EPS Project

The SDG team

Bart Vos, Marc Cuellar Barrionuevo and Baptiste Depauw

May 12, 2023

Preface

This is the end-term report of the SDG (Sustainable Development Goals) team for the European Project Semester (EPS) program offered by Novia University of Applied Sciences located in Vaasa, Finland. The EPS program is given by 19 universities in 13 different countries throughout Europe. The SDG objectives are "a set of global objectives to eradicate poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda"1 .

In addition, the program is open to third/fourth-year university/college students who want to acquire the experience of working on a multicultural project among European students. Every student is welcome regardless of their previous studies. Since its conception in 1994 EPS has prepared engineering students for the challenges they will encounter in their later work. Here, international students will collaborate in groups to improve their skills and projects. Additionally, they will take lessons together to learn more about the project.

Because the world is in a big energy transition to ensure that the consequences of climate change are contained, everybody needs to do their part. Consequently, Novia University has set the goal to be carbon neutral by 2030. To achieve this goal, they need to know where they stand now and know how to proceed.

To ensure that Novia achieves its goals in 2030, it was decided that this team should investigate where Novia stands right now and evaluate how they can improve in the upcoming years. Additionally, the team performed by Baptiste, Marc and Bart will work on energy-saving techniques, sustainability actions traveling, and reducing CO2 emissions.

In conclusion the SDG team would like to thank specific individuals. First, the team would like to express our gratitude to Novia University for hosting EPS as they are the reason the members are here. Then the team would like to thank our project coach Biniam Tefera and Roger Nylund who is the customer of the project. Also, the team would like to thank Mikko Pieska and Jonas Nyman for quickly providing us with information about Novia's energy consumption.

Contents

1 Abstract

The primary objective of this research project was to conduct a comprehensive evaluation of Novia's progress toward achieving the United Nations' Sustainable Development Goals. However, after taking an examination of the data sources and Novia's goals it was unattainable within the scope of this project. Nevertheless, the team identified a specific target that aligned with Novia's aspirations, namely their goal of achieving carbon neutrality by 2030.

To facilitate Novia's achievement targets, the team performed a thorough analysis of the primary sources of their carbon emissions, which the team identified as being primarily associated with travel, product, and energy consumption. To gain an in-depth understanding of their energy usage, the team developed an energy flow diagram containing the information. Additionally, the members created a comprehensive model that accurately predicts the impact of various energy systems, providing Novia with practical recommendations for alternative products with lower carbon emissions.

To ensure the success of this research project, the group developed a highly detailed and comprehensive project plan, which defined the mission, vision, and objectives of the project. By using a Work Breakdown Structure (WBS) to break the project down into manageable sub-goals and allocated responsibilities to team members using a Responsible, Accountable, Consulted, and Informed (RACI) matrix. Furthermore, the team developed an intricately detailed schedule to monitor the progress and ensure that the project remained on track at all times.

In addition to the formal methodology, the team considered each team member's individual preferences, skills, and strengths to create a collaborative and harmonious working environment. This approach fostered mutual respect, effective communication, and collaboration, enhancing the overall quality of the research output.

Overall, this research project provides valuable insights into Novia's progress towards achieving their carbon neutrality goal, as well as practical recommendations for alternative products and energy systems that can contribute to reducing their carbon footprint.

Abbreviations

SDG Sustainable Development Goal

EPS European Project Semester

UN United Nations

MR Midterm Report

FR Final Report

CO_2 Carbon Dioxide

STP Short Term Products

LTP Long Term Products

DITP Discarted IT Products

EM Energy Model

WBS World Breakdown Structure

RACI Responsible Accountable Consulted Informed

W33 Wolffintie 33 Builing

GSSB Global Sustainability Standards Board

NU Novia University

2 Team members

2.1 Bart Vos

I am Bart Vos. I am from the Netherlands. I am 22 years old. I come from a small town in the east of the Netherlands called Gramsbergen. It is right between the bigger cities of Coevorden and Hardenberg in the province of Over- ijssel right on the German border. I study Engineering physics at Saxion in Enschede. I am now in my third year. I like my study because it really delves into physics, simulation, experimentation and data analytics. I also did the minor Engineering of energy systems which delves into the sustainable energy systems. I wanted to do the European Project Semester because I wanted to live abroad on my own and learn more about myself.

I wanted to do the SDG's for Novia because I am interested in how energy consumption is in Finland and how "sustainable" is defined in Finland. And I have some experience with data analytics, and I am very curious to look into how well Novia is doing sustainability- wise.

2.2 Baptiste Depauw

Hi! My name is Baptiste, and I am a 3rd bachelor's student in product development at the University of Antwerp in the faculty of design. I am a very motivated Belgian student who loves innovation and creativity. This is the reason why I have chosen to go on Erasmus in Finland. It's almost unbelievable how the Scandinavian countries live in such an ecological, economic and social way, it inspires me. I noticed that traveling broadens the way of thinking. I believe travelling has a positive effect on creativity, because every country and culture has its own way of thinking. I would also like to be more independent and brush up my English. My French and Dutch are good, but I am not satisfied with my English skills. Erasmus might improve my English skills which is very important to me.

2.3 Marc Cuellar Barrionuevo

Hello. I am Marc. I am 24 years 4th year degree student in Electronics and Automatics degree (EPSEVG-UPC) at Vilanova i la Geltrú, Barcelona, Spain. My studies are attached to my interests which are robotic programming, robot maintenance, automation using robots and electronics. My fields of studies have included energy saving using controllers for optimization.

I checked what kind of outside project can be done in Vilanova. I find out that EPS Projects could be an interesting project to learn along with foreign people new and modern concepts. Then for my surprise from the Universities selection Novia was my second choice and I was accepted.

Project information

Team leader: Biniam Tefera

Customer: Roger Nylund

Institution: Novia University of Applied Sciences

Project title: Novia SDG's

Project members: Bart Vos, Marc Cuellar and Baptiste Depauw

3 Background

3.1 Objectives of the Project

Figure 1: depicts all of the United Nations' Sustainable Development Goals. The Sustainable Development Goals (SDGs) are 17 attainable targets aimed at reducing worldwide inequalities by 2030. This objective, launched in 2015, aspires to safeguard and prosper the planet while humans live in peace. All of these objectives strive to achieve a balance of environmental, economic, and social sustainability ideas.

3.2 The task

The task assigned to the team was to provide concrete guidelines for Novia Vaasa to achieve the Sustainable Development Goals (SDGs) or propose an action plan. This involved the importance of mapping starting point of these measures by familiarizing them with the long list of indicators and measurements defined for each goal and sub-goal which will not be mentioned furthermore they are searchable on SDG webpage. The team was asked to use the impact ranking of every individual SDG as their frame of reference [6]. Given the global nature of the SDGs, it was also important for the team to investigate how other institutions in Europe approached this challenge.

3.3 Requirements

The team was required to have a keen interest in learning more about sustainability concepts. As the goals were diverse, it was advantageous to have students from different fields who could bring a deeper understanding of how to actually measure the different goals. However, there were also experts at Novia University to consult with for specific guidance. The team could consist of from 3 to 5 students, and in this case, the SDG team consisted of Bart, Baptiste, and Marc. However, in the aquaponics team, there were 4 members instead.

3.4 Time

The project started on 09/02/2023 and was originally planned to end with a final report in week 16 (29/05/2023). However, a mail from the head of EPS, Roger, updated the final deadline to 12/05/2023. The final report is a scientific report, and there was a midterm report due in Week 7. After the midterm report, the team gave a 40-minute presentation to the customer, Roger, and the team coach, Biniam. The presentation covered the progress that the team had made during the first two months. The final report presentation, scheduled for 16/05/2023, would follow the same format as the midterm report presentation and would be focused on the customer and coach.

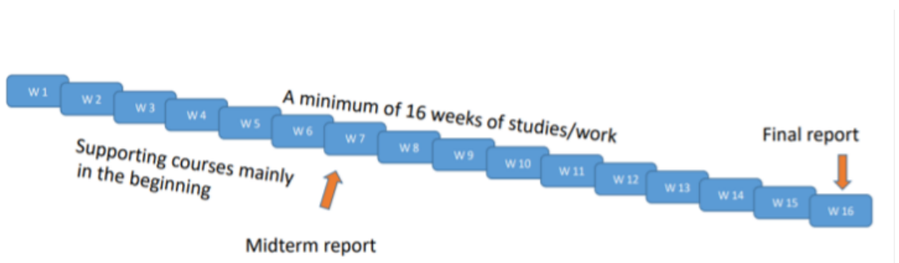

Figure 2: In this figure the planning is shown form the EPS document of Novia [1]

3.5 Meeting

The team met with the coach and customer weekly since the project began after the first week. During these meetings, a chairman and secretary were appointed (although not always the same person). At the end of the meeting, the team set new tasks and deadlines for the following week to keep the project moving forward. The next meeting day was decided at the end of each meeting, just after any questions were addressed.

4 Project planning

4.1 The Sustainable Development Goals

4.1.1 Process

The pursuit of the mission and vision for the project proved to be a challenging endeavor. In this paper, the team will elaborate on the process of their discovery. Initially, we conducted an extensive review of Novia's professed areas of concentration and engagement, as identified by the Sustainable Development Goals (SDGs). The subsequent things will present an overview of the SDGs that Novia deems significant and has committed to addressing [2].

