DEPARTMENT OF BIOLOGICAL AND ENVIRONMENTAL SCIENCES

IMPLICATION FOR THE UNIVERSITY OF GOTHENBURG TO ALIGN WITH THE GOVERNMENT'S TARGET REGARDING CLIMATE NEUTRALITY BY 2045

Scenarios and Consequences

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ABSTRACT

It is widely acknowledged that one of the most significant global challenges of the 21st century is climate change. In its Fifth Assessment Report (2014), the Intergovernmental Panel on Climate Change (IPCC) described the present extent of the problem and the hazards involved, citing greenhouse gas emissions from human activities as the primary contributor to global warming since the mid-20th century. With the last ten years showing the highest global average surface temperatures ever recorded (0.8°C above pre-industrial levels), we are already experiencing a global climate that advanced industrial societies have never confronted. As one of the major societal components, higher education institutions (HEIs) play a crucial role. They should quickly limit their carbon emissions to lessen the adverse effects of their operations on the planet and also in teaching the next generation of leaders to build a worldwide sustainable structure through distributing skills and knowledge across organizations, the government, and the general public. Within this lies the fundamental challenge toward achieving the reduction targets in carbon footprint at the regional, national, and global levels—evaluating greenhouse gas emissions from educational organizations. Numerous initiatives have been made at universities in Sweden and in other parts of the world to achieve Carbon Neutrality and a future that is ecologically sound. It might be advantageous to make behavioral changes in university residents to encourage sustainability and to use more efficient energy sources on campus. This study has examined the sustainability strategies that might be included in the operational plans of universities, with variations based on the particular institution's policies. The strategies put into action were divided into seven "sustainability categories", which are: the more sustainable built environment, energy, greenhouse gas (GHG) emissions, nutrition and horticulture, management of resources and waste, transportation, and water. Each of these categories sets the higher education institution on an appropriate path for determining the magnitude of its carbon footprint and makes its approach more logical and scientific. The research on how worldwide institutions operate in the benchmarking process was a key component of this study's empirical portion, which offers distinctive information. This review highlights how universities are putting sustainability programs into practice in line with their goals and objectives. Despite working toward the same end goal of becoming carbon neutral, various institutions provide distinctly different perspectives on sustainability. The results of this study have significance in identifying those educational institutions that have a strong commitment to becoming Carbon Neutral. Such climate-action initiatives at other universities may be facilitated by such role-model institutions. Due to several external factors like geographic and socio-political situations, higher education institutions' carbon footprints are highly diverse and exhibit various patterns. For instance, as some universities are situated in arid regions, their carbon footprints significantly increase when they employ inefficient energy sources to cool the buildings. Another aspect of this study is finding a thorough definition for the terms "Climate Neutrality", "Net Zero emissions", and other related concepts in accordance with their unique definitions in the context of universities. In addition, The University of Gothenburg's long-term and short-term goals have been investigated together with the sustainable strategies described. Ultimately, information was provided regarding the research done in Sweden regarding carbon capture and storage CCS. Additionally, it addressed whether the University of Gothenburg, one of the Swedish Universities, would be able to use this technology at hand.

Keywords: Climate Neutrality, GHG emissions, higher education institutions (HEIs), Net Zero emission, carbon footprint, carbon capture, and storage (CCS).

1 INTRODUCTION

One of the most significant problems confronting humanity right now is global warming. It has been established that anthropogenic activities have a detrimental effect on the ecosystem by raising greenhouse gas (GHG) emissions (IPCC, 2022). People are currently dealing with the reality of climate change and its impacts. As a strategy to counter this global issue, the development of a sustainable way of life has been discussed.

The Paris Climate Agreement was signed in 2015 by 196 countries with the aim of keeping global warming far below 2°C above pre-industrial levels and taking additional steps to decrease it to 1.5°C above pre-industrial levels (Unfccc, n.d.). Immediate action is required to reduce global GHG emissions by 44% below 2010 levels by 2030, with Net Zero emissions by 2050, in order to keep global warming at 1.5°C. There are many different methods to define carbon neutrality, thus it is important to come to an agreement on one definition to prevent confusion. (Sen et al., 2022). Since the Paris Agreement in 2015, the scientific community and international leaders have come to the urgent conclusion that the severity of the climate catastrophe necessitates exceptional cooperation and transformation from civilizations Is an immediate issue that requires systemic adaptation at all levels of society and in many spheres of existence.

Independent of the timing of CO_2 release, the relationship between cumulative CO_2 emissions and global temperature rise is closely linear. It is unmistakably a global effort (Supervisor & Mccormick, 2016). The IPCC claims that it is possible to achieve carbon neutrality globally by 2050 and keep warming to 1.5°C, but they highlight that this goal will need significant socioeconomic and political transformation. Various carbon budgets were put forth by the IPCC Working 3 Group I (WGI) in 2013, each one corresponding to a different probability of staying below the 2-degree limit. This budget is reduced by roughly one-fifth when non- CO_2 emissions are taken into account. It seems that we need be cautious with all emissions if we want to meet the targets (Cintas et al., 2017). Climate change mitigation and adaptation to its potential effects demand unprecedented cooperation and innovative effort. In order to reduce the world average temperature increase to 1.5°C by 2100, Net Zero emissions must be accomplished by 2050 (IPCC, 2018).

The European Union (EU) has made progress in combating climate change; in 2008, the EU established a goal of lowering greenhouse gas emissions (GHG) by 20% (from 1990 emission levels) until 2020, which was accomplished in 2017. The EU boosted its pledge to reduce GHG by 40% in 2030 before the Paris Agreement was signed in 2015; this commitment has since been enhanced to 55% by 2030 (Viable Cities,2021). The long-term goal for the EU was set at "achieving a climate-neutral and growing economy by 2050," which calls for an 80% decrease in GHG emissions and the development of sustainable methods of offsetting any residual emissions (Supervisor & Mccormick, 2016).

By 2045, Sweden has made the national decision to become carbon neutral (the EU by 2050) (Ministry of Climate and Enterprise,2021). This strategy is supported by the national effort the climate framework for universities and colleges (Omrcen et al., 2018).

It is distinctly and unmistakably believed that universities can have an impact on climate change responses through their investigation, instruction, and dedication to renewable energy sources, as well as through their operational commitments to climate change mitigation and adaptation. Reevaluating a university's commitments to sustainability and putting sustainable development practices in place are crucial stages towards lowering its GHG emissions and becoming carbon neutral. The University of Gothenburg signed a climate framework along with other universities (Staff Portal, 2020). The HEIs that have signed on believe that protecting the environment is an important and pressing issue for the future, and they pledge to act by the year 2030 to keep within the Paris Agreement's 1.5C warming limit. The University of Gothenburg intends to cooperate as one of the higher education institutions, in order to significantly advance global efforts to combat climate change in accordance with social, governmental, and international standards.

Modeling the performance of other concerned educational institutions is a low-risk and practical technique to identify the best approach for Climate Neutrality. This will affect the methods used by various institutions around the world to achieve the same goal. Additionally, this will help in comparing universities around the world as they develop different foundations and techniques to become carbon neutral. This research further demonstrates the steps that must be taken in order to achieve carbon neutrality. Therefore, it evaluates and examines the range of sustainability approaches that universities can use. This research will serve as a general guideline for higher education institutions through an analysis and comparison of sustainability initiatives at universities, which will help such institutions contribute to climate action to be more successful. Research papers on carbon-neutral universities are available, but they do not compare initiatives on a global level.

The University of Gothenburg's Vital Goals is to reduce emissions by 25% by the end of 2023, to eliminate 50% of its carbon footprint by the end of 2029 with the baseline of 2019, and to be in line with the government's goal of achieving Climate Neutrality by the year of 2045. The University of Gothenburg committed to reducing overall emissions in order to achieve the 1.5°C science-based goal, thus it is important to fully understand the objectives and to look into the facilities that the University of Gothenburg has access to in order to achieve these goals.

Reducing carbon emissions as much as possible is the University of Gothenburg's primary and significant sustainability objective. All institutions which devote attention to this issue consider it as their principal responsibility. The question, however, is what should be done with the remaining emissions in the atmosphere. If the academic institution tends to assert its carbon neutrality, it ought to get rid of any residual emissions. When an organization considers its potential to eliminate the remaining emissions, the crucial phase of the process of achieving Climate Neutrality begins, and the significance of carbon offsetting is further underscored. What does carbon offsetting actually mean from a practical perspective?

1.2 Carbon offsetting

No matter how hard we try, the great majority of us will only be able to partially eradicate campus fossil fuel use and GHG emissions. What should we do about the GHG emissions we still have? It will be necessary to use carbon offsets to cancel out those remaining emissions in order to attain Climate Neutrality (Kingsley,2022). By initiating or supporting initiatives that lower GHG emissions, we can compensate for campus carbon emissions elsewhere.

Although the idea is straightforward, the devil is in the details. Carbon offsets, however, can result in actual emissions reductions with the correct guarantees, and those who are in charge of implementing or funding these reductions have the right to claim credit for them. By creating community-centered, regionally targeted conservation of energy and renewable energy projects, universities may seek to contribute to the sustainability of their local areas while also claiming some of the credit for the carbon reduction these initiatives result in. Although carbon natural sinks have always been a tried-and-true approach that can be relied upon, it is important to determine how much they can be used given the local climate and geography. The accomplishments of Sweden in forestry management and afforestation are not unexpected. All of this is because forests are being used as a natural resource for carbon sinks. However, we also need to take into account to what extent might be advantageous for offsetting. This predicament prompts universities to consider fresh alternatives like Carbon Capture and storage (Cintas et al., 2017).

1.2.1 Carbon Capture and Storage (CCS)

A relatively pure stream of carbon dioxide (CO_2) from industrial sources is isolated, processed, and then transported to a long-term storage facility as part of the carbon capture and storage (CCS) process (*CARBON DIOXIDE CAPTURE AND STORAGE*, n.d.). The carbon dioxide stream, for instance, can be produced by burning biomass or fossil fuels. Typically, significant point sources of CO_2 are caught and then stored in a subterranean geological formation. The objective is to lower greenhouse gas emissions and so slow down climate change. Carbon dioxide capture and storage is another name for carbon capture and storage. This process involves separating (capturing), filtering, compressing, and delivering a reasonable stream of CO_2 from energy-related generators to a storage facility for extended isolation from the atmosphere.

Direct CO_2 capture is possible from industrial sources. By 2022, CCS will have captured nearly one-thousandth of all CO_2 emissions worldwide (*CARBON DIOXIDE CAPTURE AND STORAGE*, n.d.). Between 50% to 68% of carbon is successfully absorbed with this method on average, however, some projects have achieved efficiency levels of over 95%. Many CCS projects have fallen short of the promised emissions reductions, according to opponents (*CARBON DIOXIDE CAPTURE AND STORAGE*, n.d.). Additionally, opponents contend that carbon capture and storage only serve as a cover for continuing to burn fossil fuels while ostensibly reducing emissions. From the outset, it appears that we are dealing with a problematic concept that is both beneficial and untenable, operating on a razor edge. When we talk about reducing carbon dioxide and preventing climate change, the subject is really sensitive, thus it is necessary and under close scrutiny to determine to what extent this strategy can be trusted as an approach for actual negative carbon emissions (CARBON DIOXIDE CAPTURE AND STORAGE, n.d.).

1.2.2 Technological elements

Capture

The most economical places to capture CO_2 are at point sources, like sizable carbon-based energy facilities and sectors with high CO_2 emissions. Although it is technically possible to extract CO_2 from the air, the process is more costly due to the lower concentration of CO_2 in the air compared to combustion sources (CARBON DIOXIDE CAPTURE AND STORAGE, n.d.).

Compression
The CO_2 is typically compressed into a fluid after being captured. To make transportation easier, the CO_2 is compressed. The method includes this compression with the aim to make it easier and more secure.

Transport
Pipelines are used to carry significant amounts of CO_2 that are under high pressure. Transmission pipelines could burst or leak. Remotely controlled valves that can restrict the release quantity to a single pipe section can be installed in pipelines. For instance, an 8 km long stretch of a 19" pipeline, could release its 1,300 tones in 3–4 minutes.

Sequestration (storage)
Different strategies have been developed for long-term storage. The process of geo-sequestration entails injecting CO_2—typically in supercritical form—into underground geological formations. It has been demonstrated that the mechanical characteristics of the formation where carbon dioxide has been injected are impacted at the molecular level. CO_2 is kept from rising to the surface by physical and geochemical trapping mechanisms (CARBON DIOXIDE CAPTURE AND STORAGE, n.d.).

Although it was attempted to quickly discuss the differences for a better understanding of the topic and the principles of CCS, it may be interesting to explore the different forms of CCS since one of the aims of this study is to evaluate CCS, which is made in the following section.

1.2.3 Carbon Capture and Utilization (CCU)

CO_2 is captured and used in the process of carbon capture and utilization (CCU). The global challenge of considerably decreasing greenhouse gas emissions from major stationary emitters may be addressed by carbon capture and utilization. In contrast to carbon capture and storage (CCS), carbon capture and use (CCU) neither aims for nor results in the long-term geological storage of carbon dioxide. Instead, CCU strives to maintain the carbon neutrality of the production processes while converting the captured carbon dioxide into more valuable materials or goods, including plastics, concrete, or biodiesel (CARBON DIOXIDE CAPTURE AND STORAGE, n.d.).

1.2.4 Direct Air Capture (DAC)

The carbon removal method known as Direct Air Capture and Storage (DAC+S) directly removes CO_2 from the atmosphere and either permanently stores it or uses it as an industrial component (for Carbon Removal Law, 2018). The most common method of carbon capture is post-combustion. The process of directly removing carbon dioxide (CO_2) from the atmosphere and producing a stream of CO_2 for sequestration or use in the creation of carbon-neutral fuel and wind gas is known as direct air capture (DAC). In relation to DAC technology, it reduces the atmospheric concentration of CO_2 by capturing CO_2 straight from the air and exclusively using renewable energy, energy from waste, or other waste heat as energy sources. Direct air capture utilizes both liquid and solid DAC methods. In liquid DAC, carbon dioxide is taken out of the air by passing it through a chemical solution. The CO_2 is filtered out in a system in solid DAC.(Lehtveer & Emanuelsson, 2021).

CO_2 is immediately removed from ambient air using direct air capture and storage (DAC+S). In contrast, carbon capture and storage (CCS) collects CO_2 from carbon dioxide point sources. The CO_2 is subsequently transported to a storage location and sequestered there.(Lehtveer & Emanuelsson, 2021)

1.2.5 Combine Biomass Use with Carbon Capture and Storage (Bio-CCS)

Concepts that combine the utilization of biomass with carbon capture and long-term subsurface storage are referred to as Bio-CCS.
Bio-CCS has the capacity to contribute to the net removal of CO_2 from the atmosphere, in contrast to CCS, which at greatest just minimizes the amount of CO_2 entering the atmosphere. Carbon is recovered from the carbon cycle while eliminating the use of fossil fuels by trapping atmospheric carbon during the growth of biomass and subsequently capturing CO_2 from the biomass conversion process for long-term storage in geological formations (CARBON DIOXIDE CAPTURE AND STORAGE, n.d.).

1.2.6 Bioenergy with Carbon Capture and Storage (BECCS)

The technique of permanently absorbing and storing carbon dioxide from biomass (organic matter) energy generation is known as bioenergy with carbon capture and storage (BECCS). In addition to being a substitute for fossil fuel electricity, it is a geo-engineering approach that also eliminates carbon dioxide from the atmosphere. The term "bioenergy with carbon capture and storage" (BECCS) refers to any energy pathway where CO_2 is permanently stored after being captured from a biogenic source (CARBON DIOXIDE CAPTURE AND STORAGE, n.d.).
Therefore, BECCS uses the exact same technology as CCS; the only distinction is that CCS is used in industries or power plants that use biogenic feedstock or fuels.

1.3 Climate objectives of the University of Gothenburg

Goals for addressing climate change at the University of Gothenburg are divided into two parts: a short-term objective of a reduction of 25% by the end of this year as a short-term goal and a long-term goal of a reduction of 50% by the end of 2029 (Ministry of Climate and Enterprise,2021). The employment of the proper strategies is generally the same because the end goal is to attain Climate Neutrality, but this view may change if we forego short-term objectives in favor of long-term ones. it may protect our resources in this way by making the path clear and avoiding waste in order to move forward more forcefully. although it should only be considered as a preliminary hypothesis.
Various simulations have demonstrated that by delaying action on our current (short-term) goals in order to conserve resources for long-term ones, we may be able to achieve much significantly more important emission reductions by the end of the century than we could if we were to act right away. This entails reducing our short-term goals in favor of considerably more ambitious long-term objectives. This decision is difficult since it means deferring the measures that result in immediate, gratifying outcomes in favor of considerably more intensive short-term research on novel ideas that will be followed by more drastic cuts in the future. The latter strategy would place universities themselves in a much more central position than the former. This is particularly true because these early investments in new understanding will have the biggest effects on the carbon reductions that are growing the quickest.

1.4 The notion of carbon emissions Scopes

An organization must be aware of precisely what its carbon footprint is if it wants to become climate positive(Ranganathan et al., n.d.). In order to capture more carbon, the organization would also need to take on more initiatives. Calculating the Scopes 1, 2, and 3, specified below, of carbon emissions is the primary option. Some organizations are already looking further forward and have a tendency to completely erase their past footprint. The primary GHG Protocol corporate standard divides an institution's greenhouse gas emissions into three categories(Ranganathan et al., n.d.). Reporting is mandatory for Scopes 1 and 2, but it is also necessary for Scope 3, which is the most challenging to monitor. Organizations that are successful in reporting all three Scopes, however, will have a lasting competitive edge (Cano et al., 2023).

1.4.1 Scope 1

Direct emissions (owned)

Direct emissions from resources that the corporation owns and controls are considered Scope 1 emissions.
In other words, a set of actions taken at the corporate level directly cause emissions to be discharged into the environment. It is separated into four groups:

- Stationary combustion (e.g., fuels, heating sources). Scope 1 must include every fuel that emits GHGs.
- Mobile combustion, all vehicles that are owned or under the control of a company and are mobile combustion (e.g., cars, vans, trucks). Due to the growing popularity of "electric" cars (EVs), some fleets operated by organizations may now be subject to Scope 2 emissions.
- Fugitive emissions are greenhouse gas leaks (e.g., refrigeration, air conditioning units). Refrigerant gases are a thousand times more harmful than CO_2 emissions; it is important to keep in mind this.
- Process emissions, during industrial operations and on-site manufacturing, process emissions are generated (e.g., production of CO_2 during cement manufacturing, factory fumes, chemicals).

Typically, Scope 1 emissions are direct greenhouse gas (GHG) emissions from sources under the management or ownership of an organization, such as those resulting from the burning of fuel in boilers, heaters, and vehicles (Cano et al., 2023).

For clarity, it is necessary to provide more information about the terms owned and not owned emissions. To put it simply, owned emissions refer to cases in which an organization has direct control over emissions and the ability to manage their reduction. In contrast, not owned emissions refer to circumstances in which the organization does not.

