces or electrical systems that power an office.

Internet of Things the network of physical objects that contains embedded technology to communicate and sense or interact with their internal states or the external environment.

Mainstreaming Implementation strategy which embeds the objectives in as many instances as possible in order to create a broad foundation for the goals.

Medical complaints Incidents of reported medical complaints resulting from the physical work environment or work activity.

Medical costs Expenses associated with providing medical insurance or medical care to employees annually.

Millennials a person born after 1980, reaching young adulthood in the early 21st century.

Need perceived lack; something that is missing in order to do something properly.

Need Finding the act of discovering people's explicit and implicit needs so that designers can create appropriate solutions.

Opinion a personal viewpoint or belief that may or may not be founded on substantial fact.

Physical complaints Number and type of complaints of physical discomfort associated with the work environment (e.g. temperature, glare, noise).

Shared Spaces working spaces that allow individuals to rent individual desks or offers an option for those who do not have centralized offices.

Staff turnover Percentage of regular, full time employees leaving employment in a given year.

Sustainable long lasting and maintainable; often, in reference to a process involving reducing negative impact on the environment.

Temperature measure of the average kinetic energy of the particles in a sample of matter, ex- pressed in terms of units or degrees designated on a standard scale such as Fahrenheit or Celsius.

Traditionalists individuals born between 1927 and 1946.

Well-Being state of being happy and comfortable.

Work environment office surroundings or home office space.

Working remote a situation in which an employee works apart the office; not necessarily from home.

13. Abbreviations

AREC —Austrian Real Estate Consortium, ME310 sponsors: Immofinanz, ÖSW and Simacek

ATX — Austrian Traded Index

BRT — Behavioral Reasoning Theory

CFP — Critical Function Prototype, Design Thinking Method

COP — Conference of the Parties, annual UN Framework Convention on Climate Change

COVID-19 — Coronavirus disease originating in 2019 that has caused an ongoing global pan- demic.

CSRD — Corporate Sustainability Reporting Directive, preliminary revision of the NFRD

DGNB — Deutsche Gesellschaft für nachhaltiges Bauen, 2007 founded NGO promoting sustainability in the German construction industry

DNK — Deutscher Nachhaltigkeitskodex, German transparency standard for reporting corporate sustainability performance,

DNSH — Do no significant harm, EU Taxonomy criteria

EC — European Commission, representing European interests

EU — European Union, representing European governments

EP — European Parliament, representing European citizens

ESRS — European Sustainability Reporting Standard

ETS — EU Emission Trading System

GBCI — Green Business Certification Inc.; Organization that provides LEED and WELL Certificates

GBS — Green Building Standard

GFA — gross floor area is the total floor area in a building

GHG — Greenhouse Gases

GRI — Global Reporting Initiative, globally recognized (non-financial) sustainability reporting framework

HLPF — High-Level Political Forum on Sustainable Development; replacing the Conference on Sustainable Development (CSD) since UN Rio+20 conference, 2012

HVAC — Heating, ventilation, and air conditioning systems in buildings

IAEG — the UN Inter-Agency and Expert Group on SDG Indicators

IAQ — Indoor air quality; subject to pollutants within a building

IMAG — Interministerielle Arbeitsgruppe, official SDG representatives delegated by each Austrian federal ministry

IoT — Internet of Things; the interconnectedness of all devices via a cloud-based system

IWBI — International Well Building Institute

LCA — Life Cycle Analysis

LED — Light emitting diode, often used in light bulbs or light sources

LEED — Leadership in Energy and Environmental Design, Green Building classification system, developed by the USGBC in 1998

MA — Millennium Ecosystem Assessment, a UN study on the global status of 24 key ecosystem services, 2001

ME310 — Mechanical Engineering Class 310, Stanford University course in Engineering Design, Entrepreneurship and Innovation

Mgmt — Management

MOU — Memorandum of Understanding

MSR — Measurement and Control

NACE — European Classification of Economic Activities, integrating national and international statistical institutions

NaDiVeG — Nachhaltigkeits- und Diversitätsverbesserungsgesetz, Austrian implementation of the European NFRD

NFRD — Non-Financial Reporting Directive, EU Regulation

NGO — Non-Governmental Organization

OECD — Organization for Economic Cooperation and Development

ÖGNI — Österreichische Gesellschaft für nachhaltige Immobilienwirtschaft, 2009 founded NGO promoting sustainability in the Austrian construction industry

ÖNORM — national Austrian standard, issued by the recognized Austrian Standard Institute

PEB — Plus Energy Building, a building that creates more energy than it consumes

PIE — Public Interest Entity, companies with a significant public interest (e.g., listed companies with relevant size and corporate status such as banks, insurance firms, etc.)

RH — Rechnungshof, Austrian Court of Audit

ROI — Return of Investment

SBS — sick building syndrome, associates human health conditions with the time spent in indoor structural spaces

SDG — Sustainable Development Goal, set forth by the UNFCCC to help battle global climate change in the 2030 Agenda, 2015

SME — small and mid-sized enterprises

STAT — Statistik Austria, statistical office of the Republic of Austria

TEG — Technical Expert Group on Sustainable Finance, set up in 2020 to develop the EU Taxonomy Action Plan

TSC — Technical Screening Criteria, measuring EU Taxonomy compliance

UNFCCC — United Nation Framework Convention on Climate Change, 1994

UniNEtZ — Universitäten und nachhaltige Entwicklungsziele, Austrian university program for options and measures for sustainable development, 2012-2021

USGBC — Green Building Council, 1993 founded NGO for sustainable and environmentally friendly energy concepts in buildings

WELL — performance-based system to measure, certify and monitor features of the built environment that impact human health and wellbeing

WHO — World Health Organization, 1948 founded UN agency responsible for international public health

WorldGBC — World Green Building Council, 2002 founded NGO and a global network of national green building councils