4.1.2 SDG 3

Figure 3: The third figure represents the third Sustainable Development Goal (SDG) of the United Nations, which is focused on good health and well-Being. Specifically, Novia contributes to the provision of health and well-being skills, and they also play an active role in the management of national and global health concerns. (Novias selected development goals, n.d.)[2]

4.1.3 SDG 4

Figure 4: Goal 4:Quality Education: Novia prioritizes students, teachers, and quality. That is why respond to the demands of the workplace through appropriate education and applicable research. The university advocates for continuous learning and personal development. Their tasks are continually evolving, and Novia appreciate each other's knowledge. The university has an entrepreneurial mindset and approach, and Novia encourages both external and internal entrepreneurship in our students. The university encourages international students and graduates to integrate in order to assist post-graduation employment and, as a result, the regional skills supply. (Novias selected development goals, n.d.)[2]

4.1.4 SDG 9

Figure 5: The ninth SDG of the United Nations is focused on Sustainable Industry, Innovation, and Infrastructure. In this regard, it is important to note that significant and practically applicable industrial know-how is possessed by Novia, which is combined with R&D operations in sustainable energy technology. In order to ensure greater sustainability, industrial technologies, processes, and working methods are developed and innovated upon by the university. Moreover, inclusive and sustainable industrialization is promoted while innovative and sustainable energy and transportation systems are developed. The aim is to build a strong infrastructure, limit environmental impact, and encourage innovation. (Novias selected development goals, n.d.)[2]

4.1.5 SDG 10

Figure 6: Reduced Inequalities is the United Nations' tenth Sustainable Development Goal (SDG). As a university, Novia places a high value on human rights and the equality of all individuals. Novia promotes a norm-critical approach, in which individuals are encouraged to evaluate their own values and established patterns. Active talks are held to investigate how each individual may help to eliminating inequality and improving self-awareness about personal actions. Novia aspires to build an inclusive society that provides equal opportunities and living conditions for all. Novia mitigates discrimination and lowers the likelihood of conflict by fostering inclusion and equal chances. (Novias selected development goals, n.d.)[2]

4.1.6 SDG 12

Figure 7: the twelfth Sustainable Development Goal (SDG) established by the United Nations, is Responsible Consumption and Production. Novia prioritizes the sustainable and ethical procurement of services, energy, and goods. It collaborates with property owners to select sustainable energy solutions, and adopts functional waste sorting for all waste fractions. (Novias selected development goals, n.d.) [2]

4.1.7 SDG 13

Figure 8: This is the thirteenth SDG made by the UN Goal 13: Climate Action. Novia increases knowledge and capacity to address climate change. It wants to be carbon-neutral by 2030. (Novias selected development goals, n.d.)[2]

4.1.8 SDG 17

Figure 9: The UN Goal 17: Partnerships for the Goals is the seventeenth SDG. Novia collaborates and shares knowledge on science, technology, and innovations in accordance with open science and education ideals. (Novias selected development goals, n.d.)[2]

4.2 Process

The process done consisted in several steps. First step was looking up at Novia's goals, the team made the decision to continue working on goals related to our study fields. After some research, the decision was made that only goals that fit the team members will be considered such as: Goal 9: Sustainable industry, innovation and infrastructure, Goal 12: Responsible consumption and production, Goal 13: climate action, To determine whether Novia could achieve climate neutrality by 2030, an assessment must be conducted. One week following the initial inquiry, it became apparent that extensive research into comparable universities was necessary to compile relevant data for comparison with Novia's information. After that the team had to provide them with an actual grade, which was impossible. So, there is made a decision to work on goal 13: Climate action. On the theme Climate Neutral by 2030. Because there will be also a look at production is the decision made to also look at product consumption, The project includes also goal 12: Responsible consumption and production, a little bit.

4.3 Mission, vision and goals

4.3.1 Mission

Make a model based on the energy consumption of W33 building of Novia university of appleid sciense and look for solutions to make it CO2 neutral by 2030. Examine the products and travel consumed by the university and look for alternatives to reduce C02 emissions.

4.3.2 Vision

Novia university of applied sciences is carbon neutral in 2030.

4.3.3 Goals

Goal 1 Making a model to calculate possible solutions for Novia.

Goal 2 Making an energy balance sheet of Novia university for the year 2022 to visualize the energy consumption of Novia.

Goal 3 Making a strategy for how Novia can buy long term products in a sustainable way.

Goal 4 Looking for better alternatives for short term products.

Goal 5 Make a strategy so Novia can discard products in a sustainable manner.

Goal 6 Making rules on how Novia can make sure that they do not use any damaging ways of transport when there are more sustainable alternatives.

Goal 7 Making rules on how Novia can assure that they use sustainable transport rather than big CO_2 emissions

4.3.4 Energy part

First, the team made a model for the W33 of Novia to see how much energy Novia uses. Then it could look for more sustainable improvements. This model needs to be simple enough so Novia's personal could use it themselves to plan their next steps. The methodology will entail examining energy usage data from February 2022 to February 2023, with a specific focus on the building's consumption of electrical and heat energy.

4.3.5 Product part

A strategy will be made for the project so electronic waste is disposed of in a sustainable way. Instead of it being used for other purposes. Furthermore if there is no way of disposing of e-waste sustainably give Novia tips to research. Then it will look for economically available solutions to reduce the carbon emissions on short term products. Besides that the team is going to look to make an understandable strategy to ensure that Novia buys more sustainable carbon neutral products. The research will only look at the year 2022

4.3.6 Traveling part

How Novia can ensure that sustainable transport is used rather than causing big CO_2 emissions can be governed by rules. Therefore the team will try to show different possibilities for each travel with the travel information. Such as travel time, transport way and CO_2 emission. The research will only look at the year 2022

4.4 Canvas

Following the establishment of the vision, mission, and goals, a Canvas diagram was created in collaboration with our team. This step was deemed crucial as it allowed for a comprehensive evaluation of the group's strengths, weaknesses, and qualities. Furthermore, it was imperative to establish ground rules to foster a positive and productive atmosphere within the team. Through the canvas creation process, it became apparent that motivation was a key factor in the success of the project. Consequently, the decision was made to structure goals and tasks in a way that would inspire and motivate each team member to work towards their achievement. This approach, commonly used in Baptiste studies, ensures that each team member is invested in the project and fully committed to its realization. It is noteworthy that the members of the project possess diverse academic backgrounds, with Bart specializing in engineering physics, Marc in electronic and automation engineering, and Baptiste in product design.

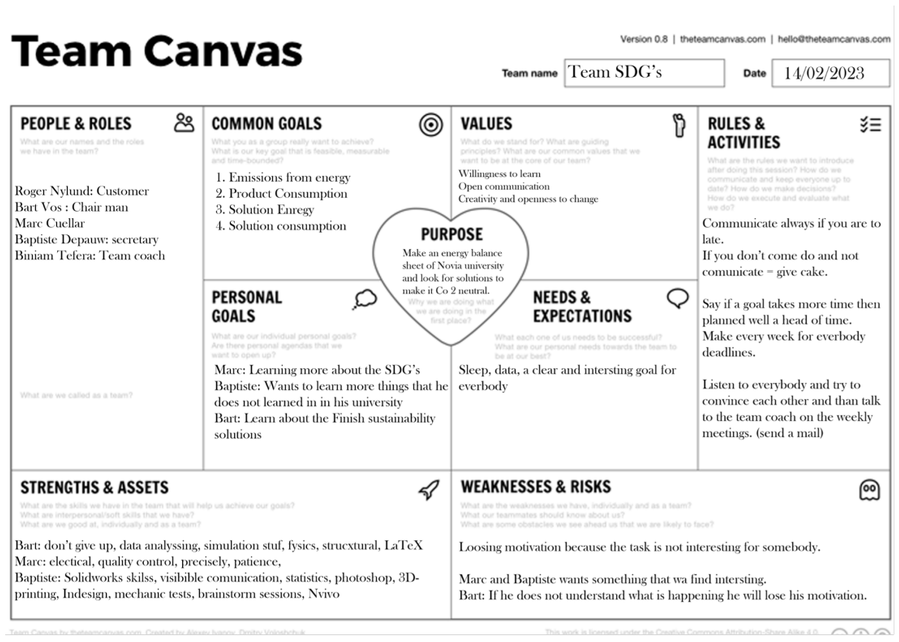

Figure 10: Here the Canvas of our project is show

4.5 WBS

Once the Canvas was ready, the team proceeded to initiate WBS. A Work Breakdown Structure (WBS) is a project management technique that is used to divide a project into smaller, more manageable pieces.

Initially, the left side of the Work Breakdown Structure (WBS) will be discussed, as depicted in figure 12

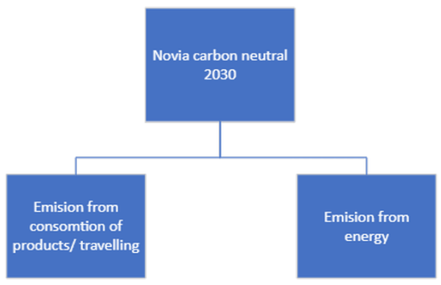

Figure 11: In this figure the two direction of the project are shown

In the team's examination of Novia's CO_2 emissions, each member approached the topic from their respective academic disciplines. On the left side of the WBS, the team focused on CO_2 emissions related to products, which generated some discussions among members. Bart expressed concerns about the feasibility of the task, as he felt insufficiently knowledgeable about the matter. This sentiment is understandable, as it is unfeasible to assess the CO_2 emissions of every product entering and exiting Novia. To overcome this challenge, the team decided to prioritize the most significant products with high CO_2 emissions and viable solutions. The team also restricted their examination of end-of-life products to only electronic products, given their relevance to circular economy principles and the expertise available on this subject matter across different fields of study.

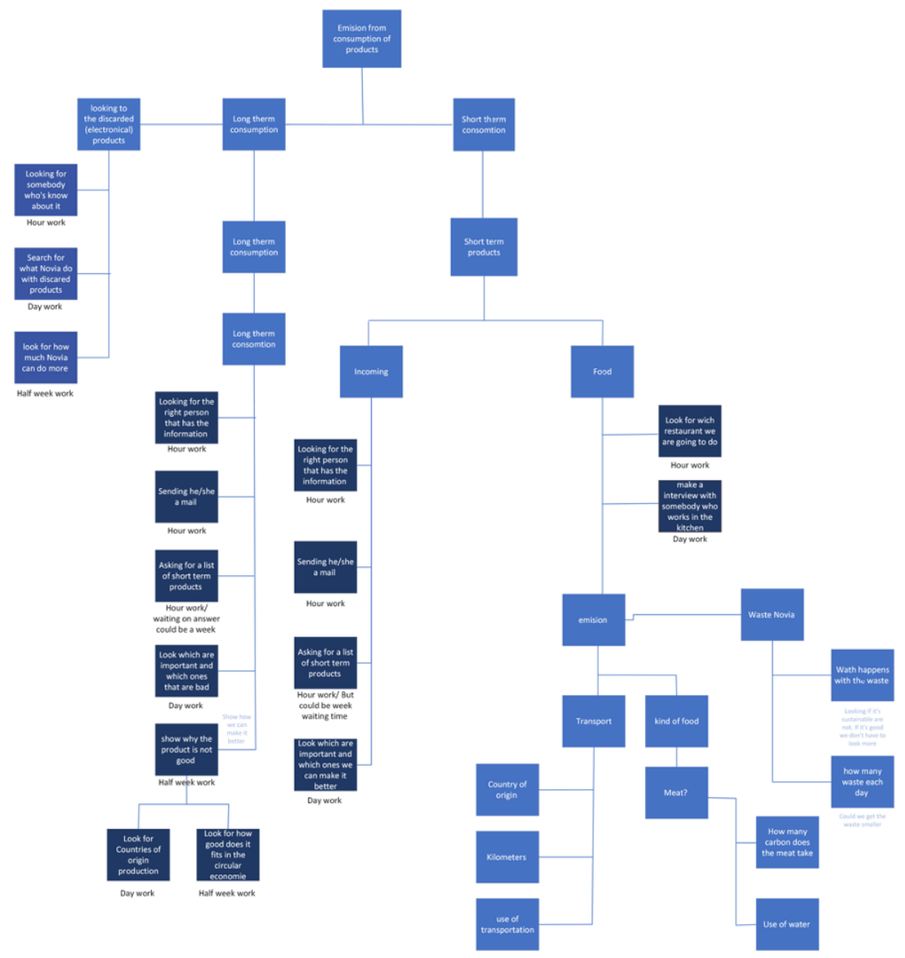

Figure 12: Here the "left side" of the WBS is shown

Next, the right-hand side of the Work Breakdown Structure (WBS) is discussed, as depicted in figure 13.