1.4.2 Scope 2

Indirect emissions (owned)

Indirect emissions from the production of energy that has been obtained from an energy supplier are known as Scope 2 emissions. In other words, all GHG emissions from the use of imported power, steaming, heating, and cooling are emitted into the atmosphere.
Electricity will be the only source of Scope 2 emissions for the majority of organizations. Simply put, there are two categories under which energy is consumed: The electricity used by the end-user is covered by Scope 2. The energy used by the services for distribution and transmission is covered by Scope 3 (See Figure 1).

1.4.3 Scope 3

Indirect emissions (not owned)

The crown jewel of emissions is what is known as Scope 3 emissions. The reporting company's value chain includes both upstream and downstream emissions and all indirect emissions that are not covered by Scope 2 fall under Scope 3 emissions. Emissions are thus associated with organizational processes. Scope 3 emissions are divided into 15 categories in accordance with the GHG convention (See Figure 1).

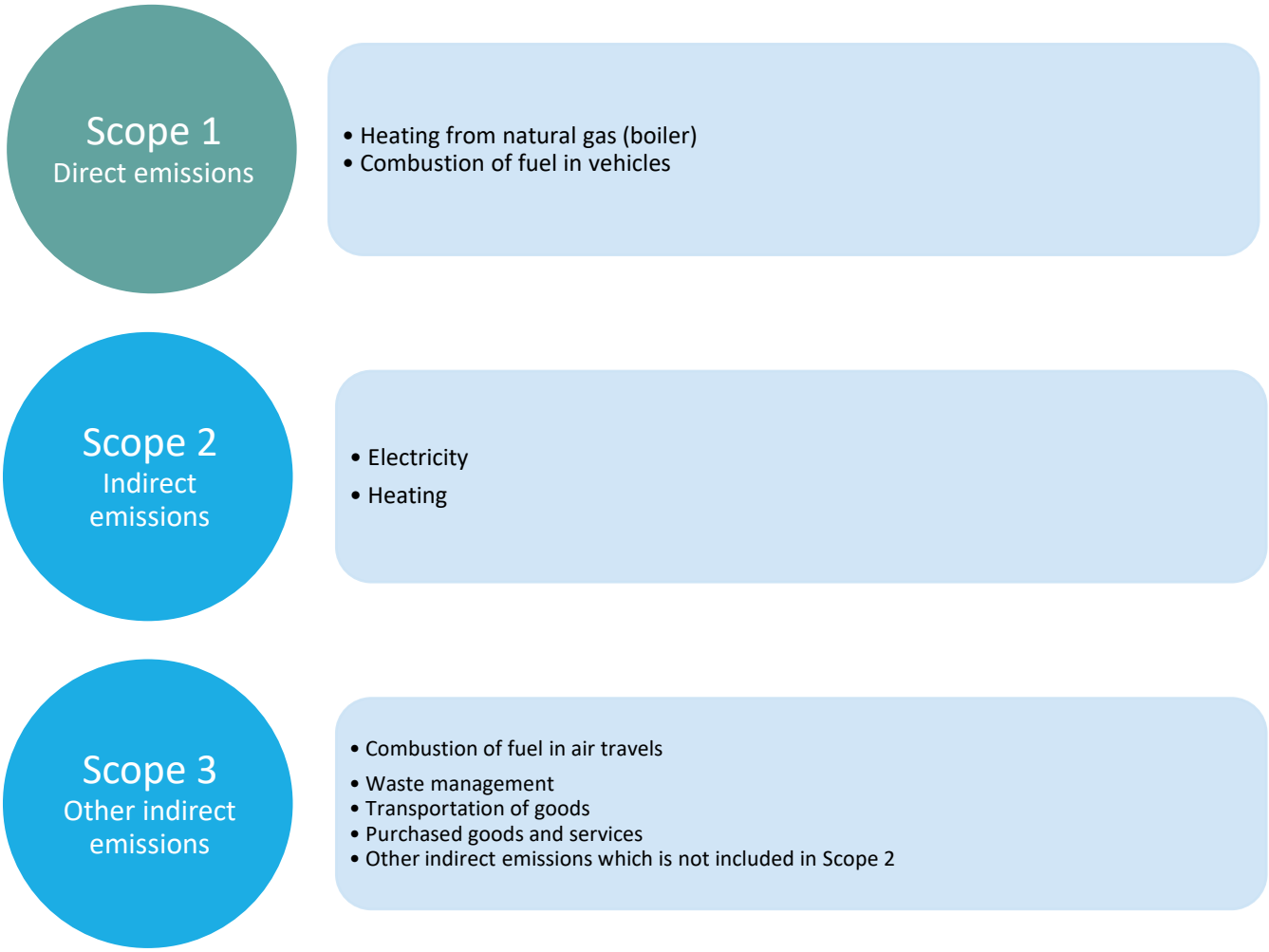

Figure 1: Components of Emissions Employing the GHG Protocol, this illustration represents the several types of emissions that an organization might generate as a result of its operations.

1.4.4 Upstream activities affecting the climate impact of an organization

There are various categories of upstream activities; for many organizations, **air transport** is one of the most important to record (e.g., air travel, rail, underground and light rail, taxis, buses, and business mileage using private vehicles). Additionally, employee commuting must be reported because it involves emissions from getting to and from work. By using public transportation and a home office, it can be reduced (As shown in Figure 2 below).

Waste manufactured: in processes refers to waste treated as sewage and transferred to landfills. Methane (CH_4) and nitrous oxide (N_2O), which are released during the disposal of waste, are more harmful per unit mass emitted than CO_2 emissions.

Include all upstream (or "cradle to gate") emissions that result from the **creation of goods and services** that the organizations purchased during that year. It is beneficial to distinguish between purchases of goods linked to manufacturing (such as equipment, chemicals, and parts) and items unrelated to manufacturing (e.g., office furniture, office supplies, and IT support).

The value chain's upstream (providers) and downstream (consumers) components both involve **transportation and distribution**. It covers emissions related to warehousing as well as emissions from ground, sea, and air travel.

The production of fuels and energy that the declaring organization purchased and used during the reporting year that is not covered by Scope 1 and 2 is considered a **fuel and energy-related activity.**

Capital goods are final products with a long lifespan that the organization utilizes to produce goods, deliver services, warehouse, distribute, and deliver goods. Capital goods include items like structures, transportation, and machines. Companies shouldn't degrade, the price reduces, or amortize the emissions from the creation of capital goods for the purposes of accounting for Scope 3 emissions. Conversely, organizations ought to take into account all cradle-to-gate emissions of capital items in the year of purchase (GHG protocol) (Cano et al., 2023).

1.4.5 Downstream activities the climate impact of an organization

For the most part, financial institutions incorporate **investments** in their reporting, but other organizations can still do so. Investments can be divided into four groups under GHG auditing: equity investments, debt investments, project finance, directed investments, and customer service. (See Figure 2)

Franchises are corporations that are allowed to sell or distribute another organization's goods or services in a particular area. Franchisees (i.e., businesses that run franchises and make a charge to the franchisor) should include emissions deriving from activities under their direct control. Franchisees have the option of declaring upstream Scope 3 emissions linked to the franchisor's operations (i.e., the franchisor's Scope 1 and Scope 2 emissions) under class 1 (bought goods and services).

Resources that are leased match those leased by the reporting organization (upstream) and those belonging to other organizations (downstream). The complicated calculating method must be disclosed in Scope 1 or Scope 2, depending on the type of **lease agreement.** (See Figure 2).

Regarding **"in-use"** products that are sold to consumers, the use of sold products is included. Even though the emissions caused by product usage vary greatly, it nevertheless measures them. For instance, it will take many years for the emissions produced during the creation of a cellphone to be offset by its use (Cano et al., 2023).

While being reported similarly to "waste engendered during processes," **"end of life treatment"** refers to products that are sold to consumers. Organizations must determine how their goods are discarded, which can be challenging because it typically depends on the user. Due to this, organizations are urged to come up with reusable goods that decrease waste sent to landfill space (Cano et al., 2023).

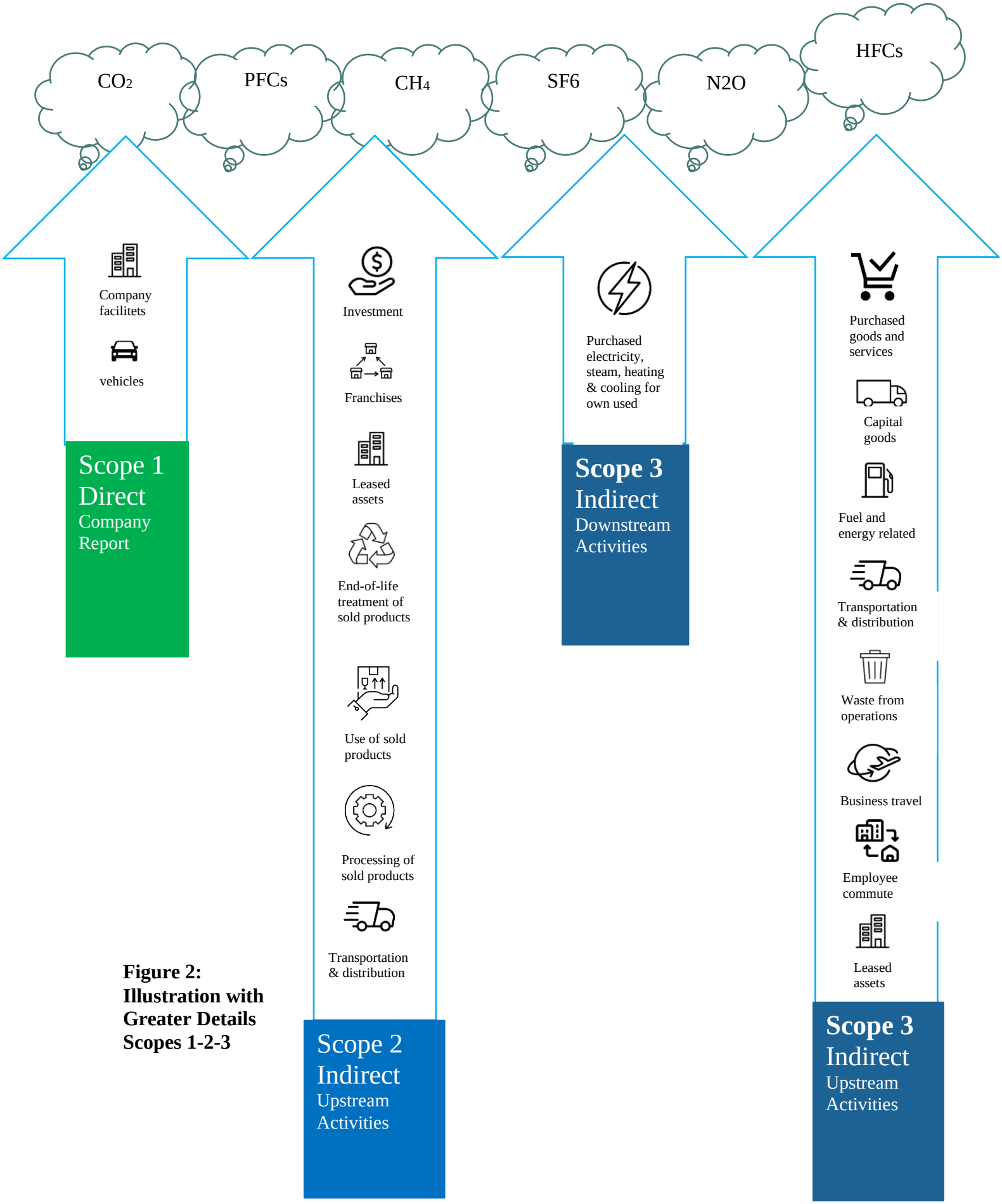

Figure 2: Illustration with Greater Details Scopes 1-2-3

In order to convey the idea in a broader approach, it is necessary to make reference to all greenhouse gases, as Scope 1,2,3 all contribute to their production, which ultimately greenhouse gases to enter the atmosphere due to human activities and are followed by their negative impacts. To better understand the source of emissions, figure 2 shows which activities fall within each Scope.

PFCs: Perfluorinated Compounds, PFCs are greenhouse gases that are employed in the production of semiconductors.

SF6: Sulphur hexafluoride, is a "greenhouse gas" that, like carbon dioxide, has long contributed to global warming.

HFCs: Hydrofluorocarbons, absorb infrared light and have a lengthy atmospheric lifespan, HFCs are powerful greenhouse gases.

2 AIMS

The goal of the project is to investigate and evaluate the opportunities for the University of Gothenburg to become climate neutral as well as the consequences and repercussions that may follow. In addition, an analysis of opportunities for the University of Gothenburg to use CCS or natural carbon sinks will be performed.

Besides that, climate compensation will also be researched in this study and a comprehensive explanation of the Climate neutrality and Net Zero concepts that are most relevant to the goals of the University of Gothenburg will be provided, including recommendations for further actions and possible limitations. Finally, the implications for the University of Gothenburg to achieve the government's goal of Climate Neutrality in 2045 will also be investigated.

Research questions

1: How can the short-term goal of a 25% reduction of CO_2 emission by the operational plan of the University of Gothenburg be achieved?

2: How can the long-term goal of a 50% reduction of CO_2 emission by the operational plan of the University of Gothenburg be achieved?

3 METHODS AND MATERIALS

In terms of research methodology, data categories, and analysis, as well as developing and conducting research, this study is based on acquiring and compiling data from the scientific literature as well as employing a particular tool for computing carbon dioxide emissions and the interviews that were held with interested universities. I employed the strategies described below to accomplish the goals of my research.

3.1 Carbon Intelligence system

The Svalna Carbon Intelligence System, a specific science-based climate service instrument for this study, was used to gather quantitative data on Climate Neutrality and extensive climate analysis. There are frequently ambitious climate goals, but there are often fewer instruments available to assess emissions and determine what has to be done to meet the targets. Svalna's Carbon Intelligence System is a novel climate service instrument. It is a technique that makes use of cutting-edge technology to calculate the overall climate impact. The outcomes are displayed in a graphical interface that is interactive and equipped with strong tools. Also, it provides expert assistance with action analysis in order to meet the climate targets.

David Andersson, a Ph.D. student at the Chalmers University of Technology in Gothenburg, Sweden, founded Svalna in 2015. He was unable to simply calculate his own carbon footprint, so he started inventing a system that eventually became the Svalna app for private consumers by fusing consumption data from the bank with emission data from Statistics Sweden. Svalna is a Gothenburg-based green technology business with customers all over Sweden that focuses on research. They are committed to collaborating in the creation of a sustainable future and have created and offered services and tools to assist individuals, businesses, and organizations in measuring and reducing their emissions.

3.1.1 The mechanism of the tool

1: Gathering financial information
Regardless of the size of the organization, the system analyzes accounting data swiftly and automatically. Sensitive information is handled safely and confidentially.

2: Computes
The amount of money spent on various categories of purchases is used to compute greenhouse gas emissions. The knowledgeable team at Svalna validates the results.

3. Customized delivery
Access to the decision-support system, reports, and presentations are all examples of this. To help you achieve the climate targets, they also provide certified support for your sustainability efforts.

3.1.2 Calculation methodology

Depending on where they were made, all transactions are divided into several categories. The value of the purchase is multiplied by the emission factor for the appropriate purchasing category to determine the effects of spending. Environmentally extended multi-regional input-output analysis was used to determine the emission factors, which are based on Statistics Sweden's environmental accounts. For the highest level of transparency and reliability, the calculation process is founded on scientific research and has undergone a review process.

The basic formula for calculating impacts is to multiply the SEK purchase value by the associated purchasing category's emission factors. For instance, "clothes" is the category for a purchase made at a clothing retailer. Then, emissions are determined by dividing the purchase

price in SEK by the appropriate purchasing category's emission factor. For example, clothing emits 0.05 kg of carbon dioxide equivalents (CO_2 e) every Swedish krona. As a result, a T-shirt that costs SEK 200 has a 10 kg CO_2 e carbon impact. The emission factors that we employ were computed using environmentally extended multi-regional input-output analysis and are based on Statistics Sweden's environmental accounting. The emission factors are average assessments of the financial impact on the environment. In essence, it works like this: If we know how much the entire population spends on clothing in a given year and we also know how much greenhouse gas emissions the clothing industry produces in that same year, we can calculate the average emission factor per monetary unit for the category "clothing." Although it is a crude measurement, it allows for the estimation of average emissions over time. However, not all emissions calculations are made using transaction data. Certain emissions can be assessed more accurately by combining regional emission factors, which account for emissions from things like district heating in your area, with primary, physical data like flight distance and energy use in kWh.

Even though there are significant differences, Svalna's calculation method can be seen as a sophisticated application of the GHG Protocol, which aims to calculate the emissions within all emission Scopes as extensively, inexpensively, and dependably as possible. For instance, the GHG Protocol does not mandate that emissions related to Scope 3 be taken into account in climate estimates for businesses, whereas Svalna's technique does so by default. The long-term objective is for Svalna's method to be fully compliant with the GHG Protocol, even though it is not currently.

3.1.3 Separation into categories

The tool employs an algorithm-based approach to categorize the transactions based on details about the supplier's SNI code(s) and the financial accounts to which the purchases are reported. In the Statistics Sweden business record, virtually every supplier (company from which you purchase goods and services) has an SNI code (it uses SNI 2007: Statistics Sweden's standard for Swedish industry classification from the year 2007).

The emission levels for the appropriate SNI categories are then used to estimate the emissions. This means that the emissions have all been computed using the same emission intensity for all purchases that are categorized as, for instance, "Computer programming, computer consultancy, etc." It also implies that different types of purchases recorded in various accounting categories may make up the categories shown in Svalna's Carbon Intelligence System. There are 99 subcategories in the SNI system that is used to visualize the emissions. Based on a study of what is contained in the categories in the SNI system, these were merged into seven broad categories (Energy, Real Estate, Goods, Services, Transport & Travel, Food & accommodation, and Others) to aid in visualization. The results should be taken with some care because this aggregation is inescapably accompanied by some uncertainties.

3.1.4 Cutting-edge technology

Transaction data is used in its innovative solution to determine greenhouse gas emissions. For individuals, data is obtained directly from the bank; for enterprises, it comes via accounting software. The data is automatically analyzed by Svalna's algorithm, and the emissions are estimated using the amount of money spent on various types of purchases. it can measure all

emissions, including those that other methods overlook, by calculating the carbon footprint based on real consumption.

When it comes to computation, depending on the terms on which the organization and Svalna have come to an understanding and the information made accessible by the organization. The calculating approach primarily relies on accounting data to determine the greenhouse gas emissions per Swedish krona spent across several types of purchases. Financial information, including charged amounts, expense accounts, and suppliers, makes up the majority of the database. A dependable way without the possibility of double counting is using economic data. When calculating the emissions from transportation, travel, and energy use, physical data is occasionally used as a supplement (e.g., used energy of different types, as well as means of transport and distance traveled).

The calculations include all emissions related to the organization's financial activities that are detailed in the accounting records to which the tool has been granted access. both direct emissions that happen straight away (such as those from equipment and vehicles) and indirect emissions that happen somewhere else. No matter where they occur, it computes. consumption-based emissions that take into account all types of emission Scopes (Scopes 1, 2, and 3). The emission factors that it employs were computed using environmentally adapted multiregional input-output analysis and are based on Statistics Sweden's System of Environmental and Economic accounts.