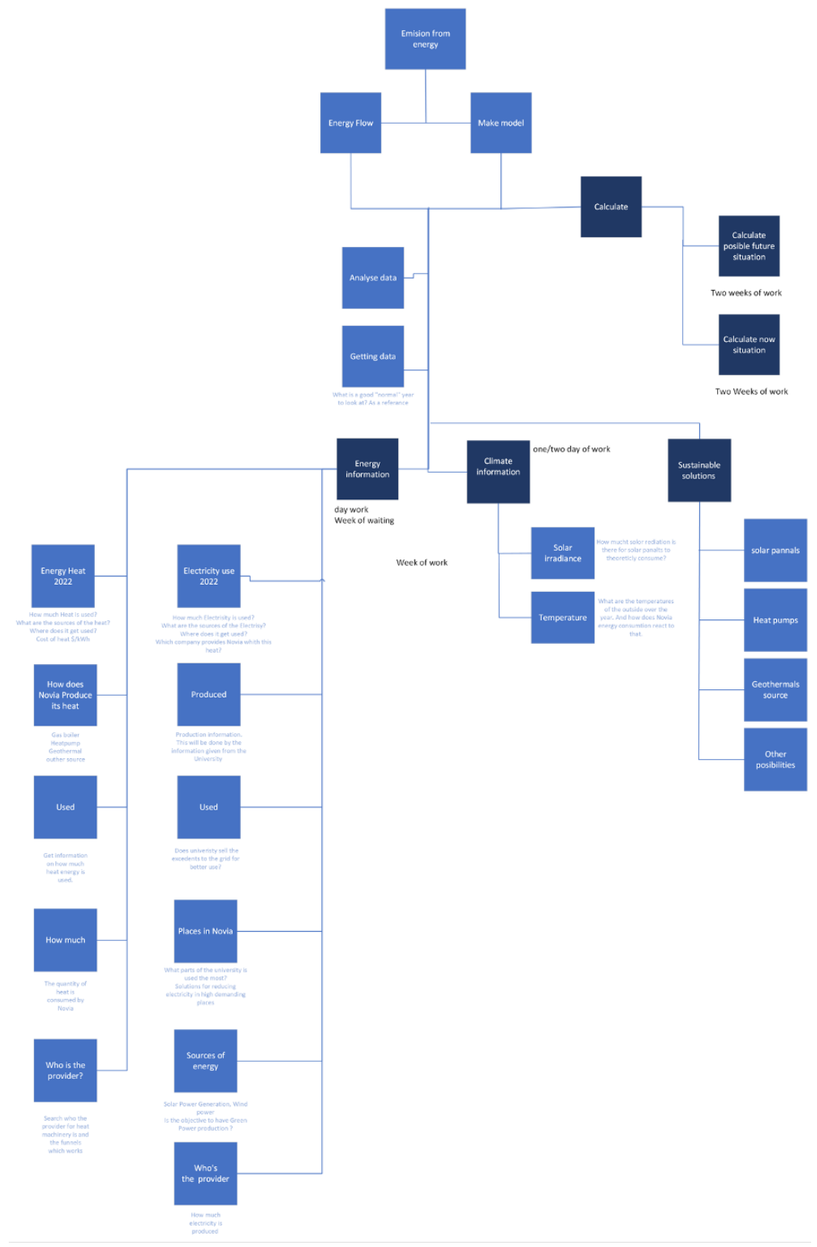

Figure 13: Here the "right side of the WBS is shown

On the right-hand side of the Work Breakdown Structure (WBS), there exist emissions resulting from energy usage. Consequently, the team intends to generate an energy flow diagram and an energy model through calculation.

This assignment is anticipated to span several weeks, requiring a substantial amount of data on the heating and electricity consumption for the year 2022. Specifically, information on the provider, consumption pattern, and the utilization of electricity is required. Additionally, climate information is crucial for the study, which includes examining solar radiation and the temperature difference between the external and internal environments of the university and how the consumption is impacted by these factors.

4.6 RACI

After finishing the WBS, the team proceeded with creating a RACI matrix to define the roles and responsibilities of each team member in the project. The RACI matrix is a useful tool that helps to clarify who is accountable for each task and who needs to be consulted or informed. The acronym stands for Responsible, Accountable, Consulted, and Informed.

The team was able to create the RACI matrix smoothly, building on previous studies conducted at their home university. It was important to ensure that no one person was solely responsible for any particular task. The team decided to work in pairs for each task, with one person responsible and the other two consulted. Being informed was not enough, for important decision-making tasks, the team proposed that everyone should have equal standing and work together on an equal basis. This approach was essential to ensure that the workload was distributed evenly and that everyone was working towards a common goal.

Person / WBS-package	Marc	Bart	Baptiste		Roger	Comments
Energy Information	C	R	C		I	
Climate information	R	C	C		I	
Sustainable solutions	C	R	C		I	
Calculate	C	R	I		I	
Food	C	I	R		I	
Incoming short term products First 3 steps	C	C	R		I	
Incoming short term products Last	R	R	R		I	
Long therm consomtion first 3 steps	R	C	R		I	
Long therm consomtion last step	C	C	R		I	
looking to the discarded (electronical) products	R	C	C		I	

Figure 14: Here the RACI table is shown

4.7 Project planning

On the subsequent page, the project schedule can be found. It is orientated horizontally, and therefore, it is necessary to rotate the page to view it comprehensively.

The planning is structured around three fundamental aspects. The schedule displays the months at the top, with weeks shown below. Each box within the schedule represents a day, allowing for a clear depiction of the duration assigned to each topic, as well as the specific task or tasks that are assigned for that particular topic. The task start dates are prominently displayed, along with their corresponding completion dates. It is noteworthy that the week count commences from the first week of 2023, rather than from the beginning of the project. The project plan is divided into two primary sections, with the first being the right side of the WBS, which pertains to energy-related information. This segment is further subdivided into seven categories. The initial two categories entail researching energy-related information in Novia and the surrounding climate. Subsequently, the team will work on the energy diagram and model, a task that is projected to take four weeks. Additionally, during this period, the team will also concentrate on developing sustainable solutions. This process comprises two steps, firstly identifying potential solutions, and secondly, evaluating the efficacy of the most efficient solutions in various areas, based on the collected research data. The last step, scheduled for week 20, entails brainstorming and exploring alternative solutions.

The second principal aspect pertains to the product information associated with electronic products that have been consumed or discarded by Novia Vaasa. This was comparatively challenging to plan, given the diverse range of components involved, such as short and long-term products, food consumption in the kitchen's restaurant, discarded electronic devices, and information about the trips made by Novia.

In certain areas, such as the consumption of short- and long-term products and discarded electronic items, information is still being sought. This made the planning process considerably challenging. Consequently, the decision was made to prioritize tasks that have the most readily available information. Accordingly, the team has chosen to schedule tasks based on the availability of relevant information, with the expectation that all necessary data will be available by then to commence the work.

The third critical aspect concerns the "project stuff" wherein the team will dedicate one day each week towards the development of the final report, a decision that was jointly deliberated upon. To mitigate the tendency to procrastinate, a weekly deadline has been established. During the final two weeks of the project, the team will work on the final report every day. Furthermore, in week 12, the team will devote each day towards developing the presentation for the midterm report.