The process records all emissions related to the use of energy and other physical inputs at every phase, from the manufacturing of raw materials to construction, transportation, and final delivery of the good or service to the customer. The emission values that the tool employs represent the overall final consumption in Sweden for calculating emissions for businesses and organizations (private, nonprofit, and public).

It is comforting to be aware that not every financial transaction result in emissions. The fundamental tenet is that only transactions that involve the purchase of products and services that the organization consumes are taken into account when calculating emissions. Salary payments, tax payments, credited bills, and pension payments are a few examples of transactions that don't generate any emissions. The same holds true for various forms of financial transfers made within an organization's departments or enterprises. These transactions are viewed as intermediary currency flows, whose emissions are to be credited to the end consumer, and which are ultimately consumed at a later stage by private persons and/or public entities.

3.1.5 Trustworthiness of outcomes

Although it is challenging to quantify, there are a number of sources of uncertainty that must be considered in order to properly interpret the findings. Future difficulties may be lessened as a result of improved data and in-depth investigations. Others are much more challenging to change. The fact that the areas on which emission intensities are based are approximate is one source of uncertainty. Another region of uncertainty is the challenge of accurately categorizing every purchase, which is connected to the grade of the accounting data.

3.2 Literature review

The primary sources of data for my inquiry are publications, studies, and scholarly papers. Literature reviews and finding information from universities that are committed to raising awareness of carbon dioxide emissions and minimizing their carbon footprint in their activities are among the most popular search subjects.
There is a need to establish scientific definitions for Climate Neutrality, carbon neutrality, and Net Zero that empower us to comprehend the issue more clearly in order to understand carbon dioxide emissions fully and how to eradicate them.

3.2.1 Net Zero emissions

I searched through papers and websites to obtain the scientific definition of Net Zero, and also located some related context in the annual reports pertaining to interested universities in the empirical part.

3.2.2 Climate Neutrality

I used the same methodology as in the previous section to approach the definition of Climate Neutrality.
These notions from the literature will be further addressed in the results section to arrive at a comprehensive definition.

3.3 Interviews of other universities for benchmarking

Getting details from other universities about their efforts to become climate neutral is the core component of my research. The very first steps were taken in January of this year and began with a suggestion made by Mr. Eddi Omrcen, one of my supervisors, that we invite other interested universities that have the same challenges as the University of Gothenburg and want to collaborate with this study by exchanging our expertise and thoughts. In response to this recommendation, we met with all of the supervisors at the end of January to explore the best method of communicating with the foreign university. We eventually decided that an interview might be the best course of action. The next step as a follow-up was to send an additional question via email after the interviews.

Eddi Omrcen requested interested universities to participate in the research via the ISCN (international sustainable campus network) platform with regard to this empirical phase. This invitation received favorable responses, and as a result, we approached six interested parties who are equipped with knowledge about achieving Climate Neutrality and their procedures, difficulties, and achievements. New parties are also being added to this list all the time. Each university that expressed interest was contacted for an interview so I could understand more about its operating objectives, procedures, and limitations. There is a designated person in charge at each university who is fully informed about the entire procedure. The interviews were made simpler by the presence of persons who were acquainted with this idea because, despite the variances, the paths to all universities shared many parallels.

After the establishment of an exhaustive schedule for every university, the next step was to create a list of fourteen questions that should be asked during the interview. The appendix

section contains all of the questions from the relative interviews. The criteria for information exchange were also taken into consideration. The questions were sent out in advance of the interviews since doing so gave the parties involved ample time to consider their responses, which improved the clarity and accuracy of the replies and increased the value of the interviews. In order to give them a choice, facilitate the process for them, and let them decide how to proceed, I wrote a summary of the dialogues and forwarded it to them for approval in terms of reference and quote. I also asked them if they wanted to remain anonymous or not.

The list of interested parties
1: Public university in Zürich, Switzerland, ETH
2: Zurich University of the Arts, Switzerland
3: The University of Technology TU Delft
4: University of Edinburgh
5: The Tech University of Catalonia, UPC
6: University of New South Wales, Sydney, UNSW

The study's conclusions will be shared with everyone who has participated in the interviews as they constitute a benchmarking analysis that provides the involved parties with relevant information that may help the participating universities' views be useful for their work with sustainability.

4 RESULTS

4.1 The data obtained using the tool (Svalna)

Out of all the faculties at the University of Gothenburg, I deliberately chose to present the results from the Svalna analysis tool for three important faculties because they are greater than the others and, as a consequence, have considerably higher emissions rates:

Sahlgrenska Academy
School of Business, Economics, and Law
The Faculty of Science

Furthermore, I chose to present the results for one particular department, namely the **Department of Biological and Environmental Sciences** because I am a student there, and looking at the department's emissions provides me with information about the emissions associated with the location of my education.

Moreover, the review of emissions took place for the period 2019 until 2022, and the tool's latest update was on January 26, 2023. All emissions have been separated into seven major groups to make it easier to track the carbon footprint of different types of activities at the selected faculties and also the particular department.

4.1.1 Sahlgrenska Academy (Sahlgrenska Akademin)

Sahlgrenska Academy is the University of Gothenburg's School of Medicine. It engages in medical, dental, and healthcare sciences research and instruction. Due to the nature of such

institutions, where the amount of emissions is significantly higher due to the number of education-related laboratories, annual reporting and having an effective strategy to cut emissions can help us get closer to the ultimate objective of attaining carbon neutrality.

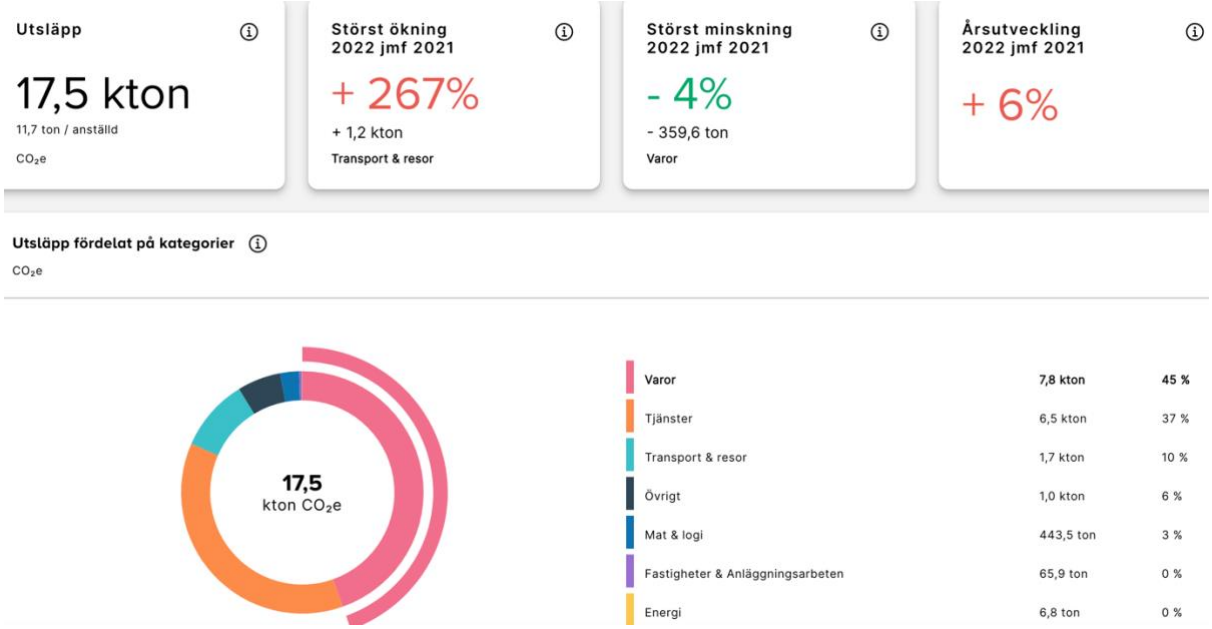

Figure 3: Emissions distributed by category in 2022

It is logical that the greater emissions in the goods category are significantly high. Computers, electrical devices, optics, chemical products, medications, and other equipment used in laboratories are included in the goods category (As illustrated in Figure 3 above).

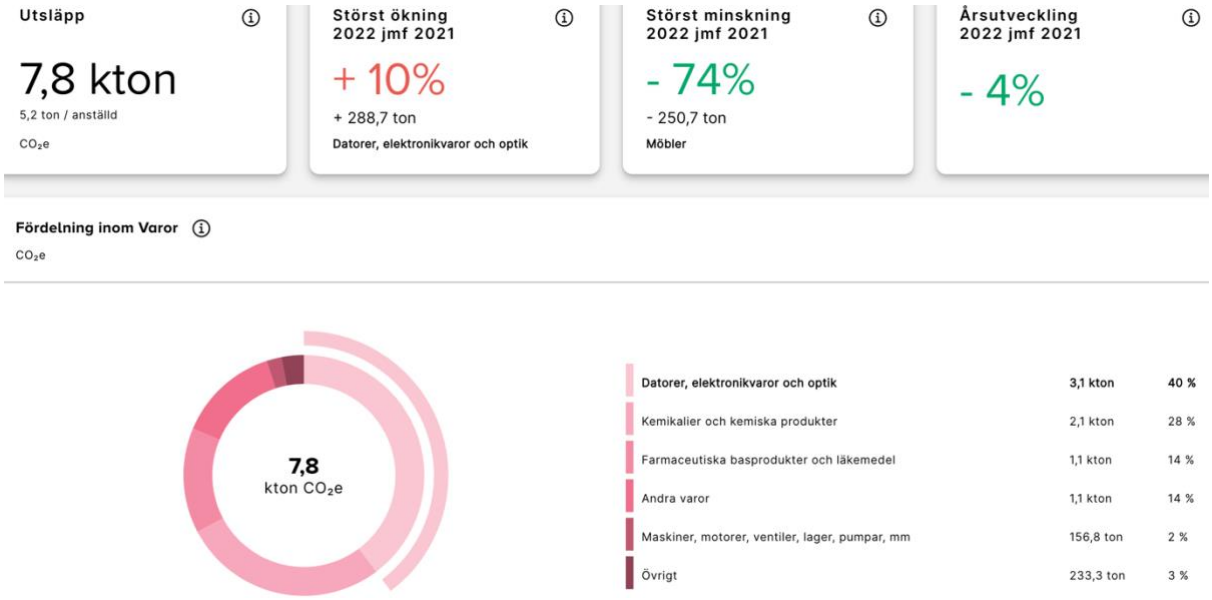

Figure 4: Component in a particular category of goods in 2022

Figure 4 demonstrates that the majority of emissions are related to the category of goods that is described in detail, as a result of the huge number of laboratories in this faculty.

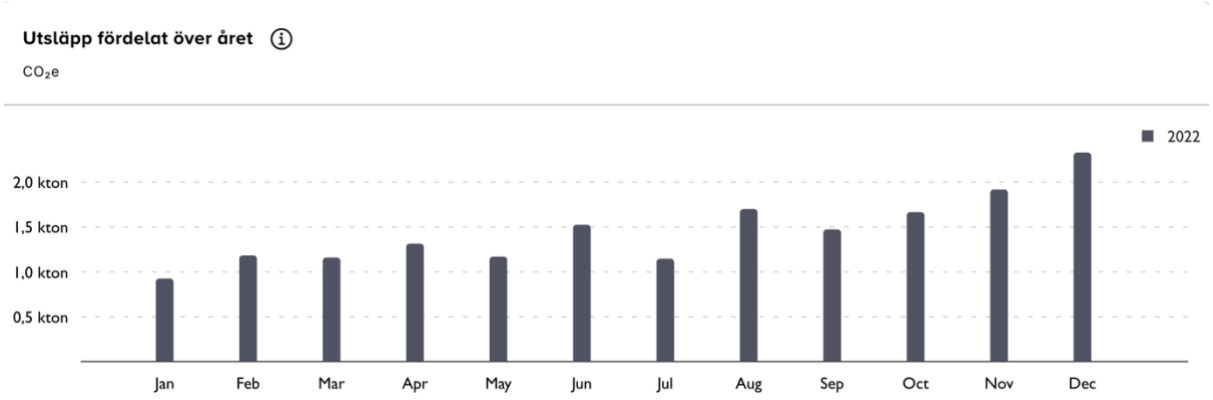

Figure 5: Emissions distributed over the year

As can be seen, the highest emissions occur in December, a month before the new year. This information was discussed with the supervisor, Mr. Fredrik Högberg, who thought "because faculty deans, who are aware of the importance that each faculty's budget, have decided to spend the remaining funds on items related to their departments' activities and items required even though the year is almost over" (Fredrik Högberg, 2023). This choice will result in an abrupt, significant, noticeable increase in emissions (See Figure 5).

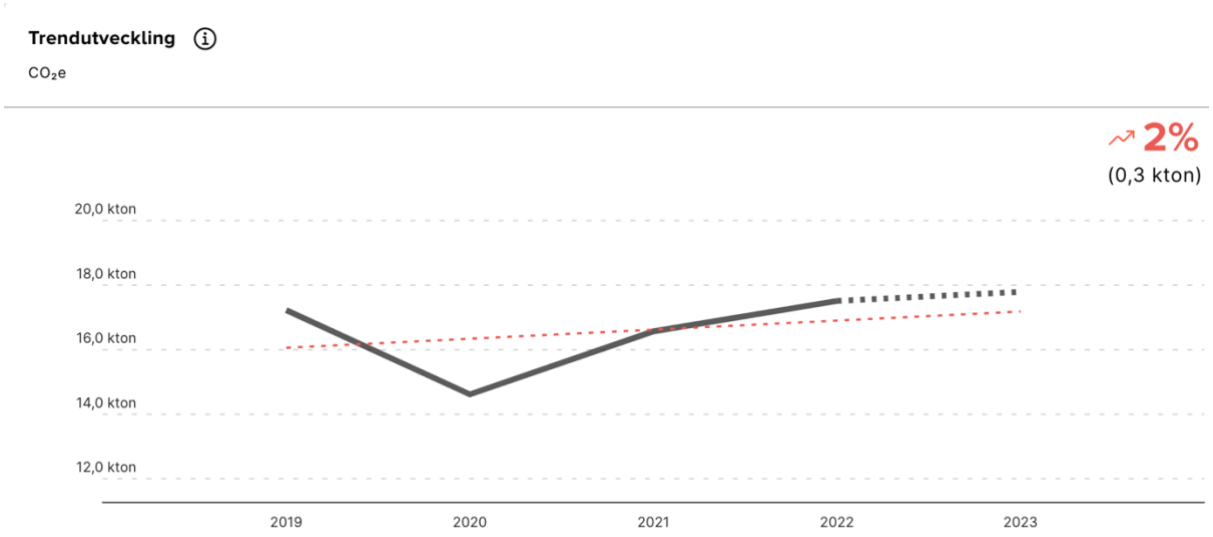

Figure 6: Trend development

This graph (6) makes it easy to observe the development of the emission rate from 2019 to 2022. based on this diagram. 2020 saw a substantial decline that may be attributed to the Covid pandemic, and as a result, it was inevitable that most types of activities would decline.

Figure 7: Trend development per category

Figure 7 specifically displays the different types of temporal development. The results of each individual's examination were unique. It has a direct impact on the faculty members' tasks.

4.1.2 School of Business, Economics, and Law (Handelshögskolan)

Handelshögskolan is one of Sweden’s top business universities. It was established in 1923 as an autonomous business college. Today, its research and collaborations continue to be of a very high standard on a global scale, confirming its status as a strong business school that is actively engaged in global business.

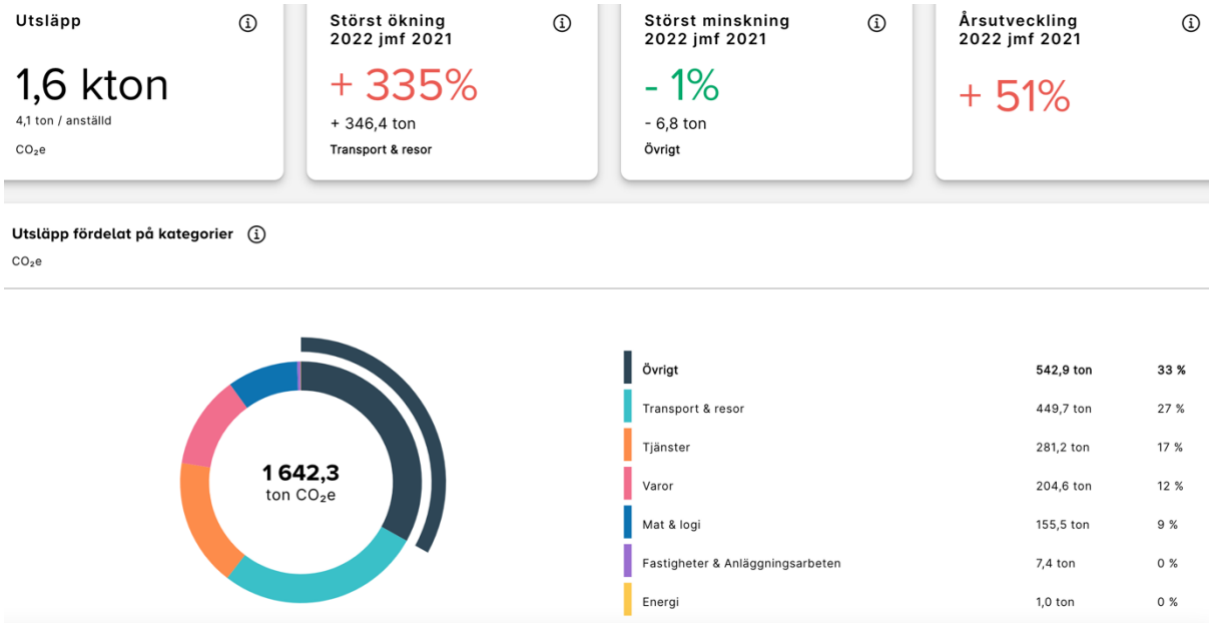

Figure 8: Emissions distributed by category in 2022

The group Miscellaneous has the highest rate of emissions, as shown in Figure 8, but what's crucial to note is that the tool did not provide any additional information on this category. It might be one of this tool's flaws**.**

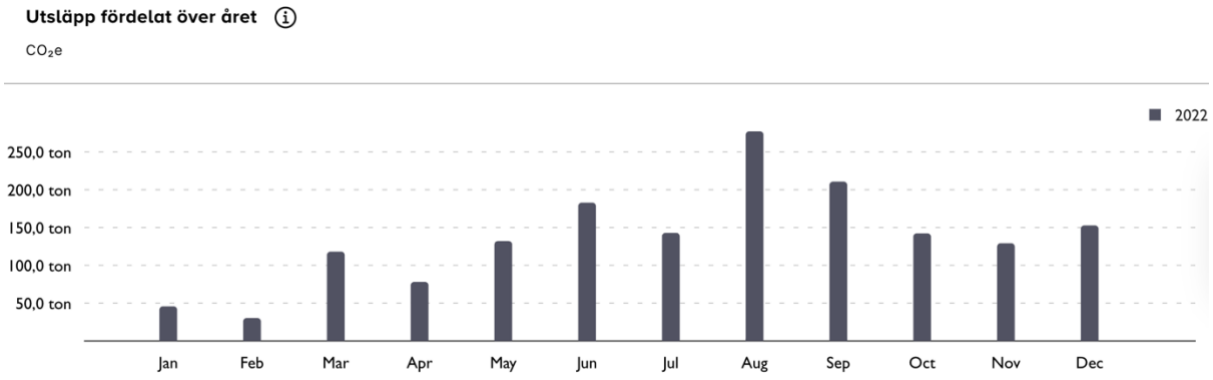

Figure 9: Emissions distributed over the year

Figure 9 demonstrates that the month of August had the highest amount of emissions due to the high quantity of things that were purchased in this month. It is understood from interactions with Fredrik Högberg that the months of August and September are crucial because the academic year is starting and faculty purchasing demands are obviously significant (Fredrik Högberg, 2023).

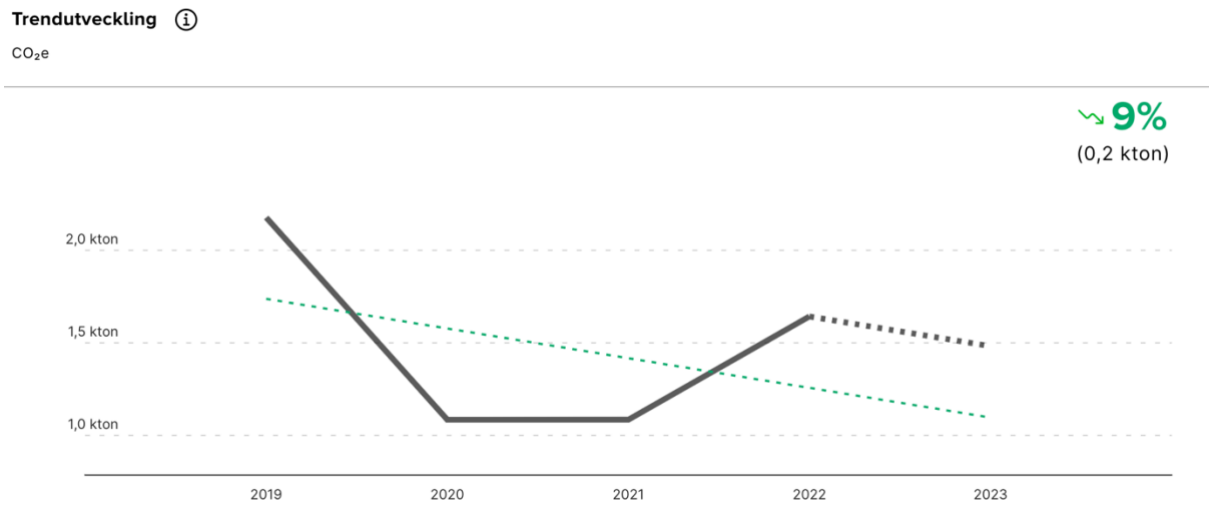

Figure 10: Trend development

Along with all the ups and downs that Graph 10 experienced from 2019 to 2022, some of which we can now comprehend. The 9% decrease (2019-2022) demonstrates the effectiveness of this faculty, and in the end, this advancement is significant.

Figure 11: Trend development per category

Among all categories, which all show a decrease in emissions according to the figure above (11), except the categories of goods and energy show an increase in emissions, with the category of energy experiencing a substantial increase. This implies that new energy-related

decisions need to be taken in this faculty. and a decision should be made to handle this emission intensity at an optimal level.

4.1.3 The Faculty of Science (Naturvetenskapliga fakulteten)

The Faculty of Science contains a number of scientific disciplines, including biology, physics, earth sciences, chemistry, conservation, mathematics, environmental science, and marine ecology.

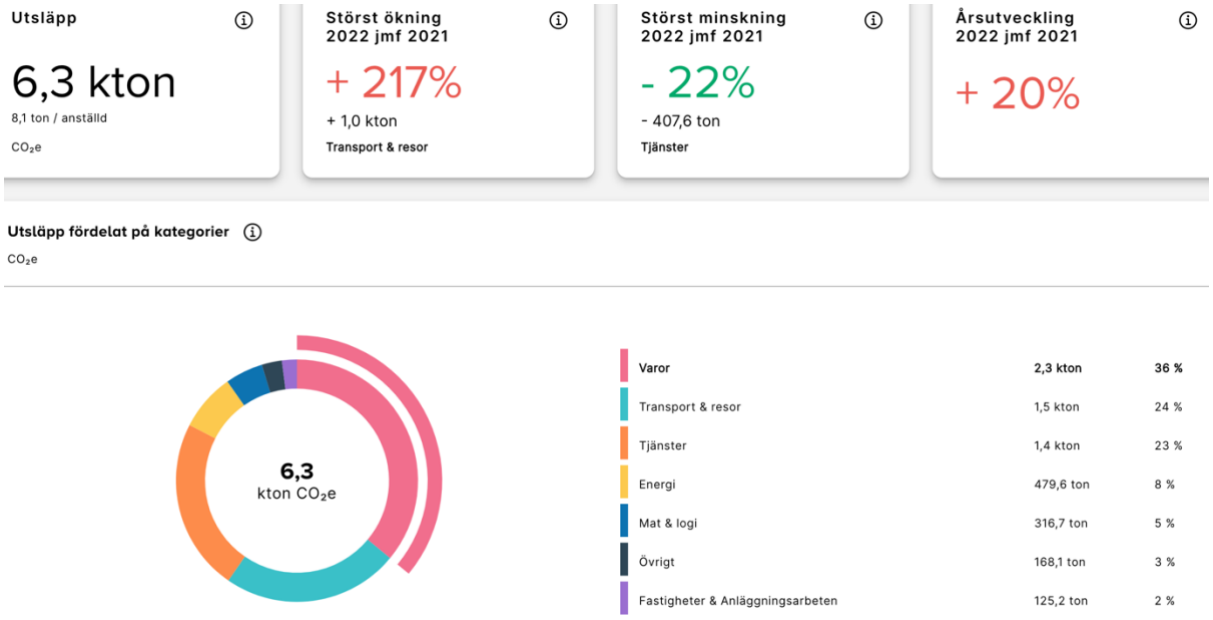

Figure 12: Emissions distributed by category in 2022

Graph 12 indicates that the category of goods is associated with the highest quantity of emissions. Perhaps this is due to the fact that this faculty has a relationship with the natural sciences, which places a high value on the laboratory and encourages a lot of research to be done there. Therefore, the idea that the amount of emission is tied to the purchase of products is not far from the mind.

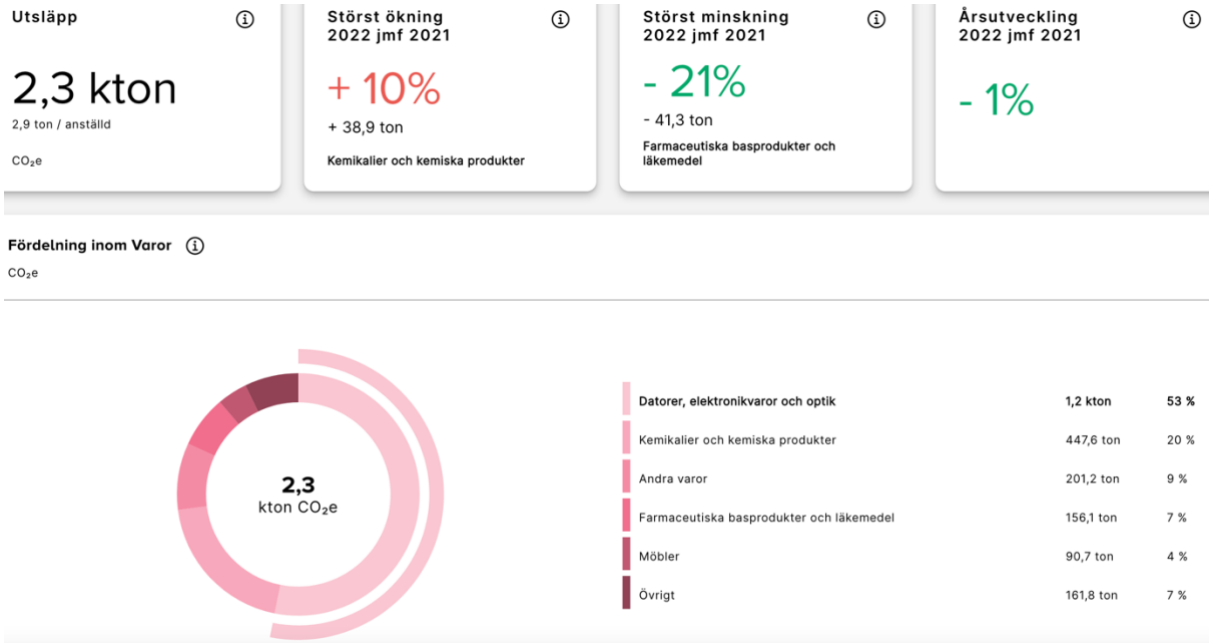

Figure 13: Characteristics of the goods category

The figure above(13) provides more information on the category of goods associated with faculty activities.

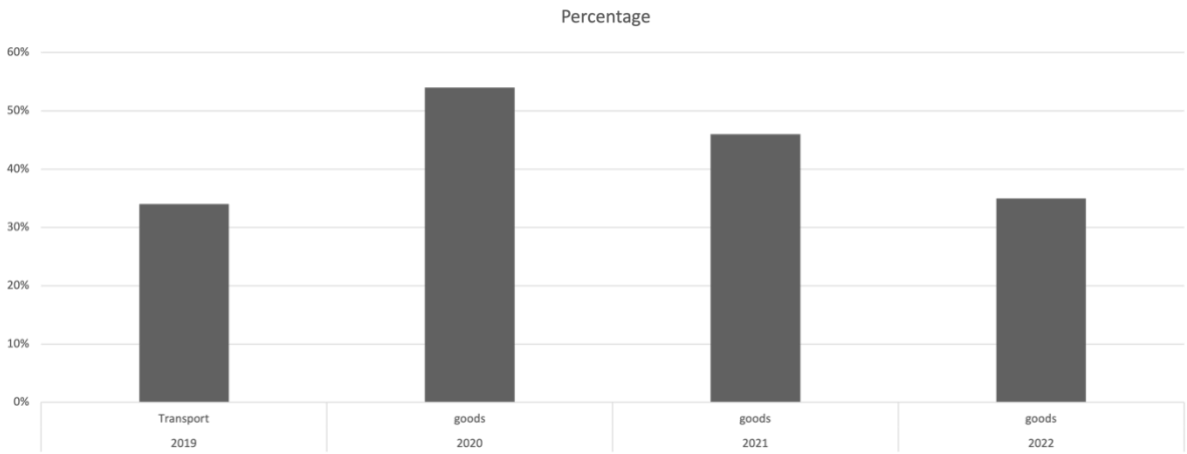

Figure 14: noteworthy categories offered by The Faculty of Science during 2019 - 2022

The group of goods indicates that, over the years, this category has dominated, which makes sense given the specific characteristics of this faculty (See figure 14).

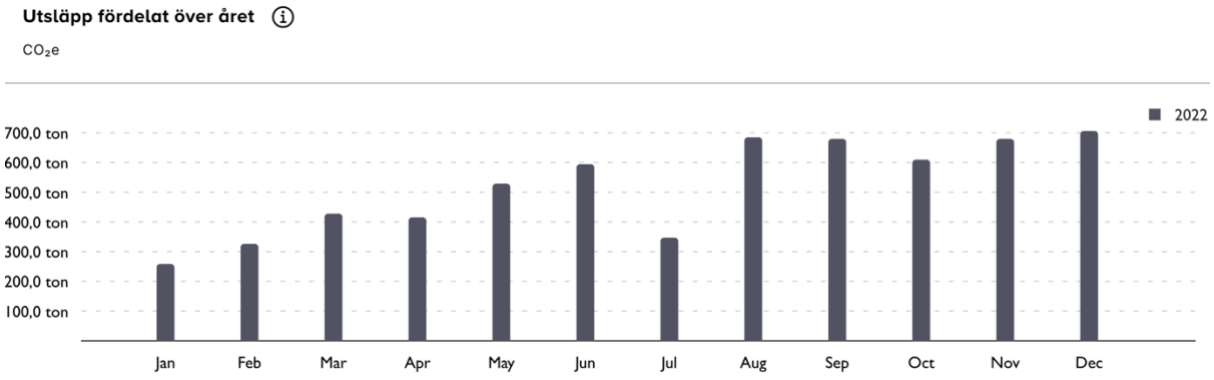

Figure 15: Emissions distributed over the year

With respect to the distribution over the year (Figure 15), it can be seen that December has the highest share of the total emissions in 2022 (a small fraction), but what makes this statistic stand out is that there is no very clear pattern to be found.

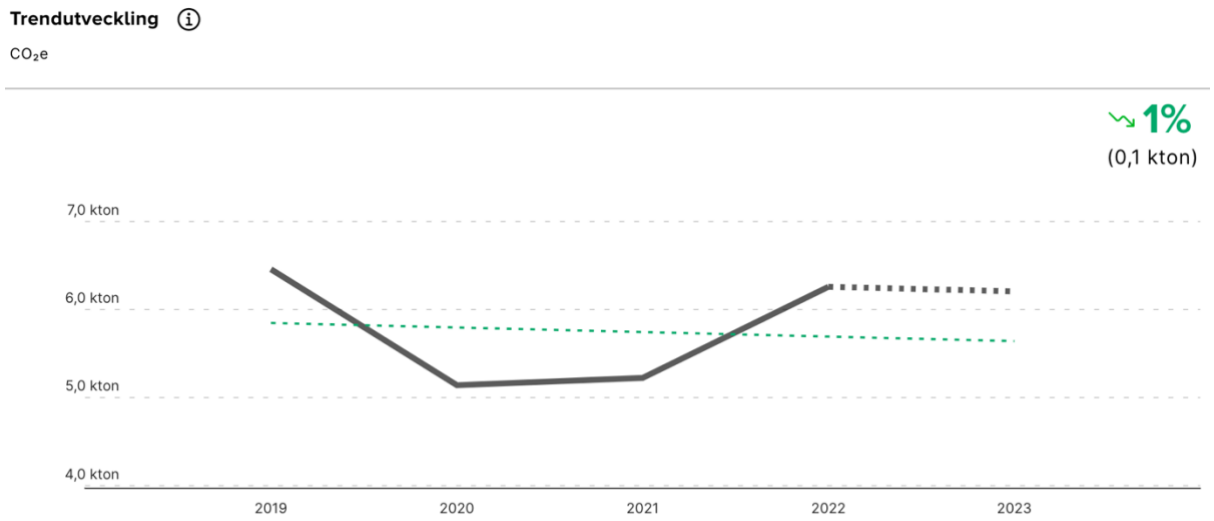

Figure 16: Trend development

According to this graph, there was a major drop in 2020 as a result of the Corona time period, followed by a gradual rise between 2021 and 2022. At the end of 2022, the emission rate had fallen only by 1% (2019-2022) as the pace at the institution has returned to its regular routine. This figure (16) demonstrates that 2019 had the highest emission rate.

Figure 17: Trend development per category

It demonstrated once more that the goods and energy category is one of the critical categories that need greater oversight to balance their emissions. And now that the real estate & construction category has been presented to this group within the faculty, this should serve as an indication of the increased significance of these categories (See Figure 17).

4.1.4 Department of Biological and Environmental Science (Institutionen för biologi och miljövetenskap)

Courses, programs, and research in environmental-related subjects are all offered at the Department of Biological and Environmental Science. While biology is the study of life, including all living things and the mechanisms that govern them, environmental sciences focus on how people and nature interact.

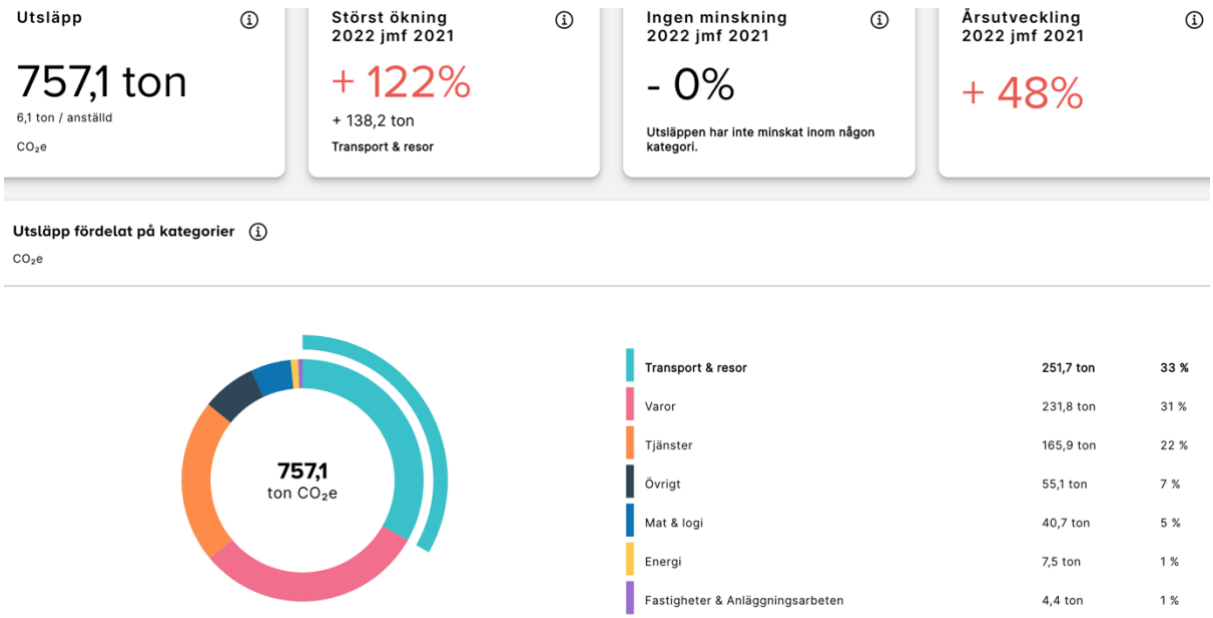

Figure 18: Emissions distributed by category in 2022

According to Figure 18, The category of transportation and travel generates the highest percentage of emissions in this department (33% compared to the size of this department). This amount is not low, but it is also notable for the slight difference in the goods category, which can be explained by the fact that the reason is directly related to the function of this department.