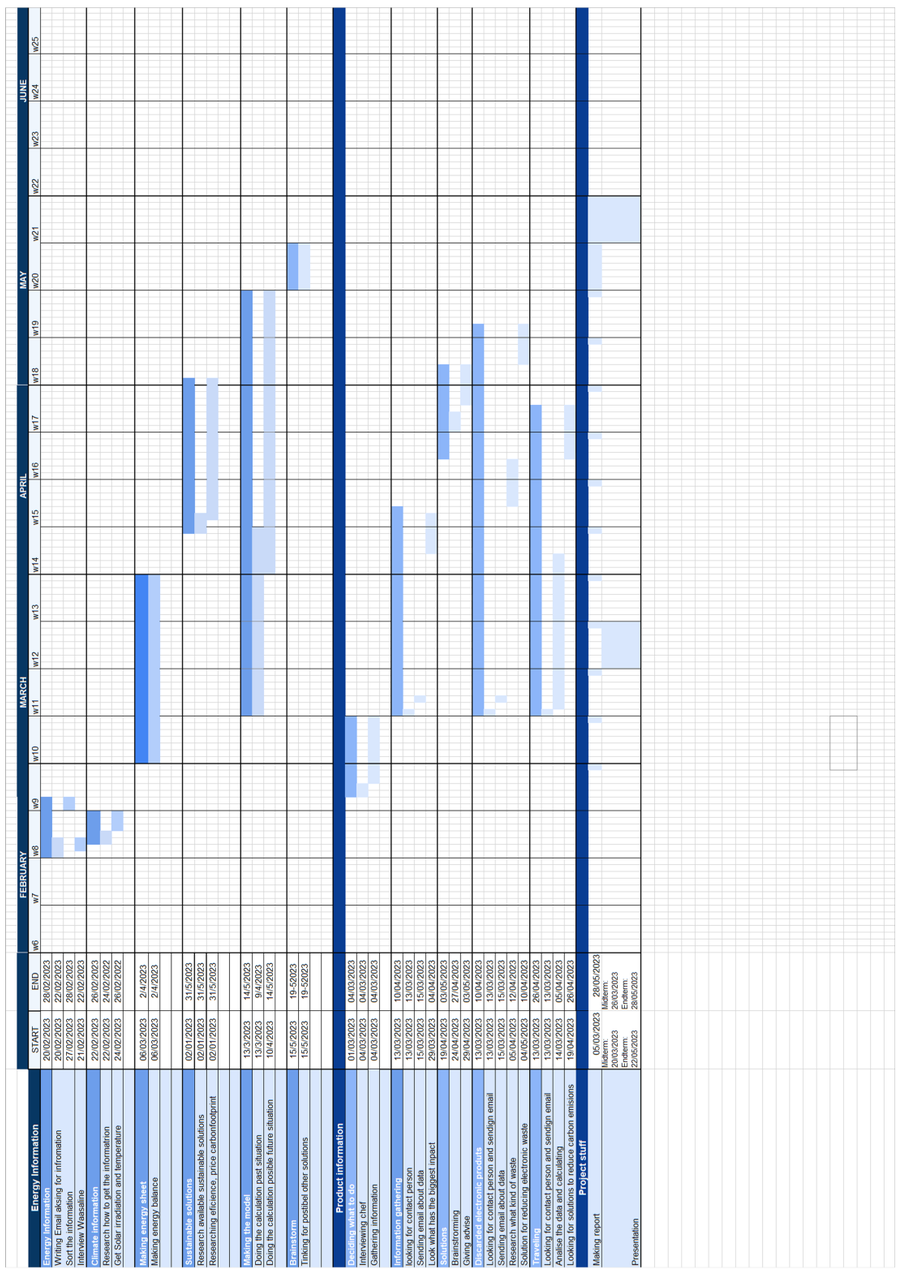

Figure 15: Here the Gant-Chart is shown

5 Additional information

5.1 SMART

The UN described Novia University of Applied Sciences as having high-quality in education sustainable ecological, social and economic development. This program has a duration of a year and was done among other Nordic Universities finalizing on January 2013.

Figure 16: Project HESI [3]

The implementation had an integrated management system for quality, environment, and safety certified according to ISO 9001 and ISO 14001 standards. Novias primary goal is to facilitate the students growth into professionals who are mindful of quality, the environment, and safety, and who prioritize sustainable development in their future careers. Management system encompasses sustainability objectives in collaboration with processes involving both staff and student In one hand this project made Novia University great image for future. The information it provides otherwise is not well emited. On their Action Network section it is said this note: "This initiative does not yet fulfil the SMART criteria." [3]

The SMART criteria

Specific:
With software the team going to track different measures of data at Novia and compare this with other universities.
Measurable:
The customer wants to find solutions, and have a better understanding of the sustainability goals. The desire of the customer is to know if Novia is in regard.
Attainable:
The goal is ambitious but achievable with the implementation of energy-efficient measures and employee education on sustainable practices.
Realistic:
Further information will be submitted. For the moment this aspect needs more information.
Time limited:
The project started on the 2 of February and finishes on 31 of May. The tasks in midterm and the final report are also part of the project time limit. [3]

5.2 Energy consumption

Novia has set a goal of becoming carbon neutral by the year 2030. To achieve this goal, the Tech department at Novia needs a way to calculate possible solutions for reducing their carbon footprint. This project aimed to provide Novia with concrete guidelines for achieving their carbon neutrality goal.

In order to provide this information, the project team needed to analyze data on heating and energy consumption from the previous year, in conjunction with outdoor temperature, to determine how temperature affects energy use and to calculate possible heat pump efficiencies. Additionally, data on solar radiation per square meter was needed to calculate the effect of solar panels. Due to the impact of the COVID-19 pandemic, the analysis focused only on the period from February 2022 to February 2023, and only on the Wolffskavägen 33 building.

The project team used a Work Breakdown Structure (WBS) to define the tasks required to achieve Novia's carbon neutrality goal. A Responsibility Assignment Matrix (RACI) was also developed to identify who was responsible for each task, and to ensure that no one person was solely responsible for any particular task. Instead, tasks were assigned to pairs of team members, and all team members were accountable for their assigned tasks.

By analyzing the data and using various tools such as heat pumps and solar panels, the project team developed several possible solutions to reduce Novia's carbon footprint. These solutions were presented in a final report, which was submitted on May 12, 2023. The report provided Novia with concrete guidelines for achieving their carbon neutrality goal by 2030, and serves as a valuable resource for the Tech department at Novia.

5.3 Energy Chart

The energy chart in the form of a Sankey diagram serves as a crucial tool in visualizing the sources of energy and their consumption in a given system. Novia's sources of energy were analyzed to separate the input and output parts of the diagram. However, this process proved to be complex and challenging due to the vast amount of information that needed to be compared. In addition, there were no appropriate tools available to facilitate the analysis, which required a significant amount of manual effort. Despite these challenges, the team was committed to producing an accurate and reliable Sankey diagram, which ultimately proved to be a valuable resource for understanding Novia's energy consumption and identifying potential areas for improvement.

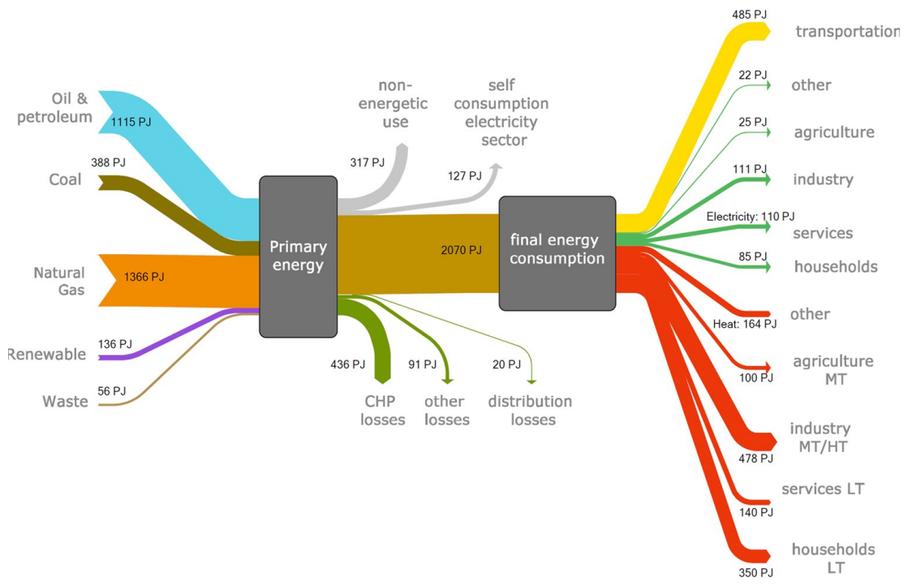

Figure 17: A example of a energy chart is shown

This image shows what the Energy Sources from the energy consumption in the Novia Universiy at Wolffskavägen 33 building could be. The team will try to make an energy shard. There will be more information about it in 7.1. Model.

5.4 Model

The purpose of this project is to evaluate the energy consumption of Novia and to provide solutions for reducing its carbon footprint. To achieve this goal, a model will be created that will analyze a year of energy consumption at Novia and make calculations based on weather data and data from energy system manufacturers that are suitable for Novia. The energy systems that will be considered include heat pumps, solar panels and geothermal heating. By utilizing this model, it will be possible to calculate the potential savings in energy consumption, cost, and emissions by implementing various energy systems and techniques.

To gather the necessary data for both the Energy Chart and the Model, the team required information on electricity and heat consumption at Novia. Additionally, data on heat loss and heat pump efficiency were needed for accurate calculations. Basic information on solar panels and data from manufacturers of sustainable energy systems were also required to calculate the possible electricity generation and efficiency of these systems.

The Energy Chart, in the form of a Sankey diagram, is a tool that will allow for the visualization of Novia's sources of energy and how they are being used. However, separating the diagram into separate input and output parts has been a complicated and difficult process due to the large amount of information that needs to be compared. Lack of proper tools has also meant that much of the work has been done by hand.

By creating the Model and Energy Chart, Novia will be better equipped to make informed decisions about their energy consumption and identify areas where improvements can be made to achieve their goal of being carbon neutral by 2030.

5.5 Matlab

Matlab is a very useful programming language for large data calculation. Because this project uses hourly data of a time span from February 2022 to February 2023 to make a model that predicts possible energy solutions for W33 building this will be a very useful tool.

5.6 Product consumption

In order to effectively manage the consumption of products at Novia University of Applied Sciences, a comprehensive list of all products consumed by the institution was needed. The purpose of this list was to classify the products into three distinct groups, namely long-term products, short-term products, and IT discarded products. Long-term products are defined as items that are used by Novia for an extended period of time, such as chairs, tables, and lights. These products require careful management, as they can significantly impact the environmental footprint of the institution over time.

On the other hand, short-term products are those that are used for a short period of time, and are then discarded. Examples of these products include toilet paper, soap, and paper towels. While these products have a relatively short lifespan, they are still important to consider in the context of sustainable consumption, as the volume of these products consumed by an institution can add up over time.

Lastly, IT discarded products are a subset of long-term products that have electrical components, such as beamers, computers, and speakers. These products require special consideration, as their disposal can be environmentally harmful if not managed properly. By classifying all products consumed by Novia into these three groups, the institution can gain a better understanding of its consumption patterns and develop strategies for more sustainable consumption in the future.

5.7 Long-term product

The purpose of this study is to analyze the products consumed by Novia University of Applied Sciences, and to propose strategies to minimize their environmental impact.

Long-term products refer to items that are used for an extended period, such as chairs, tables, and lights. The focus of this study is to ensure that these products are sustainable and easily recyclable to reduce Novia's carbon footprint. Therefore, strategies will be proposed to ensure that sustainable products are selected.

5.8 Short-term product

Short-term products, on the other hand, are used for a shorter period, such as toilet paper, soap, and paper towels. The study will investigate the source of these products, and explore alternative solutions that are more sustainable. This is because long-term products that can be reused multiple times are more sustainable than short-term products that are only used once.

5.9 IT discarded products

IT discarded products are long-term products that contain electronic components, such as beamers, computers, and speakers. These products are more difficult to recycle and have a large carbon footprint. The study will propose strategies for Novia to dispose of these products sustainably, as not having a proper strategy could be a significant source of Novia's ecological footprint.

5.10 Traveling consumption

Another aspect of the study is to analyze Novia's traveling consumption. The mileage traveled and the mode of transportation will be considered to calculate the carbon emissions associated with traveling. This information will be used to propose strategies to reduce the carbon footprint of Novia's traveling activities.