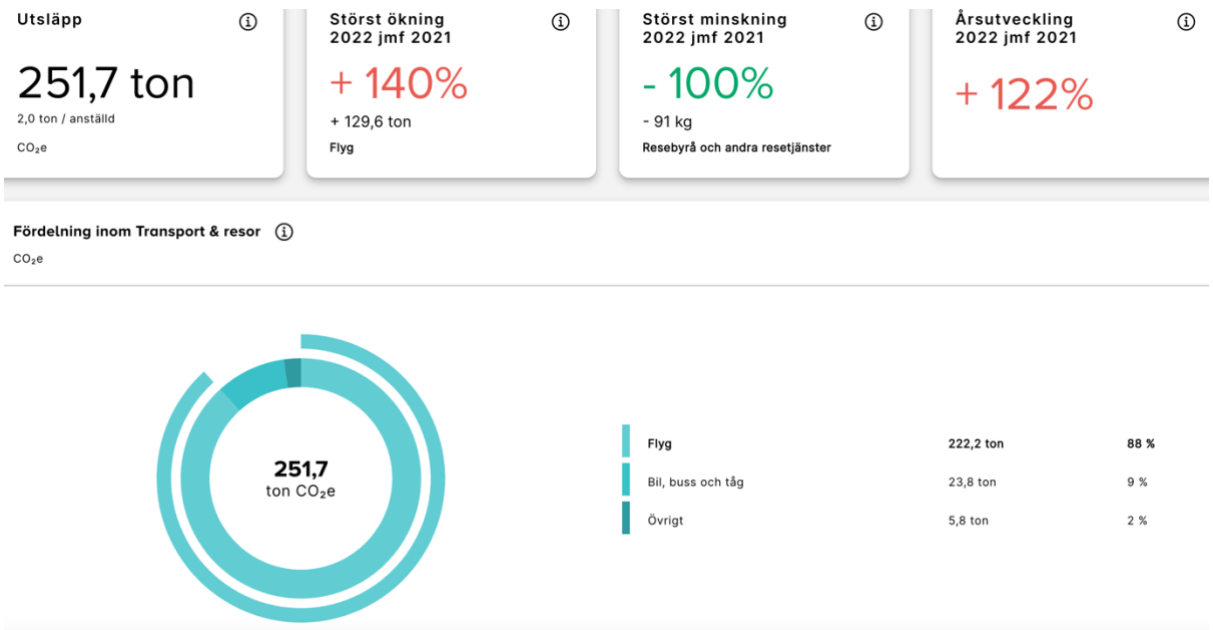

Figure 19: Characteristics of the transportation and travel

As can be seen, the category of transportation and travel includes all forms of transportation, but since air travel is particularly significant in terms of environmental damage, airline travel

has the highest emission rate (nearly 88%) in this department. Despite the size of this amount, it is significantly reduceable through ethical management, innovation, and the use of the right strategies (See Figure 19).

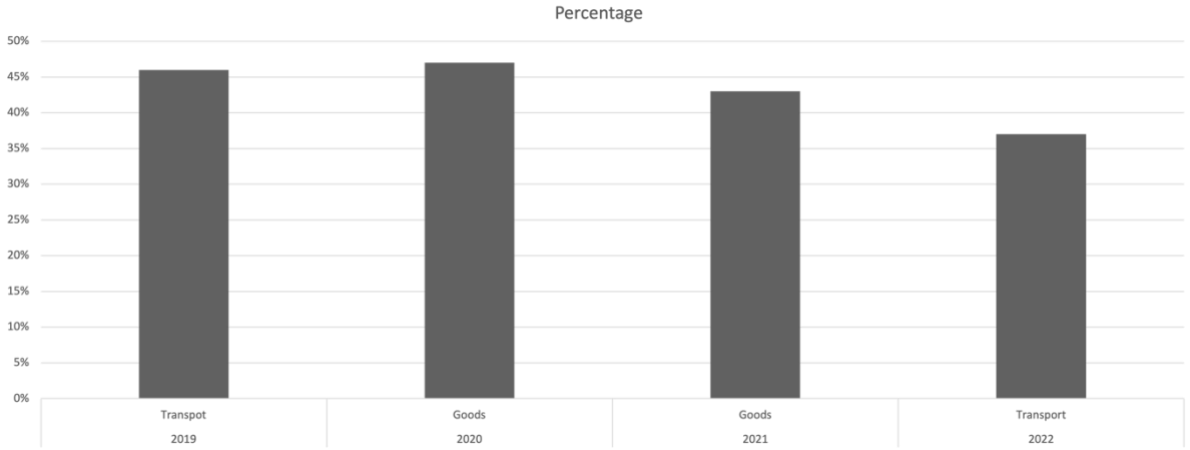

Figure 20: Significant categories from 2019 to 2022 have been presented by the Department of Biological and Environmental Science

The earliest change in the category, as indicated by the data in Graph 20, occurred in 2020, which is related to the Covid period, during which the amount of transportation was reduced, and the category of goods had the greatest emission rate. But once the pandemic was over, campus life went back to normal, and air travel again increased, the category for transportation and travel was once more given the highest emission rating.

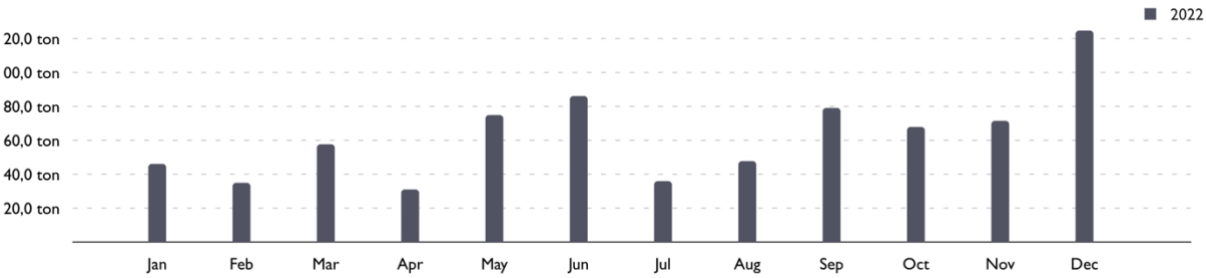

Figure 21: Emissions distributed over the year

This statistic demonstrates once more how significant December is compared to other months of the year. December is the final month of the year, perhaps this is the time of year when greater purchases would be made (Fredrik Högberg, 2023) (Figure 21).

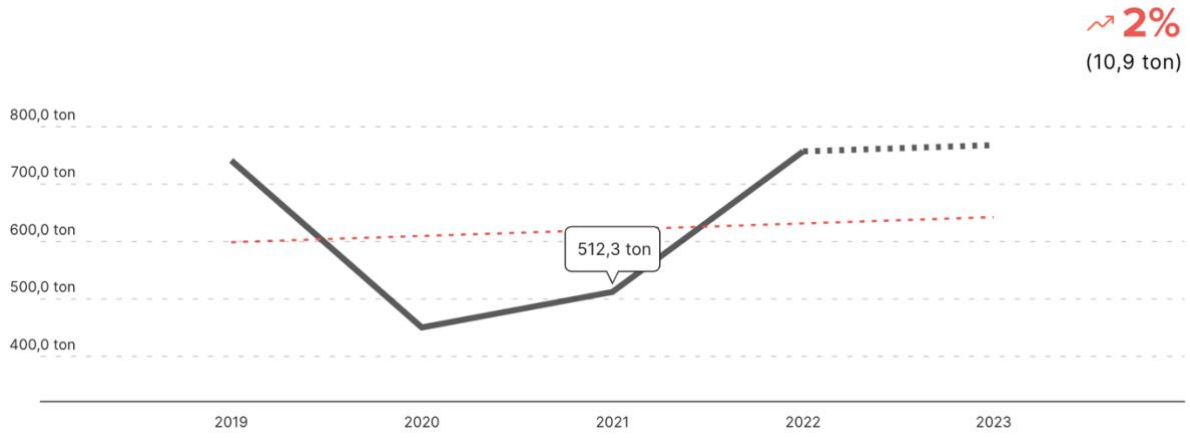

Figure 22: Trend development

Figure 22 indicates that in 2022, overall emissions increased by 2%, resulting in 10.9 tons of CO_2 equivalent emissions, an amount that can be minimized with a proper strategy.

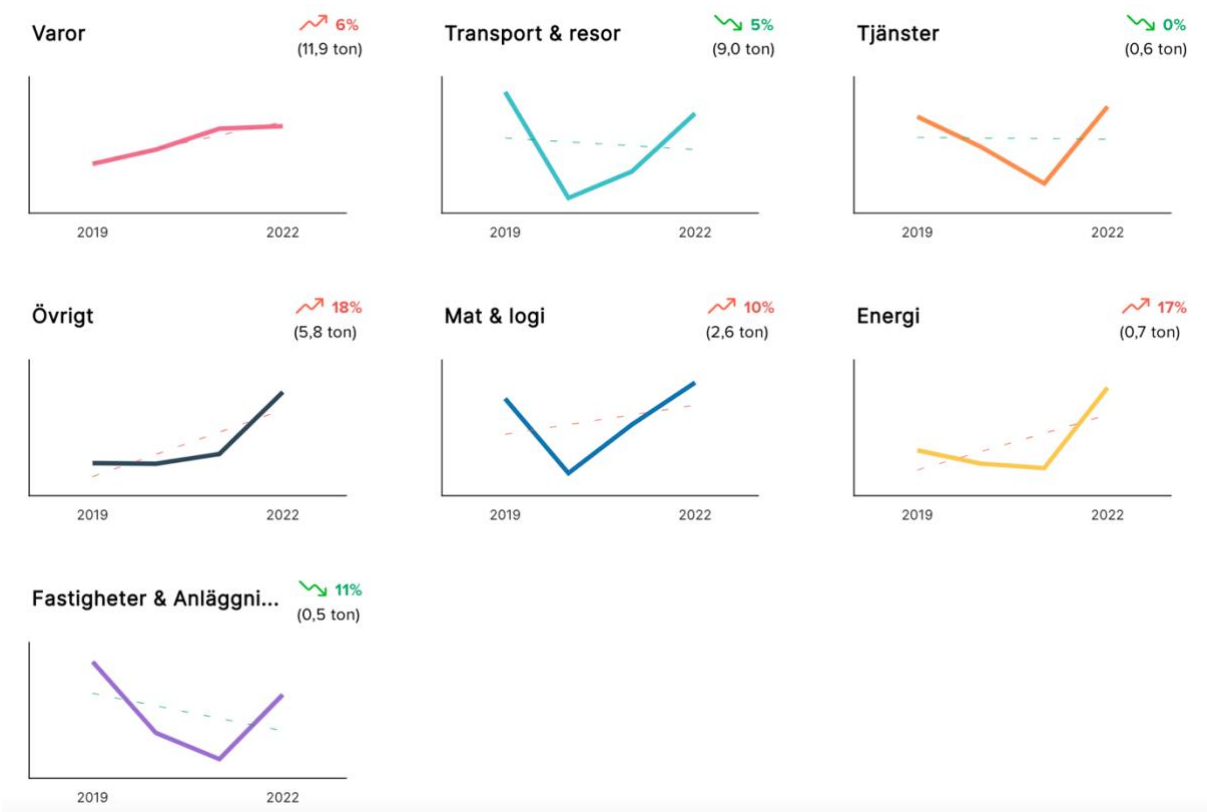

Figure 23: Trend development per category

With the assistance of this chart (see Figure 23), we can evaluate each category separately from 2019 to 2022 as well as the decline and growth in emissions for each category. The majority of the categories indicate an upward trend in the results.

4.2 The data obtained using the literature

Emphasis is placed on Net Zero, Climate Neutrality, and other related concepts in this portion of the thesis. It appears that giving a thorough, scientific definition of these concepts is required because it helps organizations understand and use them and accomplish the ultimate goal of announcing Climate Neutrality.

4.2.1 Net Zero

The idea of Net Zero emissions appears to correspond to the third wave of environmentalism, which is climate action, if we suppose that environmentalism consists of three waves. The first wave of environmentalism was concerned with environmental awareness and conservation, while the second wave was involved with sustainable development. To address the climate catastrophe, Net Zero has evolved into a call to action (Loveday et al., 2022).

In summary, the notion of Net Zero refers to the requirement to balance the greenhouse gas emissions that the globe produces with those that it consumes by a relatively quiet short timescale. The Net Zero idea has been put up as a solution to help with greenhouse gas emission reductions to help with global warming mitigation(Loveday et al., 2022). This definition can be comprehensive if we are interested in providing a unifying definition for Net Zero. The following is the Intergovernmental Panel on Climate Change (IPCC, 2022) definition: “When humans’ removal of greenhouse gases from the atmosphere over a predetermined period balance anthropogenic emissions of greenhouse gases into the atmosphere, net-zero emissions are achieved. The determination of net-zero emissions when many greenhouse gases are involved depends on the climatic measure selected to compare emissions of various gases (such as global warming potential, and global temperature change potential)”. (See Figure 24 for a better understanding of this topic)

According to the IPCC 6th Assessment Report, the expected range of global surface temperatures brought on by humans during this decade (2010-2019) relative to 1850-1900 is 1.07 (0.8 to 1.3) C. With a temperature of 1.07 °C, we are already dangerously near the Paris Agreement's target of keeping warming far below 2.0 °C, ideally confined to 1.5 °C. The Paris Agreement challenged countries to commit to reaching a balance of GHG emissions, or net-zero GHG emissions, in the second part of this century in order to limit global warming (IPCC, 2022).

The necessary reductions involve some complexity. GHG emissions include CO_2 as well as other gases such as N_2O, CH_4, and O3. Compared to, CO_2 which can remain in the atmosphere for 300–1000 years, these other gases are more transient. As a result, lowering longer-lived CO_2 emissions more quickly will lessen the amount of warming that is locked in and the rise in sea level caused by the permafrost, glaciers, and ice sheets melting, which have significant but long-lasting consequences (Loveday et al., 2022).

The Greenhouse Gas (GHG) Protocol offers a standardized framework for monitoring and regulating GHG emissions. Scope 1 refers to all direct GHG emissions, Scope 2 to indirect

GHG emissions from the use of purchased energy, heat, or steam, and Scope 3 to other GHG emissions.

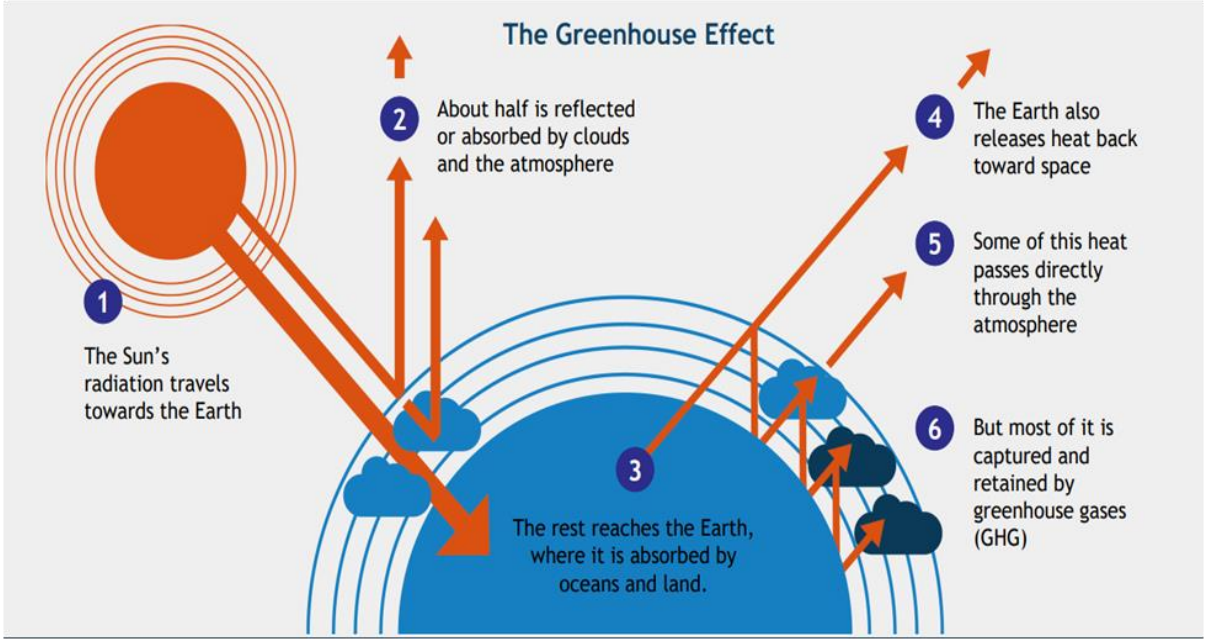

Figure 24: The Greenhouse Effect
(The figure was taken from this topic's related web pages on the internet)

4.2.2 Climate Neutrality

Climate Neutrality is a service or manufacturing method that either emits no CO_2-equivalent emissions or compensates emissions only after trying to minimize emissions and after carefully evaluating the overall sustainability effects of substitution and compensation (Opel et al., 2017).

A comprehensive understanding of Climate Neutrality and Net Zero, as well as independent definitions for each, are initially difficult to come across because of how closely they are connected. This study made an effort to independently and as much as possible give them a clear definition.

In order to achieve Net Zero greenhouse gas emissions, emissions must be balanced to be equal to (or less than) the emissions absorbed by the planet's natural absorption. To put it simply, this implies reducing emissions through climate action. It might serve as the first explanation of Climate Neutrality(Ziegler, 2016a). Climate Neutrality has gained popularity over the past ten years as an innovative, liberating idea, but it has also raised questions about whether it could encourage greenwashing and respect for justice and sustainability (Cintas et al., 2017). As part of a comprehensive strategy for climate ethics, there is a case for Climate Neutrality. It is feasible to achieve Climate Neutrality on a global scale. With an emphasis on measuring, minimizing, and offsetting. More precisely, three steps are necessary to achieve Climate Neutrality: identify "the amount of the carbon footprint," "operate emission reduction," and "find offsets for the remaining amount" (Ziegler, 2016a).

A few clarifications are required at this point. If carbon dioxide is the primary focus, the phrases carbon or CO_2-neutrality are appropriate; if greenhouse gases, in general, are the main topic, the term Climatic Neutrality should be used. The more challenging objective is to achieve Climate Neutrality because it calls for more efforts at reduction and compensation (Ziegler, 2016b).
While I discuss Climate Neutrality in the sections that follow, I only establish distinctions between it and Carbon Neutrality when the analysis demands it.

Although it is generally understood that the term refers to procedures intended to minimize the impact on current and future generations through the measurement, reduction, and offsetting of emissions, there are still various ways in which these concepts might be clarified and related. Here, the effort to contribute to a conception of Climate Neutrality will concentrate on ethical considerations (Ziegler, 2016b). It is useful to divide the practical operationalization into four parts for the analytical purpose of an ethical conception of Climate Neutrality:

4.2.3 Emissions monitoring:

When utilized in an organization, for instance, emissions from heating and electricity must be taken into account in addition to a variety of other potential actions (travel, food, products used, etc). The goal of climate-neutral processes must be clearly defined, along with a clear specification of which activities are included and which are excluded from the analysis (Torpman, 2019). For instance, a company must decide whether the mode of travel (by car, public transportation, bicycle, etc) of employees from their residences to the company should be included. In short and transparent decisions about the process boundaries are part of the evaluation task.

Reduction:
It is possible to establish both short-term and long-term reduction goals using the emissions inventory. Which behaviors can be altered or completely avoided? What reduction objectives are connected to various areas of activity including transportation, heating, and electricity? Who will profit and who will suffer from the reduction?

Substitution:
Step two is likely to cause substitution issues in practice, which may have implications for the environment. For instance, switching from energy sources with heavy emissions, like coal, to those with low or no emissions, like wind power, raises new concerns about nature conservation (Sen et al., 2022).

Compensation:
Compensation is a further way of achieving Climate Neutrality which may be required when emissions are anticipated to persist even after reduction and substitution initiatives. For instance, a company may decide to purchase carbon credits to make up for its remaining emissions; similarly, a person may choose to make up for a vacation by purchasing carbon credits equal to the emissions brought on by the aircraft ride. Alternately, if a change in land management on the property collects sufficiently extra greenhouse gases, it could produce the same compensating effect (Sen et al., 2022).

4.2.4 Greenwashing and unfairness

Carbon offsets and greenwashing are the two main issues with Climate Neutrality. This is a cluster of three connected issues, as can be seen upon closer study. Due to the range of verification criteria for carbon offset programs (*CARBON DIOXIDE CAPTURE AND STORAGE*, n.d.).

The first is methodological. In the worst scenario, there has just been a symbolic exchange of money and no more carbon compensation capacity has been added. Verifying the amount of compensation that has actually been accomplished in some situations could be very challenging, especially if the projects are dispersed throughout the globe and there is no ongoing link between the parties who purchase and issue the carbon offsets. It is reasonable to assume that there is an elevated risk of fraud and corruption (for Carbon Removal Law, 2018).

Second, even though the offsetting is progressive and complies with strict carbon accounting guidelines, it might still be problematic from a wider socio-ecological standpoint. A project for the manufacturing of iron in Brazil is used as an example. Eucalyptus trees were planted on 23 100 hectares to enable output that is climate neutral. Hence, "local farmers and Organizations have criticized the project for threatening the local flora and fauna and for contaminating the watercourse with fertilizers and pesticides (Bäckstrand & Lövbrand, 2006).

Third, the compensation choice might not encourage people and organizations to consider their reduction potential first, even if a Climate Neutrality project is not difficult in light of other social and ecological aims. If they can afford it, they will happily grab these low-hanging fruit and carry on as usual; there is no alteration to their high-emission modes of life or organizational structures. The importance of an ethical vision and principles for Climate Neutrality is emphasized by these arguments.

Full transparency of all steps of the quantification of effects on greenhouse gas emissions is necessary. All activities covered by the Climate Neutrality project have to be included in the emission accounting; the procedures are transparent and provide for a debate of alternatives and related objectives. Furthermore, compensation cannot replace reduction since the latter is a distinct and independent duty (Kasperzak et al., 2023). Lastly, substitution is expressly taken into account as part of the reduction but is noted here since it is crucial.

A further argument against Climate Neutrality is that it can appear to be a complicated utopia or "nirvana notion." Zero Net emissions in a world with high emissions is an unachievable non-place or, at best, a sector that diverts attention from the main work of creating coordinated methods for global climate protection. Once again, this argument only seems to stand when we ignore the legal and moral justifications for Climate Neutrality programs and their position within wider climate ethics (Ziegler, 2016b).

Being Climate Neutral is a duty that falls on the shoulders of the affluent, especially when it comes to organizations. In order to distinguish this view from "ordinary greenwashing" or other economic and political justifications for Climate Neutrality, one needs to have an ethical conception of Climate Neutrality. To avoid disregarding human rights and emission needs, Climate Neutrality must not be so expensive as to impose an unreasonable burden on the individual, the company, or the nation (Torpman, 2019). Cooperation of the Climate Neutrality project participants: As achieving Climate Neutrality is a difficult, mostly technical task, there should be a procedure that enables the project's participants to collaborate on its development.

Climate Neutrality aims to ensure a prerequisite for taking pleasure in many notions of the desirable; it is one contribution to sustaining a "safe zone" just for societies (Ziegler, 2016a).

4.2.5 Carbon Neutrality

Carbon Neutral, which was designated the word of the year by the New Oxford American Dictionary in 2006, has now gained widespread acceptance (Sen et al., 2022). The balance between generating carbon and absorbing it from carbon sinks is what is meant by the term "carbon-neutral" (also known as "Carbon Neutrality"). Any ecosystem that absorbs more carbon than it emits, such as forests, soils, and oceans, is considered a carbon sink. The European Union Commission estimates that between 9.5 and 11 Gt of CO_2 is absorbed annually by natural sinks(Opel et al., 2017). No man-made carbon sinks have been able to date to remove enough carbon from the atmosphere to stop global warming. As a result, organizations have two alternatives for being carbon-neutral: either dramatically decreasing their carbon emissions to Net Zero or balancing their emissions through offset and the buying of carbon credits.

From another perspective, a state of Net Zero carbon dioxide emissions is known as Carbon Neutrality. This can be done by stopping to utilize coal, oil, and gas to the point where carbon dioxide emissions are drastically decreased and eliminated from the atmosphere. The phrase refers to carbon dioxide-releasing operations connected to transportation, energy generation, agriculture, and industry. A carbon footprint also includes other greenhouse gases that are assessed in terms of their carbon dioxide equivalence, even if the term "Carbon Neutral" is employed. Even though CO_2 is the most frequently detected gas, the phrase "climate-neutral" acknowledges the larger inclusion of other greenhouse gases in climate change (Sen et al., 2022).

The European Parliament claims that Carbon Neutrality is attained when a zero balance, also known as a zero-carbon footprint, is left in the atmosphere between the amount of CO_2 that is emitted into the atmosphere and the amount that is removed through various methods. It is a commitment in a carbon-neutral organization to assess the CO_2 emissions generated. This goes hand in hand with figuring out how to cut those emissions and make up for them by cutting emissions somewhere else or extracting an equivalent quantity of CO_2 from the atmosphere. Carbon Neutrality often only accounts for CO_2 emissions from corporate operations, not those from other emissions of greenhouse gases associated with the activities of the organization (Sen et al., 2022).

4.2.6 Differs between Net Zero and Carbon Neutrality

To support the goal of keeping global temperature increases to 1.5 degrees Celsius, as established in the 2015 Paris climate agreement, a corporation must cut its absolute emissions throughout its entire supply chain to achieve Net Zero. Although the more modern "Net Zero" term is regarded as "the gold standard for corporate climate action," it should be noted that both terms (Carbon Neutrality vs Net Zero) refer to various acts that are crucial components of the whole as we fight climate change. Both concepts are essential parts of an attempt to reduce emissions that are being made to meet climate commitments(Loveday et al., 2022).

Carbon Neutrality is a term that refers to a specific area of corporate operations and normally only accounts for CO_2 emissions. On the opposite hand, Net Zero refers to a company's elimination of all greenhouse gas emissions throughout its entire supply chain. As was already mentioned, the words "Carbon-Neutral" and "Net-Zero" are partly but not completely

interchangeable. Companies are attempting to lessen and balance their carbon footprint in both cases. Net-Zero carbon means no carbon was emitted from the beginning, hence no carbon needs to be caught or offset when the term "Carbon Neutral" refers to balancing out the overall quantity of carbon emissions. For instance, a business could declare its energy to be "zero carbon" if its building runs solely on solar power and consumes no fossil fuels. Therefore, it is important to define Net-Zero carbon or emissions when using the term "Net-Zero." The balance between greenhouse gas emissions (GHG) created and GHG emissions removed from the atmosphere is what is meant by Net Zero emissions, on the other hand. Net Zero, then, refers to the time when human activity ceases to increase the amount of climate-warming gases in the atmosphere(Loveday et al., 2022).

4.2.7 Few additional pertinent expressions

"**Climate Positive**": refers to actions that go further than attaining Net-Zero carbon emissions to improve the environment by eliminating more CO_2 from the atmosphere.

"**Carbon Negative**" and "climate positive" are synonymous.
Climate Positive and carbon negative are similar concepts. When an organization captures or eliminates more CO_2 from the atmosphere than it even contributes, this happens. The corporation then delivers less carbon emissions, which has a favorable influence on the climate.

"**Carbon Positive**": Organizations define climate positive and carbon negative as being "carbon positive." As it is mostly a marketing term and is understandably unclear, we normally steer clear of it.

"**Net-zero carbon emission**": When an action emits Zero Net carbon dioxide into the atmosphere, it is said to be "net-zero carbon emitting."

4.2.8 Is Carbon dioxide the only topic at hand?

No, it concerns all greenhouse gases, including carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and ground-level ozone. Although this is not a comprehensive list, for the time being, consider greenhouse gases to be a blanket phrase for the dangerous substances we are releasing into the atmosphere.

4.2.9 CO_2 equivalent (CO_2-eq)

In order to assess the emissions of other greenhouse gases according to their global warming potential (GWP), the phrase "carbon dioxide equivalent," often known as " CO_2 equivalent," is employed. By turning the equivalent amounts of other gases into carbon dioxide, which has the same potential to cause global warming, this is accomplished. The fundamental distinction between CO_2 and CO_2e is that whereas CO_2 just accounts for carbon dioxide, CO_2e also includes all other gases, including methane, nitrous oxide, and others. The expression "Carbon dioxide equivalent" (CO_2e), on the other hand, refers to the number of metric tons of CO_2 emissions that have the same global warming potential as one metric ton of another greenhouse gas (Loveday et al., 2022).

4.3 The CCS method and its potential application in Sweden

Examining the CCS technique, which is covered in greater detail in this section, and its different forms was another aspect of this study. This innovative approach demonstrates which of its sorts is dependable and available in Sweden.

In the second half of this century, the signatories to the Paris Agreement on climate change (the Paris Agreement) must aim to achieve equilibrium between human-caused greenhouse gas emissions from sources and removals from sinks(Unfccc, n.d.). Many nations around the world have adopted or are moving toward adopting Net Zero emission targets, with the assumption that developed nations will take the lead in these initiatives.

According to Sweden's 2017 climate policy framework, by 2045 the country must have no net emissions of greenhouse gases into the atmosphere and should then reach negative emissions. As net negative emissions cannot be achieved entirely by reducing emissions, achieving this goal will necessitate additional actions along with extensive emission mitigation. Without a plan for supplemental measures, the framework for climate policy cannot be put into practice. The information that I use in this section and refer to it multiple times comes from a government investigation into whether Sweden and Swedish institutions might use CCS and other varieties of this technology. (SOU 2020).

Few nations have made as much progress toward achieving Net Zero emissions as Sweden. This will demonstrate unequivocally that Sweden intends to act in accordance with science to contribute to the Paris Agreement's aim. However, neither significant risks nor insurmountable challenges support Sweden in delaying its course of action. More than two-thirds of Sweden's total area is covered by trees, making it a lightly populated, forested nation. The ability to produce renewable raw materials sustainably and actions that affect carbon storage in soil and forests are therefore crucial to reducing Sweden's national net emissions.

The strategy's main objective is to support Sweden in achieving the objectives of the country's climate policy framework. The plan is to make it possible to apply additional measures to reach the targets for 2030 and 2040 as well as the goal of Net Zero emissions by at least 2045. Additionally, by using additional measures, it will be feasible for Sweden to achieve net negative emissions of greenhouse gases just after the Net Zero goal has been fulfilled (SOU 2020).

4.3.1 Targets for supplementary measures

• Sweden must implement additional measures by 2030 that would save at least 3.7 million tons of carbon dioxide annually.

• Sweden must implement additional measures by 2045 that would save at least 10.7 million tons of carbon dioxide annually. This level is to be able to increase after 2045.

• The amount of yearly produced supplemental measures will keep growing between 2021 and 2045.

At the same time that emissions from industrial processes reach levels close to zero, basically, all societal use of fossil fuels must be stopped. This can be accomplished in part by gradually

eliminating the use of fossil inputs and by implementing CCS technology generally in sectors like cement production, where fossil carbon emissions cannot be avoided.

The agricultural industry is anticipated to emit the most greenhouse gas emissions in 2045. Biological activity account for the majority of agricultural greenhouse gas emissions, which are often dispersed over a wide area and difficult to control and catch (SOU 2020).

To stay in line with the Paris Agreement's aim and Sweden's intention to be a leader in the fight against climate change, it is possible that the national climate targets will need to be tightened up. The ability to meet more stringent climate targets at the national or European level may be enabled by supplementary measures if society in Sweden is effectively transformed to achieve extremely low greenhouse gas emissions.

As I indicated in this study, there are various forms of CCS technology, but considering all possibilities in light of Sweden's requirements for achieving Net Zero, it appears that bio-CCS is more accessible and practical than the other CCS forms. Although technical, legal, political, and commercial risks or obstacles could delay or halt bio-CCS projects, even though the inquiry's recommendations aim to reduce these, commercial risks are likely to pose the biggest threat to project implementation in the case of bio-CCS. A greater scale of testing has not yet been done on other technical methods for the removal of greenhouse gases, which are still in the early stages of development. Additionally, there are currently no common regulations or systems in place to track and report the negative emissions produced by these technologies. Over time, it might be obvious that some supplemental measures should be prioritized over others (SOU 2020).

Sweden is in a good location for bio-CCS. Currently, more than 100,000 tones of biogenic carbon dioxide are emitted by about 70 facilities in Sweden. From a 2045 perspective, Sweden has a realizable potential for bio-CCS of at least 10 million tons of biogenic carbon dioxide annually (SOU 2020). By 2045, Net Zero emissions are the desired long-term climate objective, and bio-CCS is well suited to help achieve this goal at a reasonable cost. From a geological standpoint, there is space for storing carbon dioxide from Swedish CCS (including bio-CCS) in Sweden or close by in the near future. A technically and financially viable alternative to Swedish CCS projects is carbon dioxide storage in Norway or another North Sea nation (SOU 2020).

For the coming years, shipping by sea is the only practical choice for delivering carbon dioxide to a storage location while doing CCS, including bio-CCS, in Sweden. Although there is little practical experience with CCS, including bio-CCS, the knowledge situation is generally favorable, so CCS, including bio-CCS, can be implemented in Sweden without having to wait for the outcomes of ongoing or future research projects. Even though the removal of biomass increases slightly compared to the current situation, Swedish bio-CCS is deemed to have very limited effects on biodiversity at the amounts necessary to achieve the objective of Net Zero emissions.

The overall management of CCS concerns in Sweden is presently being handled by no agency. The task of coordinating the activity of agencies on CCS, including bio-CCS, has not been assigned to any agency either. This is a weakness that has to be addressed. It is crucial to increase chances for efficient information sharing across organizations, private actors, academics, and society because CCS, particularly bio-CCS, is a technological chain that has not yet been established or made a name for itself in Sweden (SOU 2020).

The University of Gothenburg appears to be a government-affiliated educational institution, based on the information available. can act in precisely the same manner to attain this technology. And this review can be quoted in accordance with the general potential.

4.4 Information obtained from the interviews with other universities

Six universities were investigated and communicated with. Before every interview, any materials pertaining to the annual report, the rate of achievement in minimizing emissions, or other pertinent data given by the universities were evaluated in order to formulate more precise questions. And as a result, the data I'll cite in this part comes from both their report and the interviews they performed.

Although there were many instances of similarities and there were interesting differences as well, the results from the interviews with the universities varied and were largely related to the particular policies and decisions of the universities. The discussion part includes an overview of the research conducted by the universities as well as information on their objectives and annual reports on the amount of carbon dioxide reduction.

4.4.1 Public university in Zürich, Switzerland, ETH

Two Campuses and sixteen Departments
ETH Zürich, Federal Institute of Technology
By 2030, ETH Zurich intends to achieve Net Zero in its internal operations. The goal is to cut GHG emissions by at least 50% from the baseline year of 2006 to 2030. With its own resources, ETH Zurich intends to reach the Net Zero objective. It recognizes the magnitude of the transformation that will be necessary as well as the significant costs and consequences of delay. At the same time, it recognizes that the collective effort to reach Net Zero by 2030 will present several chances for social and technological advances in its operations as well as for coming up with solutions to support science, economy, and society that is climate friendly. In terms of lowering emissions from its energy source, ETH Zurich has already made great progress. With a three-step plan, the university is establishing the prerequisites for achieving the Net Zero objective.

1. Actions: ETH Zurich reduces emissions in order to get rid of GHG-intensive structures and operations.

2. Technology: ETH Zurich uses technical tools to increase the effectiveness of structures and processes and is converting to less GHG-intensive processes.

3. Innovation: Nearly inevitable leftover emissions are captured via negative emission technologies, particularly for carbon storage. The yearly ETH report is the foundation for all of the information provided in this part.

The University will be concentrating specifically on actions in the following areas as it works toward carbon neutrality.

A) Construction, redevelopment, information and communication technology (ICT), and procurement

The ETH Campus, business operations, and conduct of all ETH Community members are the focus of efforts. Buildings (heating, cooling, and power), commutes, campus mobility, business trips (including air travel), catering, purchasing, and information and communication technology all have smaller GHG footprints.

B) Research, education, and sharing of knowledge
Many ETH researchers are putting in a lot of effort to create solutions for handling multiple crises. They are working to establish an atmosphere of hospitality to attain carbon neutrality through research and partnerships with other universities. And the university has a special curriculum in place for this.

C) Investments in currency
At ETH Zurich, asset management employs a structured cash-flow strategy.

ETH Zurich tracks its progress toward being a climate-neutral university and publishes reports on it. All GHG emissions are considered in this procedure and reported as CO_2-equivalent emissions in compliance based on the Greenhouse Gas Protocol.

Ms. Claudia Zingerli took part in the interview. Head of ETH Sustainability, Office of the President.
She had a fascinating hypothesis regarding Net Zero. “Regarding the precise definition of Net Zero, we distinguish between a measurable (“hard”) net-zero with a target and reduction path respectively, that can be monitored and a (“soft”) net-zero calling for action to be taken for addressing, avoiding, and reducing indirect emissions. This definition of Net Zero is currently being elaborated and consolidated.”

Likewise, about how to overcome the first and most important restriction in relation to achieving the target, she believes, yes, “in our own backyard (YIMBY)! Instead of Not in my backyard (NIMBY). Make the transformation within the organization happen instead of only calling for transformation in society.”
Responsibility and urgency were two big challenges. Also, the main and first things that came to her mind as she thought about their progress so far were intergenerational and environmental justice as challenges.
The owner of the building located in ETH Zurich is the Federal State. Only a small percentage of buildings is leased. It denotes that the university is not the main owner.
She said about the Scopes (1-2-3): Roughly 90% of our overall emissions come from Scope 3. While technology advancements have made it possible to lower Scope 1 and 2 emissions by 48% from 2006 levels and will eventually enable them to be reduced to almost zero levels, Scope 3 emissions will be more challenging to address. In addition to creating strategies to cut the other Scope 3 emissions, we intend to establish binding reduction targets for Scope 3 emissions brought on by air travel.
ETH has sixteen departments. A carbon tax on emissions from air travel has been developed by some departments or is being considered for implementation. They helped departments establish reduction targets for flight-related emissions for the year 2025.

4.4.2 Zurich University of the Arts, Switzerland ZHdK

A public university with one Campus and five Departments
ZHdK offers an academic setting that encourages the creation of remedies for ecological, social, and economic transformation. ZHdK integrates the theme of sustainability into the

everyday organizational life of its members and uses sustainability as a major criterion for decision-making according to the Sustainability Report of 2022-2021 this university the Operational sustainability is split into three main categories:

1: Operational sustainability
2: Services' Action Areas
3: Outlook

For each category, there are multiple subcategories that make the way clearer.
An intriguing development at this university concerned how the concept of Climate Neutrality was first brought up by students, who then asked the university board to sign a letter regarding the climate emergency. Following that, they began to draft a more thorough sustainability plan for the campus, which they called operational sustainability. Their current objective is to become climate neutral by 2030. By 2030, they plan to cut CO_2 emissions by 50% from our base year of 2018.