Overall, this study will provide Novia with valuable insights into their product consumption and traveling activities. The proposed strategies will enable Novia to reduce their environmental impact and move towards a more sustainable future.

6 Mails received and sent

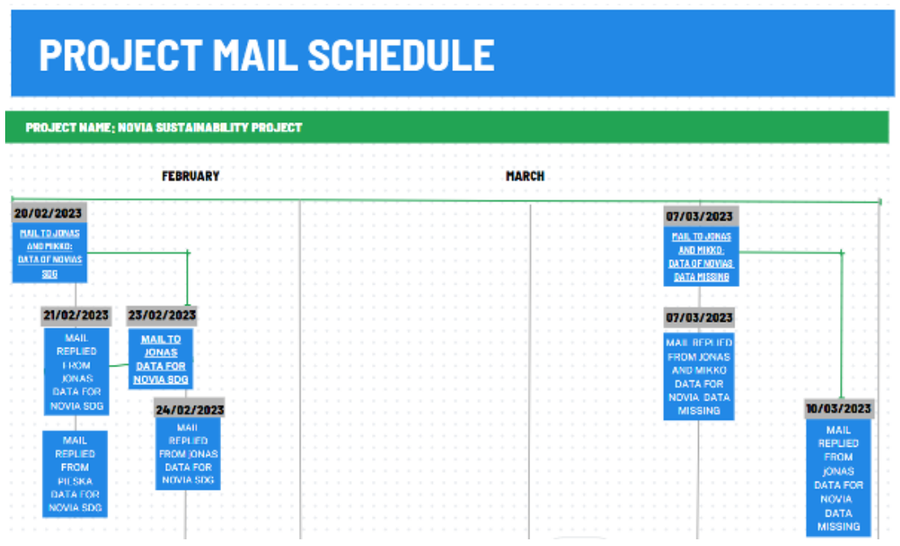

Figure 18: In here the time table of when the team sent mails is shown

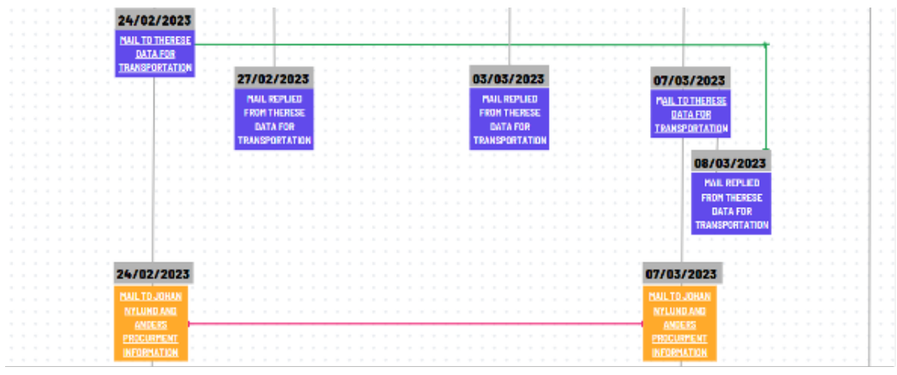

Figure 19: In here the time table of when we sent mails is shown

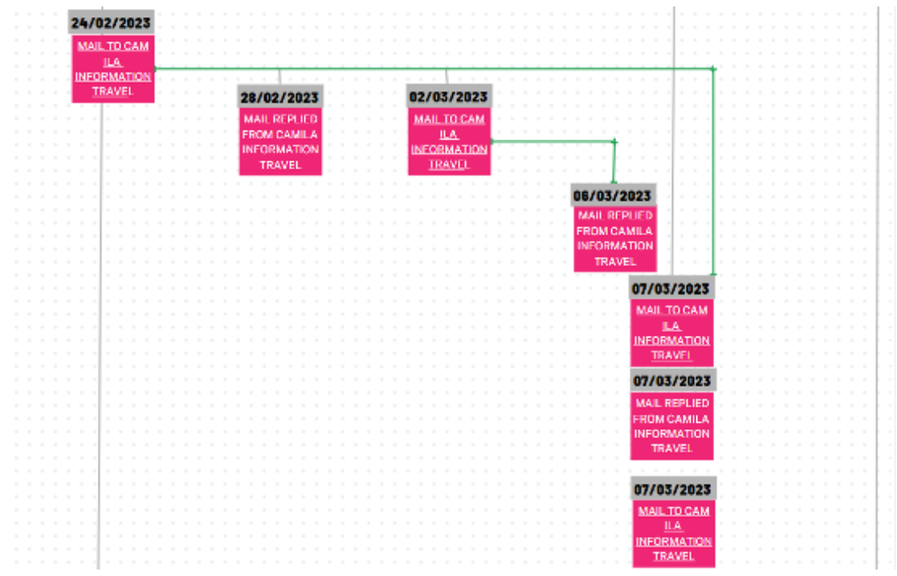

Figure 20: In here the time table of when we sent mails is shown

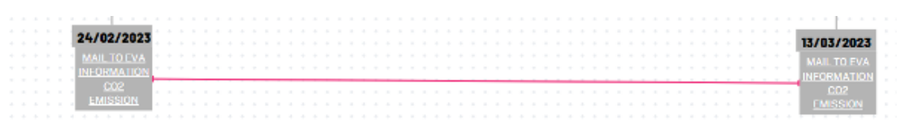

Figure 21: In here the time table of when we sent mails is shown

The Project Timeline Schedule is a visual representation of the communication process between the project team and Novia University of Applied Sciences in obtaining information related to sustainable practices at the institution. The schedule is designed as a time chart diagram with different coloured lines and boxes, each representing a specific topic of information requested.

Blue colour is used to represent the request and replies related to Novia's SDG information, specifically focusing on the consumption of the building located at Wolffskavägen 33,

Purple colour is used to represent the travel data requested,

Orange is used to represent procurement information,

The red colour is used to represent the communication related to travel information,

While the grey colour indicates the communication related to Novia's CO_2 emissions.

The timeline schedule provides an organized and comprehensive overview of the communication process and the progress made toward gathering the required information.

After categorizing the colors for the different topics, a timeline was created and arranged in chronological order. The initial email that was sent is located at the top left corner of the chart.

Regarding the first topic (Data Novia SDGs), it has been commenced the communication on the 20th of February with two individuals. The following day, they replied to the inquiry, and consequently, we shifted the corresponding box a bit to the right indicating the progression of time.

As both emails were sent on the same day, they are arranged in a vertical alignment. Any subsequent questions or follow-up messages that we sent via email were located on the right side of the corresponding response.

When a topic is in progress, represented it with a green line extending to the

right until all questions are addressed. Once all inquiries were answered, the green line extended downwards to the last message received. So far, only 3 of the 5 topics were opened and closed.

Represented in a red line if the sent email regarding a specific topic but did not receive a response. The red line indicates that the team has not yet received a response, and it may only consist of one box until the team sends another follow-up email.

The benefit of sorting all the mailings is to ensure the receiving data is on date for the project management. This represents how clear and well organized timeline schedule to track the different topics and corresponding emails related to the project. Using different colors and lines to represent each topic is a helpful way to visually distinguish between them. It is also good to have a system for indicating when a topic is still open or if is in need to follow up with someone who has not yet responded. Keeping track of communication in this way can help ensure that all necessary information is obtained and that the project stays on track.

7 Interview

7.1 Interview kitchen:

The project team conducted an interview with the chef of the restaurant located at Wolffskavägen 33. This was done in order to gather more information about the food theme, which is located on the left side of the WBS. The interview with the head of the kitchen in building Wolffskavägen 33 revealed. Below are the most important questions and answers from the interview.

When do you start cooking?

We start cooking at 7:00-7:30 o'clock

When do you stop cooking?

Closing at 3 pm, someday we cook until 2:30 pm sometimes we stop at 12 am. It's depending on the circumstances when we stop cooking. It depends on the day. On Friday we don't cook as much, and we only cook in the ovens because it's almost the weekend.

And at the weekend?

At the weekend everything is closed.

How was everything in covid? Cooking and energy usage?

The school was closed and because of this he sold take away only. So, the kitchen was still open. We were still cooking in this building. We sold 80%-90% less meals in covid than normal.

Timetable kitchen during covid:

It was closed from March 2020 until 2022 February. Whole of January was closed. In 2022.

Are there isolation changes in the kitchen last year? There are no isolation things that are changed.

What are you doing with the waste in the restaurant?

Food waste has a different bag than other garbage. These are then taken away by the collection service and recycled properly.

It may be a question you do not want to answer and that is okay, but can you tell me where you purchase the food?

I am sorry, I do not want to answer this.

What do you think takes the most energy in the kitchen?

The fridge and freezer take up a lot of energy.

7.1.1 Conclusion interview

The interview provided the researchers with valuable insights for the project. Initially, the team decided not to pursue the food component further as the head of the kitchen declined to disclose information regarding the procurement of meat and its processing. It is completely understandable that the team cannot continue working on the transport and food components due to the head of the kitchen's refusal to disclose the procurement process of the meat. Moreover, it is noteworthy that significant efforts are already being made to mitigate food waste in the restaurant. Customers are charged extra for a second plate and the food waste is collected and segregated by the collection service. The kitchen efficiently manages its waste, thereby not posing a major issue.

During the interview, additional valuable insights were obtained for the project. The opening and closure of the restaurant during the COVID-19 pandemic were discussed, as well as the hours of operation for the kitchen. This information was particularly useful for analyzing the building's heating electricity consumption and scheduling meetings accordingly.

8 Weekly Meetings

This phase of the project involves documenting all the information that the customer, Roger, requires and the progress achieved by the project thus far. The team will compile the information gathered from the various individuals involved in the project.

In the initial stages of the project, the group identified the need to understand the customer's requirements. Subsequently, the researchers arranged a virtual meeting with the customer to discuss the project's future, Novia's needs, and other relevant information. Prior to the meeting, the group created a comprehensive list of topics to be covered during the discussion. Following the meeting, the group held a second meeting to consolidate the key points discussed in the previous meeting.

8.1 First meeting 9th of February

During the meeting, the team discussed the customer's requirements and identified the sources that the researchers should refer to. It was recommended that the team should define the project and consider the goals that are relevant to the researchers' studies. Furthermore, it was suggested that the team should create a canvas to assess their strengths, weaknesses, and individual roles within the group. Additionally, It was advised to select the chairman and secretary for the project by the next meeting.