The interview was done by Ms. Nadja Fässler-Keller, Head of Administration / Sustainability Office.

She identified the changing behaviors of campus residents as a significant obstacle that they are still attempting to overcome. She believes it is very challenging to break routines and habits, and the behavior audit presents problems for the sustainable team in terms of traveling, food sustainably, etc.

The first steps they took in the transportation sector led to significant successes, and after that, they began researching other sectors. From her perspective, going down this path is like walking through a fog; you have to take baby steps and keep an eye on the road.
Due to the fact that they are not the building's owners, they are faced with a number of obstacles when it comes to the infrastructure and emissions from the heating and electricity systems.

Regarding their targets for CO_2 reduction, they made it quite clear that the area in which we have the most impact should be our first priority. Therefore, it seems sensible to focus initially on the main sources of emissions. And they began with the first balance of greenhouse gases. It was affecting campus catering services and air travel.
Lack of targeted investment is another challenge they have because a budget incompatible might lead to serious issues.

4.4.3 The University of Technology TU Delft

The Public technical university with one Campus and eight Departments
Sustainable development has always been at the centre of TU Delft's operations. TU Delft aspires to be carbon neutral and circular by 2030, according to its Strategic Framework 2018-2024. Sustainability underwent a paradigm shift in 2019. Climate Action was the anniversary year's topic. On and off campus, TU Delft strives to be a university that operates entirely sustainably. The campus will be circular, climate-adaptive, and contribute to the quality of life of both its users and the environment through all of its operations.

The environmental goals of TU Delft
1: By 2030, all TU Delft-related activities conducted on and from the campus will be carbon neutral.

2: By 2030, all resource and waste movements through the campus will be circular.
3: By 2030, be able to cope with heat, drought, severe rain, floods, and extreme weather.
4: Improving living quality by increasingly focusing on biodiversity, security, health, comfort, and inclusivity.
5: Highlighting its quality and sustainable nature on campus by hosting and showcasing cutting-edge initiatives and living laboratories.

The products (stationary, equipment, furniture, etc.) and services (hired externals) that TU Delft purchases account for half of its emissions. All future purchases must pass the sustainability, and particularly the circularity, test. Furthermore, it is crucial to make the entire product supply chain sustainable.

TU Delft will need to make the geothermal well operational as a new source of high-temperature (HT) heat for the campus' district heating system, taking the place of hot water from the cogeneration plant, which is now fuelled by natural gas. The mid-temperature (MT) return flow that heats the majority of the campus buildings can eventually be used to distribute geothermal heat to other areas of the city of Delft.

The renovation or transformation of existing buildings on the campus is a measure for any heating system that can be taken without any regrets. It is best to start with the constructions that utilize the most energy per square meter. Along with the aforementioned building renovations, the university has to begin rolling out photovoltaics (PV) as soon as possible.
The above items are possible for TU Delft because they are the owner the property and this ownership gives the sustainable development group the right to choose and decide to do what they want and keep them closer to the ultimate goal of Climate Neutrality.

In an interview with Dr. Ivan Ligardo-Herrera, a postdoctoral researcher at the Energy and Industry from TU Delft, he discussed one of the largest difficulties facing the supply chains for all the products and services we purchase. as well another difficulty is the construction of new buildings.

Relating to top priorities, he highlighted that their primary obstacle is construction, followed by all the equipment needed for the various laboratories they have in relation to their type of instructions in the university. They take into account having sustainable catering on their campus.

He talked of creating a dashboard to monitor CO_2 emissions, similar to a monitoring dashboard. This dashboard provides information on emissions and makes it simple to monitor the carbon footprint, just like a fully separate component would. He hopes to have that dashboard available so they can monitor their progress and eventually accomplish their objective.
Regarding carbon offsetting, he considered it to be the institution's primary duty to decrease its carbon footprint and enhance sustainability and reduction initiatives. "Reduction is the main task," he stated.

4.4.4 University of Edinburgh

The public university with five Campuses and nine Departments
The University of Edinburgh wants to be Net Zero by 2040. They shall take action in the areas of operations, wise investing, learning and teaching, and research into renewable energy

prospects in order to fulfill these new commitments. The five campuses of the university will serve as active learning spaces where they can experiment with new ideas. As part of the measures needed to prevent catastrophic climate change, they will lower their energy consumption, increase their usage of renewable energy, and look into new ways to reduce their direct and indirect emissions. This Strategy identifies energy, gas, and business travel as the main contributors to the University's emissions after a thorough evaluation of those emissions. To minimize emissions in these sectors, we are consequently creating focused programs.

The right person to talk to about the purpose and accomplishment of the university was Andrew Arnott, Manager of Climate, Biodiversity, and Sustainability. He presented the following points:

This Strategy identifies electricity, gas, and business travel as essential components. To cut emissions in these locations, we are creating focused programs. To accomplish our goals, we will launch brand-new initiatives, such as the Sustainable Campus Fund, which will help the University save money on energy. We will spread sustainable travel guidance to raise knowledge of alternate travel options, reduce the emissions that business travel contributes to, and transition our fleet of vehicles from fossil fuel to electric power.

Future projects will be developed to alter our operational procedures and lower emissions. A new task group will look into the university's renewable energy options because direct carbon offsetting and investments in renewable energy have the potential to significantly reduce our emissions. We will keep checking to see that the University's waste, transportation, purchasing, and food policies are in line with this Strategy. Our yearly Principles for Responsible Investment report is made available to the public online. Over the next five years, renewable energy will account for the majority of electricity growth, and by the time our undergraduates reach middle age, they will have supplanted all other energy sources.

Regarding the concept of Net Zero, he believed that: “Although the term "carbon neutral" should entail aiming for Net Zero, it is frequently used by businesses that make minimal efforts to cut their emissions before turning to offset. By 2040, the university will achieve Net Zero. primarily by drastically reducing our emissions—probably by about 90%—and then sequestering the remaining emissions in the land we own and manage, where we will plant trees and regenerate peatlands. We can also do this by forming direct bilateral partnerships for forestry and peatland restoration. Therefore, we don't frequently buy carbon offsets on the open market.”

The supply chain, in his opinion, was this university's biggest concern. He stated that because there are likely many organizations like us, our supply chain makes up the majority of Scope 3 for us. Therefore, there are challenges with data and influence, both of which are significantly improving as data improves due to increased demand, and your influence grows due to rising demand for the same actions from suppliers.
In accordance with what he said, they are property owners, and this ownership has provided them with a number of advantages, including the flexibility to modify their campuses in a sustainable way, which is precious.

4.4.5 The Polytechnic University of Catalonia (UPC)

A public university with nine Campuses

The person who has been in charge of the sustainability endeavor at this university was Pere Losantos Violas. In our conversation, he asserted that this university was taking steps to become Carbon Neutral by 2030, particularly with regard to emissions that occurred under Scope 1 and 2, and that they hoped to address the challenges associated with Scope 3 afterward. They were the first university in Spain that decided to be climate neutral and afterward many others bring up this idea.

The intriguing part of the process's beginning is that a group of students brought up the idea of reducing their carbon footprint for the first time and presented it to the university administration. This was the first phase of their journey.

When we discussed the difficulties, he brought up the emissions produced by boilers and gas-powered items regarding heating systems, as well as the fact that some air conditioners cannot be removed. He also mentioned that it takes time to get rid of all these emissions and replace inefficient equipment of this kind with renewable energy sources. It is considerably more difficult to improve these procedures if you are a public university without specific investment or financial affairs.

They have spent years reporting their emissions, making efforts at mitigation, compensation, and obviously adaptation for years to come. Dealing with these processes has caused them to believe that it will be tough to convince all academic institution members of the value of carbon neutrality, regardless of their position.

They are owners of properties of campuses that have benefited them in some ways, and they also consider using renewable, efficient energy, but they first want to change all the boilers and related systems before attempting to lower their electricity usage. In addition, waste management, equipment oversight, and personal transportation are other sustainable techniques that are being developed.

Regarding staff and student conduct, he stated that the faculty of architecture is more aware of its emissions, which may, be explained by the nature of this faculty. in general, its emissions are lower than others.

Our discussion has revealed that they are a concerned university. When it came to environmental issues, progress was being achieved despite obstacles, and given the noted constraints, the progress was quite significant.

4.4.6 University of New South Wales, Sydney (UNSW)

A public university with one campus and seven faculties
As a university with a strong focus on both education and research, UNSW Sydney provides excellent instruction in addition to leading-edge study. For the Sustainable Development Goals (SDGs) to be achieved, universities must play a crucial role.
Their strategies are organized as follows for each area:
1. Commitments: High-level declarations outlining our intended course of action.
2: Targets are the specific, quantifiable outcomes against which they evaluate their development.
3: Activities: the actions we do that assist our goals and commitments get accomplished.

The areas that matter most to the students and staff are where UNSW chooses to concentrate.

This includes switching to renewable energy, tracking and achieving Net Zero GHG emissions, and preparing their operations for climate threats. Estate Management is in charge of managing onsite solar energy projects and energy sourcing. Staff members from facilities management, building, purchasing, merchandising, travel, and investment services, as well as suppliers and academic specialists, are participating in measuring and lowering our entire GHG footprint.

Thanks to a new solar car park system erected on the rooftop level of UNSW's Botany Street parking garage, students and employees may now use renewable energy to charge their electric vehicles on campus. One of Sydney's largest EV charging facilities, with six chargers.
The photovoltaic (PV) system makes use of UNSW-developed PERC solar cells, which have bifacial technology that allows them to produce power from light hitting both the front and rear of the PV module.

The sustainability aims cover overall emissions from UNSW operations (known as "Scope 1 and 2" emissions, primarily from energy use) and the value chain (indirect or "Scope 3" emissions from acquired goods and services, construction, investments, travel, and other sources). Although Scope 3 emissions are often higher than Scope 1 and 2, they are difficult to monitor, outside of an organization's direct control, and their reduction calls for extensive, long-term organizational reform as well as supply chain engagement.

The head of environmental sustainability at UNSW, Dr. William Syddall, was the person who was supposed to be in charge because he was completely aware of the entire procedure. He provides the following explanation of the challenges and difficulties related to Scope 3:

We thoroughly evaluate every aspect of our whole value chain footprint. And we take that into account in our aim, which, as far as I'm aware, is exceptional compared to most universities. Therefore, we discovered that our supply chain accounts for around 50% of our overall emissions, and our investment activities account for another 20%. However, I believe that most universities wouldn't keep track of that. Therefore, I believe it is important to say that upfront because it demonstrates some of our primary areas of attention, which are primarily related to supply chain emissions. So, I'd say the Scope 3 emissions, and just complexity are some of the toughest obstacles to overcome.

He claimed that they signed a power purchase agreement for 100% renewable energy, which allowed for the construction of a big solar farm. This was one of Australia's largest at the time. So, we claim that as a company, we actually began by switching to renewable electricity, which is maybe not the best course of action; in an ideal world, you probably start by evaluating your entire footprint before developing your policies.

They are in a position to make the best reduction decisions because they are the owners of campus structures. which gave them total authority over their structures, enabling them to use them any way they like.
In terms of how to enhance employee behavior, he thought that behavior transformation simply revolves around sustainability and emission reduction. That would be, as well as processes all around. We have internal procedures for maintaining labs and for making purchases, for example. Despite the laboratory's sustainability initiative. we should increase internal participation; however, my team only has two members, and we are a small group. therefore, we must focus on areas where we can have the most influence.

He stated: "We made a commitment to doing compensation to offset our Scope 1 emission in 2018. As a result, we declared that we would have Net Zero emissions under Scopes 1 and 2 by 2020. The strategy was to eliminate electricity from Scope 2, offset Scope 1, and concentrate on lowering Scope 1. We have offset Scope 1, which is a rather tiny amount, since then. Offsetting travel is something we've looked at, and there have also been debates about it."

I want to share with you a thoughtful idea he had regarding CCS. He said." A functioning CCS project, or even several functioning CCS projects worldwide, don't exist in my opinion. I'm not persuaded by the advantages of it, therefore. I believe the risk is the increased use of fossil fuels. And I believe we can all agree that we need to cease utilizing fossil fuels immediately. If we say, "Oh, we'll capture the emissions then," if CCS is used to manage and justify new fossil fuel projects, new oil and gas projects, and new automobile projects, then I believe that's a huge problem."

5 DISCUSSION

5.1 Tool-related data

The information from the tool demonstrates that there is a direct connection between faculty activities and emission rate. In general, The amount and the category of emissions will vary due to different activities in faculties associated with their characteristics and demands. Consequently, we might be able to get closer to having the best strategy, one that works specifically with the faculties' ways of operating. The value of looking at each faculty as a distinct case study will produce significant findings.

Due to the type of figures from the tool from which I gathered information, I focused on them in the result section in order to better communicate the notion.
The most significant external factor that affected the form and amount of CO_2 emissions across all faculties was the pandemic Corona phase, which had an enormous influence on both.

The original plan was to be able to manipulate the input data to produce the desired output data, comparing and analysing the climate impact of various scenarios. Unfortunately, it is presently not possible for the tool to evaluate scenarios simulating the action of the faculties with respect to their climate impact. Perhaps the tool will be developed to make this kind of analysis possible in the future. Additionally, the tool had minor flaws that prevented me from getting accurate data when I sought more in-depth information about a variety of categories. For instance, the tool was unable to give me a list of purchases made in the School of Business, Economics, and Law when I asked about purchases belonging to the category of miscellaneous. which might be considered one of the weaknesses of this sophisticated instrument.

5.2 Implications for strategies of the University of Gothenburg

Universities are without a doubt at the frontline of approaching Carbon Neutrality through a variety of sustainability efforts (O.Opel & N.Strodel, 2017). Utilizing renewable energy sources, encouraging change in behavior, boosting energy efficiency, and putting strategies in place for achieving Carbon Neutrality are all crucial strategies that need to be implemented across universities given the current initiative for the phase-out of fossil fuels (O.Opel & N.Strodel, 2017). This review makes it clear that while some universities stand out for

achieving exceptional results in their Carbon Neutrality initiatives, other universities still need to make additional efforts to improve their initiatives. These accomplishments are directly tied to the objective of achieving carbon neutrality, not to the university's overall standing globally.

A more sustainable built environment, Energy, Greenhouse gas (GHG) emissions, Nutrition and Horticulture, Management of Resources and Waste, Transportation, and Water have all been identified as seven sustainability categories in this assessment that can help lower a university's carbon footprint (Sen et al., 2022).

Since there is a lack of investigation into higher education institutions' efforts to become completely carbon-neutral, this study aims to fill that gap in the body of knowledge.

The following can be used to illustrate the particular scope of this research:

• Identify the primary causes of GHG emissions in universities.
• Consider measures to lessen these key contributing factors.
• Describe the primary techniques used by institutions to gain full carbon neutrality.
• Analyze and compare a few top and growing institutions outside of Sweden in terms of the difficulties they face and the approaches they have taken to achieving sustainability and carbon neutrality.
• Establish standard operating procedures or directives for initiatives and approaches that other universities can adopt.

The following requirements must be met by universities in order to become carbon neutral under the Climate Efficient Carbon Neutral program:
• Measure emissions and reduce them whenever possible;
• Offset remaining emissions;
• Publicly report on their carbon neutrality; and
• Undergo independent validation (i.e., audit or verification) by an environmental auditor or carbon consultant at least once a year (See Figure 25).

Figure 25: Requirements for climate efficient Carbon Neutral program

The initiatives for sustainability are broken down into the categories for sustainability shown above in the ensuing subsections. In order to establish a road for the case study institutions to achieve carbon neutrality, it seeks to discover both commonalities and contrasts in the tactics they are employing (Sen et al., 2022).

The empirical findings of this paper show that higher education institutions emphasize the effective use of natural resources throughout the learning system as well as to provide a balanced, equal, and inclusive socioeconomic growth through education, investigation, and democratic reform, not only for their employees but also for the society at large (O.Opel & N.Strodel, 2017). Although there are obstacles in the way of achieving sustainability objectives and carbon neutrality, numerous universities have transformational plans in place that are meant to provide leadership through sustainable practices. It is advised that universities create long-term strategic approaches toward this crucial area in order to motivate, put into practice, and develop sustainability strategies. This recommendation is based on case studies of selected universities that are leading in their efforts to achieve Carbon Neutrality.

It is necessary to clarify that I chose the most significant strategies to discuss in the text below based on data from the literature, data from the various sustainable strategy reports from interested universities, and data from those universities' annual reports. I chose these strategies because they were more repetitive and practical.

5.3 Sustainability categories

The strategies put into action were divided into seven "sustainability categories," which are:

- A more sustainable built environment
- Energy
- Greenhouse gas (GHG) emissions
- Nutrition and horticulture
- Management of resources and waste,
- Transportation
- Water

Each of these categories sets the higher education institution on an appropriate path for determining the magnitude of its carbon footprint and makes its approach more logical and scientific.(Sen et al., 2022)

5.3.1 A more sustainable built environment

The phrase "sustainable building" refers to a structure as well as the use of resource- and environmentally conscious methods during all phases of a building's life, including planning, design, construction, operation, maintenance, refurbishment, and construction. The built environment principles of the university could be incorporated into the sustainability policy after a review of the university's policy approach, which used management principles. Any actions impacting the built environment and the natural environment should be identified at all stages of the design and construction processes. This will make it possible for the structure to include environmentally friendly elements like a rooftop solar energy system to optimize self-generation, a high-performance building facade to tasks effectively through shading, glazed windows, and other substances, signal timing control for the air conditioning system to inform building users when to use natural ventilation and monitoring devices connected to the university energy management system to track power consumption (Sen et al., 2022).

Older campuses that serve as symbols of culture and history should receive special consideration. Utilizing adaptive reuse and cutting-edge heating and cooling techniques will maximize sustainability results while respecting the history and distinctiveness of this historic precinct. The university's top priorities are to integrate environmentally friendly design principles into all phases of project lifecycles, look into cutting-edge international standards that apply to precinct-level design and development, review and update the university's design standards to allow for the integration of sustainability commitments, create guidelines for environmentally friendly design standards for both major and minor renovations, and put in place a zero-emission policy (Cano et al., 2023).

The matter of ownership

To enable and encourage the integration of environmentally friendly initiatives into the built environment, a set of rules need to be created. These guidelines are a prerequisite of the university's operational project design guidelines. The built environment of the institution must incorporate sustainability through sustainable building design and construction (Sen et al., 2022). In most cases, a university owns a building from conception to operation to repair, re-purposing, and demolition, but for those institutions that do not own the property, the work is more difficult, and they have to consider alternative possibilities to influence the property owners.

Regarding specifically the University of Gothenburg, Since the majority of the University of Gothenburg's property, including its campuses, is owned by the Akademiska Hus, active dialogue with that organization may help the university get closer to its objective. Despite this it cannot be denied, the institution has clearly faced restrictions as a result of this lack of ownership, and its decision-making authority has also been significantly reduced.