8.2 Second meeting 16th of February

During the second meeting held on February 16th, the group discussed the difficulty in evaluating Novia's progress towards the SDGs and concluded that a deeper understanding of what the SDGs entail and how Novia can move towards them is necessary. The members also deliberated on the creation of models and identified the information required for this purpose. They deemed this approach to be appropriate for the project. Furthermore, the group received an email requesting electricity and heating data, which necessitated a revision of the project plan.

8.3 Tirth meeting 22nd of February

During the tirth meeting, Biniam Tefera was introduced as a new member of the project. The group discussed produce consumption and the possibility of including it in the project. Furthermore, an email was received with a list of contacts to reach out to. Biniam Tefera was appointed as the new team coach and Roger Nylund officially became the project's client.

8.4 Fourth meeting 7th of March

In this meeting, Roger was unavailable. Therefore, the group discussed the kind of data that had been received. As the data was for the entire university, the team considered if it would be better to calculate the energy consumption for the whole university. The conclusion was that if there was information related to a particular topic that was applicable to the entire university, it could be used, but the energy model and diagram would be created only for the Wolffskaväagen 33 building. The possibility of carbon dioxide compensation was also discussed. However, the team realized that it was necessary to discuss this with Roger, the customer. The group also discussed the option of requesting the raw data used to create the Excel file received earlier that week, to calculate the year 2022. However, it was concluded that this would be done only if necessary, as it would require a significant amount of work. Biniam inquired about the planning and requested the Gantt chart be sent to him.

8.5 Fifth meeting 13th of March

During the meeting, the team discussed the issue of not receiving a response to an email that was sent and deliberated on the best course of action. Additionally, they considered the possibility of requesting raw data in case it may be needed in the future. The team also had a discussion about the upcoming midterm presentation and the contents of the midterm report that needs to be prepared.

9 Data received

9.1 Heating data

The heating data the team received is from the 1st of January 2018 at 00:00 until the 19th of February 2023 23:00. This is data from Wolffskavägen 33 building.

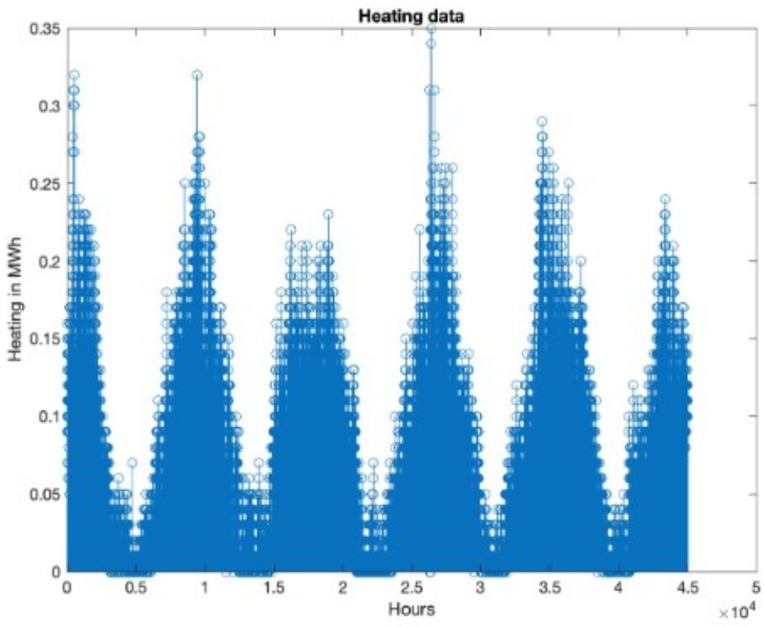

Figure 22: In here all the heating data the team received is shown

9.2 Electricity data

The group has received electricity data pertaining to the period starting from the 1st of January, 2020 at 00:00 and ending on the 20th of February, 2023 at 03:00 for the Wolffskavägen 33 building. However, there are 80 hours of data missing. Bart has successfully identified the specific dates corresponding to this missing data and duly notified the data source.

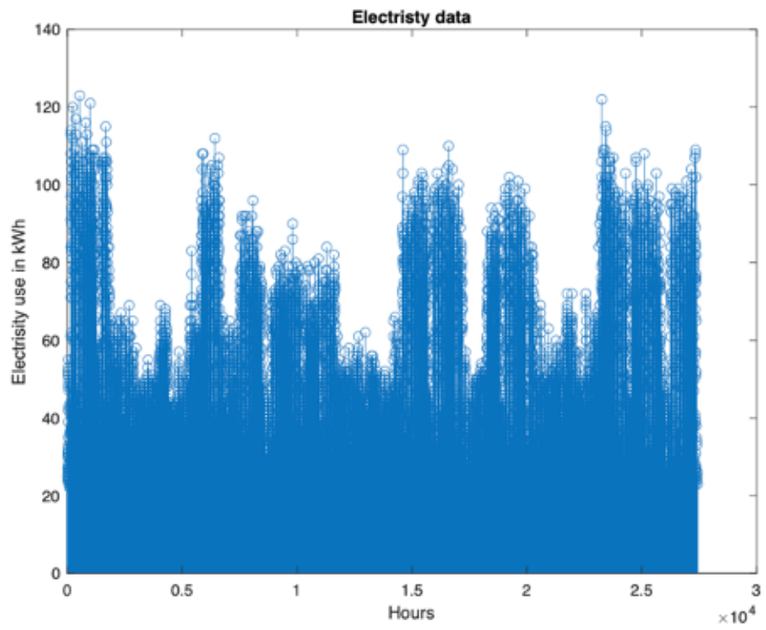

Figure 23: In Here all the electric data we received is shown

The team has also received a schedule for the air system, which allows for an evaluation of the energy consumption during weekdays from 7:00 to 16:30. Additionally, through an interview, it was discovered that the kitchen begins cooking at 7:00-7:30 and ceases operations between 12:00 and 14:30. This information can be utilized to analyze energy usage and identify potential sources of energy consumption.

After the heat data gathering, the group received information about the hourly consumption. The original document contains two sheets, one with the following data and the other with the raw data.

Average of power hourly	Collumn tag							
Row tag	mon	tue	wed	thu	fri	sat	sun	Total general
0:00:00	24,5	23,5	24,8	25,0	25,0	24,8	25,0	24,7
1:00:00	25,0	24,0	24,8	24,6	24,5	24,5	24,8	24,6
2:00:00	24,8	23,8	24,6	24,8	24,8	24,8	24,8	24,6
3:00:00	24,5	23,5	24,4	24,8	25,3	24,8	24,8	24,6
4:00:00	25,3	24,5	24,6	24,6	25,0	25,0	25,0	24,8
5:00:00	25,8	24,5	25,6	27,6	29,3	25,8	26,0	26,4
6:00:00	36,8	38,8	37,0	34,0	35,3	26,3	25,5	33,5
7:00:00	55,5	62,8	60,4	59,8	56,0	27,5	27,8	50,6
8:00:00	52,3	57,8	57,2	53,2	52,8	29,5	30,5	48,1
9:00:00	47,8	51,8	54,2	52,8	49,3	36,8	28,5	46,4
10:00:00	47,8	49,8	49,0	50,4	47,3	37,5	28,3	44,6
11:00:00	43,0	47,3	46,8	47,2	46,0	36,3	27,3	42,3
12:00:00	44,3	49,0	47,2	45,2	46,5	36,8	27,0	42,5
13:00:00	45,8	50,8	48,8	48,0	46,5	36,5	27,5	43,7
14:00:00	45,0	47,0	47,0	46,0	45,8	26,3	27,5	41,0
15:00:00	40,5	41,5	41,4	41,4	41,3	25,8	27,0	37,3
16:00:00	33,5	35,5	34,6	35,2	34,5	26,8	27,3	32,6
17:00:00	27,3	29,3	28,6	28,4	28,8	27,3	27,3	28,1
18:00:00	27,0	29,0	28,4	27,4	28,0	25,5	27,8	27,6
19:00:00	26,8	29,0	29,2	27,8	28,5	25,8	27,5	27,8
20:00:00	26,8	28,3	28,2	27,6	27,5	24,8	27,0	27,2
21:00:00	26,8	27,8	27,6	27,6	27,8	26,0	28,0	27,4
22:00:00	26,8	28,3	27,8	27,0	27,5	26,5	28,3	27,4
23:00:00	25,8	27,0	26,8	26,2	26,8	25,3	25,3	26,2
Total general	34,5	36,4	36,2	35,7	35,4	28,2	26,9	33,5

Figure 24: Here the a table of average Energy Consumption is shown

Every cell is the Energy Consumption of electricity in kWh. Each cell column refers to a different day of the week and the row of the hour which is consumed. At the end of each column and row the energy consumed is the average of the week within an hour in a row and the average of the day within a column.

When the cell is grèeen it means the electricity consumption is on average low. When the cell is red the consumption is higher than average.

The team aimed to analyze the weekly electricity consumption of Novia by compiling all the relevant data into a graph. This approach enabled them to identify the peak points and periods of lower consumption. Additionally, they sought to distinguish between consumption patterns during the Covid, Pre-Covid, and post-Covid periods, as this would provide valuable insights into the university's energy usage habits.

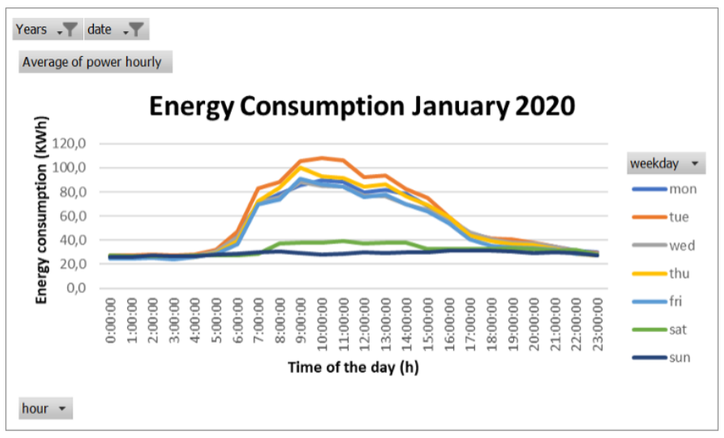

Figure 25: This figure shows the heat used by Novia of January 2020

In Figure reffig:HeatJan2020, the graph is titled "Energy Consumption January 2020," indicating that the data presented is from a time period prior to the arrival of the Covid pandemic, which brought changes to the energy consumption plan.

Initially, it can be seen that electricity consumption starts at 7:00 am, which is consistent with our previous argument. Since this is a large machine, it needs some time to reach its maximum working capacity, hence the slow increase in consumption. On Monday, for example, consumption rises gradually from 70 kWh to 85 kWh on Tuesday. The maximum consumption point is observed at 10:00 am, which is exactly 108 kWh. After this peak point, consumption begins to gradually decline to a low of 20 kWh.

Also, it's visible that on Fridays there is still something happening in the University. This is due to some activities University does in these days.

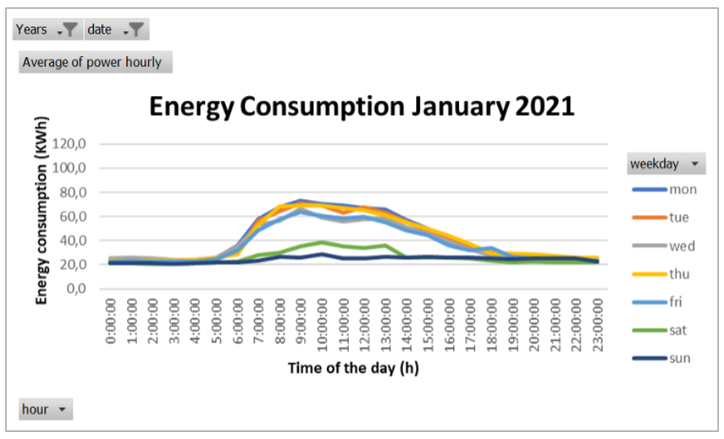

Figure 26: This figure shows the heat used by Novia of January 2021

In figure 26 the "Energy Consumption in January 2021" can be seen. This means when Covid began.

Upon comparison with the previous image, it is evident that the consumption of electricity was reduced by half in contrast to the previous year, 2020. This implies that a significant number of people did not attend the University, and the consumption of electricity was consequently reduced. This reduction in activity resulted in decreased energy consumption. The maximum consumption point was recorded on Monday at 9:00, with a value of 73.0 KW.

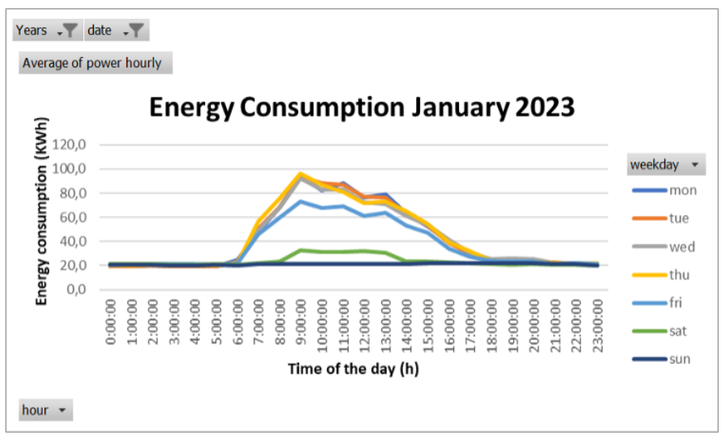

Figure 27: This figure shows the heat used by Novia of January 2023

In Figure 27, the graph shows the energy consumption in January 2023, after the Covid pandemic. It can be observed that the consumption is nearly equivalent to that of the year 2021. The maximum in this month was 96.5 kWh on Thursday at 9:00. If we compare the 96.5 kWh consumption versus the 108KWh it does not seem a big difference also we are talking about the maximum peaks.

To sum up, the evolution of Energy consumption declares that Covid helped the economy of Novia as the consumption dropped. Also, the consumption it is been reduced a bit between the previous and post Covid.

9.3 Traveling data

This is the information the University of Novia about traveling:

In 2021 there were 35 trips abroad for a total of 168 days

In 2020 there were 50 trips abroad for a total of 211 days

The years 2020 and 2021 were heavily impacted by the global pandemic, resulting in limited travel. However, in 2022, a total of 190 trips were made abroad, amounting to a combined duration of 869 days.

From the total amount of trips, 76 were to Sweden, 20 to Germany, 17 to Norway, 13 to Denmark, 6 to Greece, and 5 each to France, the Netherlands, Italy, Tanzania, and other destinations. Despite this information, more specific details are needed in order to accurately calculate the expenses incurred during these trips.

Of particular importance is the location of departure, as Novia University is situated in different cities within Finland, as well as the specific cities being visited within the destination countries.

Fortunately, an excel document has provided valuable information regarding the calculation of Novia's trips in 2019, 2020, and 2021. To facilitate our calculations, the team will categorize the modes of transportation as flights, boats, cars, and public transportation, each requiring distinct calculations. However, further details such as fuel consumption for cars are not available in Novia's records. This was how the team wanted to do it before the midterm report. In this area, there are things that are going to be changed after the midterm report.

9.3.1 Flights

- Short flights, less than 463 km
- Long flights, domestic, more than 463 km
- Long flights, foreign countries, more than 463 km
- Long-haul flights, more than 3700 km

9.3.2 Cars and the amount of kilometres

9.3.3 Public transport

- Bus (long-distance transport) km
- Train (long-distance transport) km
- Local transport (bus, train) €
- Train (foreign countries) €
- Bus (abroad) €

9.3.4 Car ferry/cruise ship

9.4 Product research information

The team started looking for studies that it can use to give advice to the university on how to buy products in a sustainable way with low CO2 consumption.

The team found 4 qualitative tools so Novia can consume in a better way. These tools could be interesting to use later when the products are analysed.

9.4.1 Met-Matrix and relatives

This document provides a qualitative description of known data related to the various stages of a product's life cycle. The model is presented in the form of a matrix with intersecting rows and columns. The rows in the model correspond to important elements of product sustainability, namely, material, energy, and toxic emissions.

The columns represent different stages in the life cycle of a product, namely production, distribution, use, and discard. Each column encompasses a comprehensive analysis of the product at each stage. Please refer to Figure 28 for a visual representation.

MET -matrix

MET-matrix	Material	Energy	Toxic emissions
Production			
Distribution			
Use			
Discard			

Figure 28: Here the Met-matrix is shown

The group will provide an illustration of a Material Energy Toxicity (MET) matrix for a copying machine that Novia plans to procure, as shown in Figure 28.

MET -matrix

MET-matrix	Material	Energy	Toxic emissions
Production	Depletion raw materials	Process energy	Air pollution
Distribution	Packaging	Fuel	Air pollution
Use	paper consumption waste and packaging	Energy consumption	Ozone production
Discard	Recycling of device		Selenium drum

Figure 29: Here the Met-matrix is shown but filled in

MET-Matrix takes a lot of time to make but is very qualitative.

9.4.2 LiDs-wheel

LiDs-wheel is a systematically organized collection of design guidelines that comprehensively covers the entire life cycle of a product. It serves as a brainstorming tool to identify suitable products for Novia while also.

providing a visual representation of the environmental benefits of a product. In the LiDs-Wheel, eight essential aspects of sustainable product design are considered. The closer a point is to the center, the less sustainable the product is in that aspect. Conversely, the further away from the center a point is, the more sustainable the product is in that aspect. If there are points close to the center for a specific aspect, it implies that the product is not sustainable in that regard.

Conclusion: The LiDs-Wheel provides a quicker way to visualize the sustainability of a product compared to the MET-Matrix. While it is still a qualitative approach, it offers a more comprehensive and intuitive representation of environmental benefits.

9.4.3 Eco-Star

The Eco-star is another structured set of design guidelines that consider the entire life cycle of a product. Its advantage lies in its consideration of both ecological and economic aspects, making it particularly useful for Novia's purchasing decisions. Moreover, its visual representation simplifies the decision-making process, ensuring that the products chosen for the university are both beneficial for Novia and the environment.

The diagram presented below depicts the Eco-Star model, which divides each pane into two triangles, representing distinct stages in the product's life cycle. The outer triangle represents the ecological aspect of the stage, whereas the inner triangle represents the economic aspect. Each triangle is marked with five statements, and a positive response to each statement results in further coloration of the triangle. This process yields a colored Eco-Star, providing insights into the product's strengths and opportunities concerning both ecology and economy [reference]. Please refer to figure 31 for a visual representation of the model.

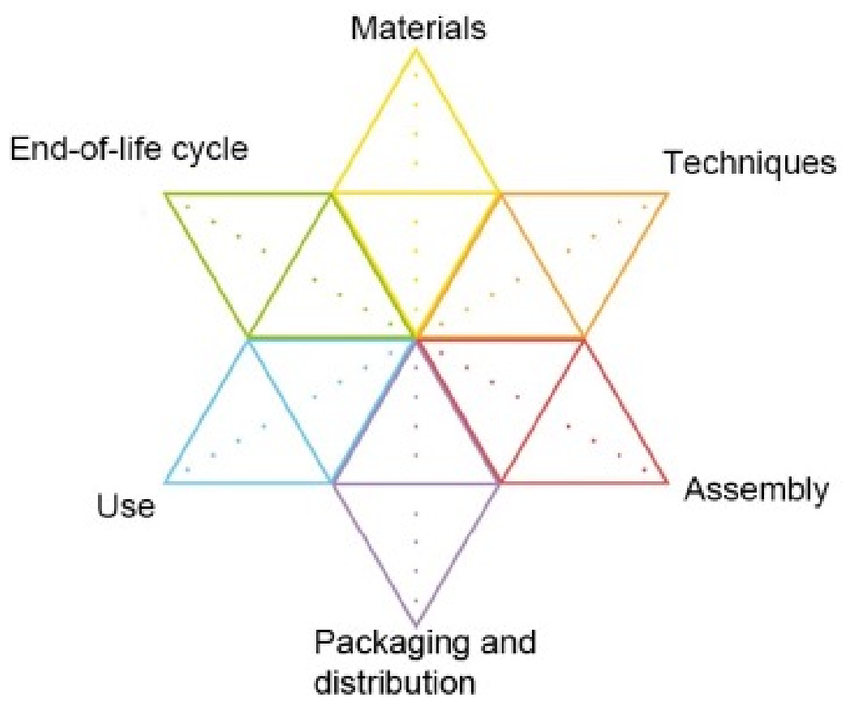

Figure 30: Here the eco-ster is shown

Here is an example of a chair desk that Novia intends to purchase, as illustrated in Figure 30.