5.3.2 Energy

Utilizing more renewable energy sources and consuming less energy from non-renewable sources, such as fossil fuels, is what is meant by "sustainable energy" (such as solar, wind, rain, and geothermal heat). By putting policies, processes, procurement, and development into place, energy management strives to lower carbon emissions and the expenses associated with energy usage. Among the university's most recent energy-saving initiatives are energy performance contracts, which also include modifications to property management and control systems. Buildings and systems are observed to make sure they are functioning properly. Other initiatives include installing photovoltaic and solar hot water systems, upgrading lighting systems to LEDs (light emitting diode), replacing diesel fuel with natural gas and LPG (liquified petroleum gas), and ensuring that all significant new construction projects receive a 5-star Green Star rating (Opel et al., 2017).

For a university and its students, energy challenges are also planned and held. The energy strategy for the organization will be examined. The approach will concentrate on key areas such as energy efficiency, more onsite renewable energy sources, energy storage, electric vehicles, the elimination of natural gas, external power purchase agreements that will exclusively contract electricity from solar and wind references, and energy productivity.

The university's Net Zero Initiative should facilitate the transformation to an energy-efficient, renewable energy-powered future by upgrading and maximizing campus resources. One of its dedicated paths to align with the government's target by 2045 is to collaborate with industry partners and communities while adhering to its fundamental principles, which include significant energy-saving measures in existing buildings, performance criteria for new construction, and collaboration.

5.4.3 Greenhouse Gas (GHG) Emissions

Gases known as GHG are able to both absorb and emit heat from infrared light. In the last 150 years, GHG levels in the atmosphere have increased significantly, almost entirely due to human activity. This is the main activity causing climate change on a global scale.

All of society's inhabitants have a responsibility and should act in accordance with their responsibilities like HEIs a special part of society's body in order to achieve the reduction of these GHG effects (Sen et al., 2022). The universities that signed the climate framework are committed to utilizing a negative investment strategy for fossil fuel firms and a positive investment strategy for organizations and funds that promote the environment in order to become climate neutral. with the aim of completely withdrawing from investment funds that are exposed to fossil fuels. This criterion entails achieving Net Zero emissions by 2045 or earlier, outlining the measures that will be taken to do so, acting in the direction of Net Zero while documenting where carbon reductions are being made, and pledging to report progress on an annual basis (Sen et al., 2022).

Generally, the University of Gothenburg requires the following items in order to have an easy path toward offsetting:

In accordance with climate criteria for Carbon Neutrality, the university purchases and distributes offsets after the reporting period has ended. Once the annual carbon emissions asset has been established and the total number of required offsets has been determined, this is done. The university's sustainability committee should create a set of three standards to help guide decisions about the purchase of carbon offsets.

• The unit cost of the offset option
• Financial support for locally based initiatives to the extent that they are regarded as financially viable
• Preference for initiatives that are in accordance with the University of Gothenburg and provide a high level of participation

5.3.4 Nutrition and horticulture

When managed properly, agricultural production, forest management, and the fishing industry can produce enough food for everyone while also producing respectable incomes, promoting development that is centered on the needs of the people, and protecting the environment by increasing public awareness of the importance of effective environmental management (Sen et al., 2022). In line with this, the university places a strong emphasis on best practices for managing the impact of its activities on the environment. On-campus vegetable gardens, food allotments, and individual trees offer a variety of fresh food options. While some have restricted access, others are accessible to every staff member and student. Sustainable dining and food and beverage purchases are two important food categories. Attempts to reduce food

and eating waste as well as support for sustainable food systems are important parts of this issue. In addition to encouraging students and staff to dine in and bring their own cups and containers, the introduction of a Plastic Free Dining scheme included the development of a supporting promotional campaign(Sen et al., 2022). Many on-campus cafes also offer a coffee discount to promote participation in the program to bring their own cups. These initiatives include giving discounts to customers who bring their own coffee cups and containers, creating menus that feature seasonal vegetables and fruits, boosting the number of vegetable dishes served, only using high-welfare meat, serving vegetarian and vegan meals every day, buying goods from local or reasonable vendors, and doing away with single-use plastic drink bottles (Sen et al., 2022).

The food supply chain and the university's operational footprint have a significant impact. This helps the university to make better use of its purchasing power to meet the strategic objective of changing the world by achieving Climate Neutrality while also enhancing supply chain operations (O.Opel & N.Strodel, 2017).

5.3.5 Management of resources and waste

The efficient use of material resources to reduce waste production and the management of garbage in a way that actively advances the environmental, social, and economic objectives of sustainable development are the cornerstones of sustainable resource and waste management. According to teaching, research, and general living and working at the university, pupils and staff at universities consume a large number of goods and services(Sen et al., 2022). Due to the cumulative effects of the product's manufacturing, distribution, use, and disposal, every purchase has an effect. The existence of a Sustainability Committee is required. By incorporating a waste hierarchy into all university operations and activities, this plan provides guidance to the entire university community in achieving their resource recovery and waste minimization goals. (Sen et al., 2022)

With the aim of quantifying waste generation, improving opportunities for resource recovery from all waste types, and identifying the infrastructure, services, and logistical solutions required to support a comprehensive resource recovery program, the university promotes improved resource recovery on campus (Opel et al., 2017). The university commits to tracking and reporting important indicators relating to resource acquisition and recovery and collects a range of data in support of this. Procedures are required for laboratory activities, which can be applied at both the individual and organizational levels. These procedures are broken down into four units: energy, water, purchasing, and recycling. These are some fundamental but essential factors in resource and waste management. For the institution, sustainable laboratories are vital. Since laboratories have the potential to conserve resources, it is crucial to try and minimize waste generation without compromising integrity or safety (Opel et al., 2017).

The processes used to manage used office furniture through a program for donations developed with nearby non-profits and schools may be advantageous. These pieces of equipment are now being used effectively and kept out of landfills. The next idea is that the sustainable team of the university could offer refurbished staff laptops to students who needed them through the laptop equity project (Sen et al., 2022).

Main efforts include looking at larger-scale recycling options for organics, considering waste prevention in purchase decision-making, enhancing bin classifications and arrangement to

increase recycling rates, expanding the scope of the Reuse Program to include the recovery of all furniture and equipment, tracking waste data by disposal method on a daily basis and reporting on a regular basis, and improving contractor management to ensure proper garbage disposal. These techniques are simpler to use and maintain for Swedish universities because Sweden is one of the leading nations in the world for waste management.

5.3.6 Transportation

Transportation that promotes social equality, public health, and economic growth while preventing or minimizing harmful environmental effects and the depletion of natural resources is referred to as sustainable transportation (O.Opel & N.Strodel, 2017). This emphasis area includes how individuals travel to and from campuses as well as how staff and students travel for academic purposes as part of the efforts to lower Scope 3 emissions. The main element in lowering GHG is the travel habits and patterns on all campuses and facilities. If the university makes an effort to encourage and support staff and students in choosing environmentally friendly transportation options to get to and from their places of employment and education, including carpooling, car sharing, public transportation, electric vehicles and bicycles, cycling, walking, as well as the development of secure parking for their vehicles, it has taken a big step to achieve Climate Neutrality. (Sen et al., 2022).

It's important to comprehend the significance of the carbon footprint from travel because it wasn't taken into account in the University of Gothenburg's carbon budget how many emissions come from travel to or from campuses. According to the University of Gothenburg's carbon budget, there is no room left to describe how serious this problem is. Due to its high emission rate, travel to and from universities is significant. However, by implementing certain procedures for staff and students, it is possible to significantly reduce CO_2 emissions.

5.3.7 Water

Natural resources like water are scarce. Ensuring the availability of high-quality water in the future is the aim of sustainable water management. Water is used by all groups for a wide range of purposes. The grounds at all institutions also need to be watered. Many documents, including the university's sustainability policy and chemical management procedure, demonstrate the institution's commitment to lowering water use and pollution (Sen et al., 2022). The universities are committed also dedicated to lowering potable water usage and reintroducing water to the hydrological cycle. Sweden currently faces fewer water-related challenges than other nations but should in any case preserve this natural resource to promote sustainably.

It is envisaged that the University of Gothenburg will be able to move closer to achieving its major objectives by utilizing these strategies and any other techniques.

5.4 Further recommendations

- The targets cover the total emissions from operations at the University of Gothenburg (´Scope 1 and Scope 2 emissions) as well as the value chain (indirect or Scope 3 emissions from construction, investments, travel, and other sources). Although Scope 3 emissions are often higher than Scope 1 and 2, they are difficult to monitor and outside of an organization's direct control. Their reduction calls for extensive, sustained

organizational reform and supply chain involvement. So, while achieving all emissions, including Scope 3, may appear challenging and out of reach for the University of Gothenburg's short-term aim, there should be a thoughtful plan for the long-term goal.

- Daily purchasing decisions have an effect on both individuals and the environment. The University of Gothenburg shall strive to use its procurement procedures to purchase goods and services that have the least negative environmental effects and the greatest potential for positive economic and social effects. It could adopt a risk-based strategy, guided by an evaluation of the environmental, social, and economic risks and possibilities in its supply chain, in order to concentrate on the areas where we can have the biggest impact. The goal of the university is to address these dangers and possibilities. Staff and students are primarily involved in this focus area's activities, which could be overseen by a sustainable team. The university's supplier selection and relationship management practices are important. The thing that is obvious should be concentrated on the organization's long-term objective for this area and in addition, it should be worked on as a daily practice, which then incorporates the short-term aim as well.

- The university should strive to establish wholesome and regenerative spaces for learning and work where people can interact with nature through the planning and administration of campuses. This Management may work with personnel from various faculties, students, consultants, and governmental organizations. The goal of the University of Gothenburg should be to optimize the use of existing spaces in order to lessen the need for new construction and to use new assets sparingly when new development is necessary. Due to the time constraint, this attempt for the short-term aim can load a lot of apps and be partially developed.

- The campuses of the University of Gothenburg utilize a lot of water and electricity, which are resources we depend on to do the essential tasks involved in higher education and research. As a result, in order to establish sustainable campuses for staff and students, the University concentrating on increasing our energy and water efficiency.

- Waste management is likely the most obvious daily environmental concern on campus and is a top responsibility for both students and staff. According to the waste hierarchy, this target area covers the University’s initiatives to get rid of single-use plastics, increase recycling, and reduce what we throw in landfills. The institution should work to reduce costs, enhance waste awareness among students and employees, and protect natural resources by reducing waste practices and behaviors. Sweden is one of the world's leaders in waste management, thus it can be assumed that everyone involved in this issue needs more attentive supervision and can be included in short-term goals.

- For employees, students, and visitors, access to and around campuses is crucial. The University of Gothenburg should promote active and public transportation options as much as possible, with bicycles being the most environmentally friendly method of transportation, in order to reduce environmental effects and increase health and well-being outcomes. The University of Gothenburg should offer facilities in its locations,

such as secure parking lots with electric vehicle charging stations. Therefore, the university's short-term goals should promote such development in this area.

6 CONCLUSIONS

Despite the fact that Swedish Universities are among the leading institutions vying to be labeled as carbon-neutral, there isn't a lot of publicly available data on the universities' path to carbon neutrality or on the documentation and upkeep of their carbon-neutral status. Public reporting of activities is essential for carbon neutrality. As a result, this can both support the maintenance of carbon neutrality and serve as motivation for other higher education institutions to increase their sustainability efforts. The way universities are putting sustainability programs into practice in keeping with their mission and values is an intriguing finding of this review. Despite working toward the same end goal of becoming carbon neutral, various institutions provide distinctly different perspectives on sustainability.

It's also essential to point out that, according to currently available information, the COVID-19 outbreak led to lower carbon emissions for that period, as shown by information gathered from university reports. Due to the COVID-19 pandemic, the University of Gothenburg has also reported significant reductions in emissions, which suggests that universities and university teaching can be reimagined to become more sustainable. Researchers have also suggested that higher education should seriously consider continuing to enhance digitalization in light of sustainability.

In campuses

An initial and updated greenhouse gas inventory is used to determine your starting position for emissions and to track your progress as you move forward. This information influences the strategy you create and the actions you take. The climate action plan must:

- Establish, evaluate, rank, and schedule greenhouse gas (GHG) reduction tactics.
- Outline finance alternatives.
- Be adaptable enough to accommodate periodic modifications.
- Contain strategies for incorporating everyone on campus.

- Facilities managers and their personnel will be crucial to these efforts because campus operations, particularly direct and indirect energy use, account for a large portion of the carbon footprint.

- Your climate action plan must, above all, be compelling and realistic enough to win the support of your campus community as well as the endorsement of your administration.

It is a very difficult goal to completely get rid of campus operations' emissions of greenhouse gases. Here are some additional useful actions that can use on campuses:

- Promote maximum energy efficiency and conservation of resources
- Make wise fuel decisions and use as little oil and natural gas as possible.
- Installing renewable energy systems like wind power or solar energy sources on campus and eventually purchasing 100% green power
- Use only the greenest, most energy-efficient constructions like Net Zero emissions buildings
- Find alternative sources of energy for vehicles and campus transportation.
- Optimize space usage.

- Campus waste reduction campaigns of all stripes, forceful comprehensive recycling, picking up initiatives that promote purchasing fewer, environmentally friendly green products made with the highest possible recycled material (for example, 100% post-consumer content recycled paper), and purchasing goods that are produced locally, including meals, all help to reduce emissions. It is vital to implement these practices even though some of the GHG emission reductions linked to them are unlikely to be recorded or assessed by a GHG inventory.

- Higher education institutions must switch to carbon-free renewable energy sources including solar, wind, biomass, geothermal, and hydropower in order to become climate neutral.

- Although having a gold-certified or Platinum building on campus is certainly a source of pride, every new building, unless it is a zero-energy building, increases your campus's carbon footprint. By making the most of existing space and avoiding new constructions, we can lower carbon emissions and save money on operational costs.

- At larger universities, pupils, instructors, and employees commuting may total millions of miles driven annually, leaving a significant carbon footprint. Enhanced use of public transportation, bicycling, carpooling, and promoting the use of more fuel-efficient vehicles are a few possible strategies. The majority of these emissions might ultimately need to be offset.

- A climate action plan must be persuading enough to win the support of campus leaders and the broader community while also being intelligent enough to map a realistic route to Climate Neutrality. A wise plan would carefully analyze funding and financing potential, maximizing grants and incentives from foundations, alumni, and the local, and governments.

6.1 Final concluding points

There were some points that might be highlighted and whose review would produce insight, based on the information I gained through the interviews and how it integrated with information from the literature.

- I found that the universities that own the buildings on their campuses, the freedom of action and the flexibility to choose what would be beneficial along this path to attain the goals boost the speed of their progress towards the ultimate goal because the success rate is substantially higher.
- If we discuss specifically the University of Gothenburg, it is crucial to interact with Akademiska Hus because it is known that Akademiska Hus is the main owner of the buildings and that the University of Gothenburg does not own its campuses' buildings as many other universities. It is necessary to have a more fundamental understanding, which in this case enables the institution to concentrate more freely on its carbon emissions and do a more precise calculation.
- Another very obvious discussion was how much more effective universities are when they do not have financial issues and are given targeted financial support. The goal-achieving process moves significantly more quickly for institutions that have no challenges, or at least less difficulty with investment. The significance of this issue is thereby doubled. In order to achieve Climate Neutrality and Net Zero, this clears the path and makes the goal realistic.
- Higher education institutions advance more quickly when they invest in their staff, educate them about the university's sustainability goals, and then involve them in implementation. The most progress has been made when behavior on campus is strictly enforced, in particular when it comes to transportation and catering.
- The University of Gothenburg has a lower carbon footprint in terms of carbon dioxide emissions in this area (catering, food, and beverages) because it does not have an extensive cafeteria or big restaurant area managed by the university itself like other higher institutions, which is effective in and of itself.
- Universities that commit to a rigid operational plan-based strategy to submit a detailed report of their activities along with the precise amount of emissions each year are more productive because, if we consider it a requirement, it fosters a sense of internal responsibility and university efforts to reduce the carbon footprint.
- Another point is that various sustainability groups collaborate on a common objective in developed universities. Each group is in charge of and oversees a number of partial or general activities, allowing for more accurate monitoring of the release rate of carbon dioxide. On the other hand, group work is always more effective. Nevertheless, some of these organizations are made up of interested students who wished to play a part in this process. For instance, a group that only works on the offsetting project and examines all the current cases and possibilities, or a group that is only responsible for researching and looking into all issues surrounding this issue. Another group that checks and assesses the potential for targeted investments and solves problems related to economic issues or perhaps an organization that is in charge of encouraging campus personnel and students to behave more sustainably, primarily through education.

Colleges and universities have a distinct responsibility to exhibit intellectual and ethical leadership, convey optimism by setting an example that motivates others, and fulfill their unique place in society. Let's get underway because the coming years are really important.

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9 APPENDIX

This part includes a complete list of the queries I asked during the interviews with the universities which consist of 14 related questions.

1: Some general information about your university
2: Have you decided to take action or set a target for reducing CO_2? Regarding Climate Neutrality, have you made a decision?
3: Who makes the final decision on these matters (process for being climate neutral) and circumstances as a senior official? principal deans or the rector or university board or a network of decision-makers?
4: Have you provided a clear concept of Climate Neutrality and Net Zero for your organization?
5: What may you mention if you want to address the initial and most significant restriction that you encountered during this process?
What do you bring up when you wish to discuss challenges and difficulties? Is there any particular legislation related to your country that served as a restriction on this process?
6: I want to ask you: are you the owner of the buildings? If so, what actions help you to accomplish the goal? If not, how do you deal with this restriction?
(Since it's more important for some universities that aren't the primary owners of properties to decide how can their emissions, which are tied to structures, be eliminated)
7: Are you aware of the significance of Scopes 1-2-3 emissions in terms of achieving Climate Neutrality and Scope 3 as a crucial link in the value chain?
What are your challenges surrounding Scope 3?
How do you visualize eliminating Scope 3 emissions to achieve Climate Neutrality?
8: Do you have a system for carbon budget?
Did you make any exceptions when defining your carbon budget in relation to system boundaries?
(The boundaries of a system could be determined by what the carbon budget includes and what it doesn't.)

9: What informal decisions, internal exercises, and procedures have you modified for each faculty to get you on track with respect to aligning with the carbon neutrality and Net Zero approach?
which faculties are more conscious of their own emissions?
10: Which techniques do you use to visualize the effects that your internal or external activities have on the climate in your university?
Do you use a specific tool in your organization to calculate emissions?
11: Given the various university departments and your statistics on the amount of emissions, how does your organization respond to or choose which emissions should be eliminated more quickly? What are your top priorities?
12: What are your thoughts on climate offsetting/compensation?
What strategy may be utilized to practically invest in this area, in your opinion, if we want to think about the benefits and drawbacks of climate compensation?
What techniques can be safer and more dependable? (
For instance, relating to how we are aware that some techniques, such as planting trees in certain locations, are unsafe)
13: Has your university taken any steps to apply the CCS (Carbon Capture and Storage) technique?
To what extent does your organization think it is presently a feasible solution?
14: The achievement of the goal (CO_2 reduction or Climate Neutrality) will undoubtedly need targeted investment.
Has your university made any unique investments, and how was it able to use funds in a purposeful manner?