Figure 31: A picture of a wheelchair

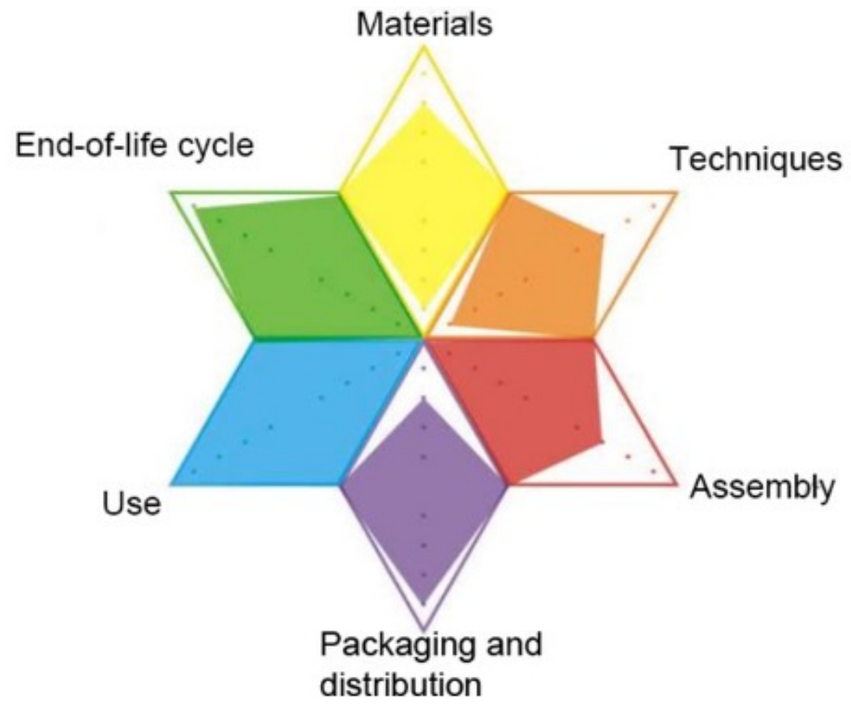

Figure 32: Here the filled in eco-star is shown [4]

On the example, you can see that chair assembly, for example, is very economical but not at all good for ecology. On the other hand, the use in both ecology and economy is very good.

Conclusion of the studies:

For Novia < Met matrix < Lids wheel < Eco star

The team is of the opinion that the Eco-Star model is the most beneficial for Novia due to its efficient time consumption in comparison to the MET-Matrix. It provides a comprehensive analysis of the product from an economic and ecological standpoint, making it an excellent tool for decision-making.

Most of this information is from this source[4]

10 Wolffskägen 33 layout

The team has obtained a floor plan encompassing all the floors of Novia, providing valuable insights into the layout and infrastructure of the building. This information includes the number of classrooms, pipe placements, toilet locations, and the purpose of each room.

Such details are essential for accurate energy and heating calculations. Figure 33 illustrates an example of a floor plan in the Wolffskavägen building.

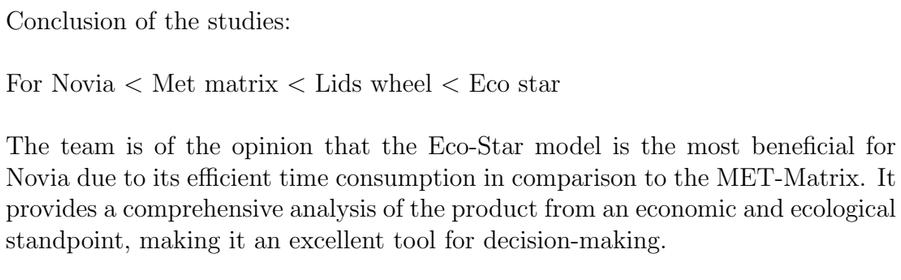

Figure 33: Here the blueprint of the school is shown

11 Real State information

The obtention of an Excel document that contains valuable information regarding the carbon emissions of Novia University's real estate sector. The document encompasses data contained between the years 2019, 2020, and 2021 and includes comprehensive details on Novia's various buildings. Specifically, the data highlights the carbon emissions associated with diverse aspects of the properties, including heating, electricity consumption, cooling, water usage, waste management, repairs, operation and maintenance, as well as outdoor area upkeep.

12 Interesting graph excel 2020

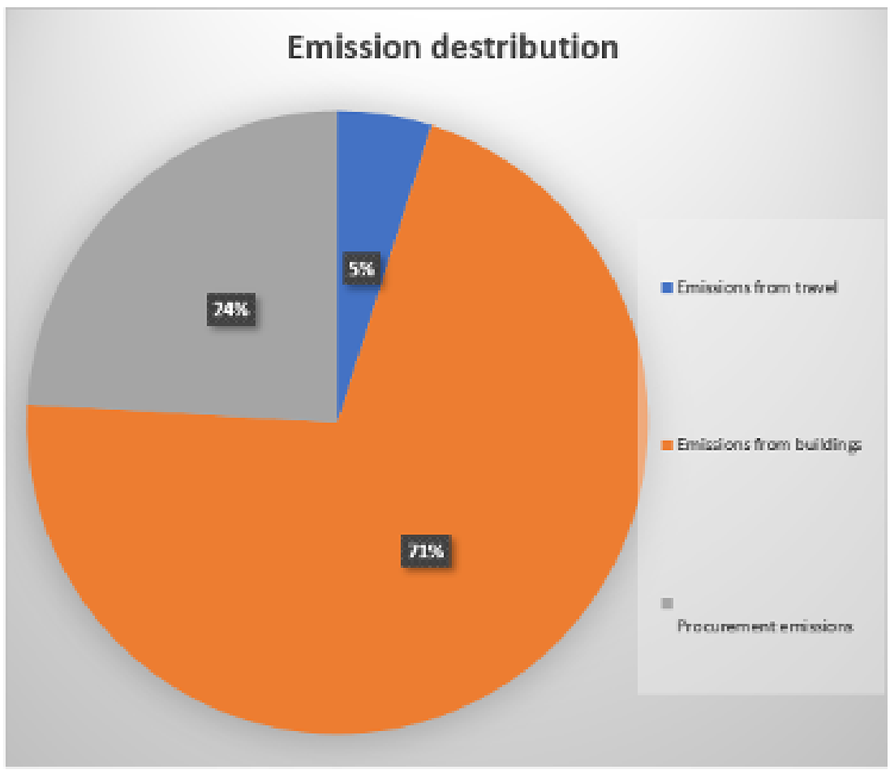

Figure 34: Here emission distribution of the year 2020 is seen.

Figure 34 was during Covid pandemic. It shows the distribution of the CO_2 emissions in % from the total amount produced. This data was received by mail by mail.

13 Future of project after the midterm report

Initially, the research team prioritized the acquisition of information that has yet to be received, via additional contact or alternative means. Following this, the team will construct an energy diagram and a model, a process that will require extensive calculations and, possibly, experimentation.

Once the current situation has been adequately modeled, it will seek out relevant data on sustainable energy systems in order to integrate this information into the model, enabling us to forecast the economic and ecological implications of adopting a new energy system. Ultimately, the team will engage in brainstorming and discussion to determine the optimal implementation strategy.

Regarding travel, our team aims to identify a method or strategy for promoting sustainable travel practices throughout Novia University. Teams' goal is to empower travelers to make sustainable choices while highlighting the distinct differences in CO2 emissions between various travel methods.

For short and long-term product, the team is currently compiling a list of commonly used items, from which the members will select and examine key products to determine whether more environmentally friendly alternatives exist. Additionally, the team is developing a sustainable procurement strategy that will enable Novia to conveniently purchase products with low CO_2 emissions.

In terms of IT waste management, the members are awaiting data regarding the specific types of discarded IT products to inform our selection process. Once these items have been identified, the team will explore innovative solutions to address IT waste management. One potential solution is the creation of an interdisciplinary course that engages students from various fields to collaborate on IT product management within the university context.

14 Product part

14.1 Process of consumption

First time that the team got a kind of list of products was on 17/03. This is the list that was received.

Baptiste requested more specific information on the university's purchase of mobile phones and furniture, as the information available was not detailed enough.

On March 21st, the team received a correspondence containing detailed information on the long-term consumption of W33 and Technobothnia, in the form of an Excel spreadsheet. The spreadsheet provided specific details regarding each product, including the supplier from which Novia procures the product, brand

Long term product		
Product	**Brand**	**Cost**
Office furniture	Isku	1288
Office furniture	Isku	920
Phone	Elisa OYJ	220,28
Defillibrator + cabinet	Safeaid	1473,55
Projector to classroom	All in All IT-Solutions	2209
Gamin consol to EPS Escape Room	Amazon	73,94
A chair carriage	Hexaplan Oy	53,51
First Aid kit	Merplast	213,26
4-Port Hub with Power Adapte	Rait Ab Oy	149,95
darkening curtain	Miimun Kangas Oy	152,4
DIGITAL DOCUMENT CAMERA	Dustin Finland Oy	364,6
14 Monitors	Dell Oy Ab	2710,82
8 keyboards and mouse	Dell Oy Ab	151,68
8 Monitors	Dustin Finland Oy	1632
8 Dell Latitude laptops	Dell Oy Ab	7200

Figure 35: Product information

name, cost, product name, and quantity.

On 24/03, the team received a communication consisting of 55 bills in Finnish, which required payment by the University of Novia Vaasa. As a first step, the team translated all the bills into English. Subsequently, the team created an Excel document to keep track of the bills, with a provision to add all the products to it. The first sheet of this document is titled 'All for one' and includes all the products purchased from different companies, for both long-term and short-term use. In addition, there are other sheets in the Excel document, each containing product information from a particular company that Novia has purchased from. This approach made it more convenient for the team to manage the bills.

14.2 Product Analisis

As previously mentioned, the product data received has been divided into three parts: long term, short term, and IT discarded products. After meeting with the IT staff and asking them some questions, it was decided not to work on the IT discarded products due to the IT company research. More specific information will come later.

Initially, the ten most expensive long-term products in terms of total price were analyzed to determine the company's sustainable actions. The same methodology was used for the short-term products, but the selection method was to use the factory where Novia spends the most money on.

To evaluate how sustainable a company is, the following factors are essential along with some concepts that need to be explained before conducting the analysis.

The factors that explain how committed an institution is to sustainability are the certifications the enterprise has. These certifications provide a clear image of the company for environmental commitment.

Certifications for sustainability include:

ISO standards are tools to ensure that organizations meet a set of requirements and that the standards are implemented correctly. They enable companies to prove that they are reliable and competent, which translates into an increase in benefits and work volume. These certifications give an improved image, productivity, confidence, turnover, and access to international markets.

Links:

- https://consultoria.anexia.es/blog/3-certificados-para-demostrar-la-sostenibilidad-de-tu-empresa
- https://www.normas-iso.com/

The next certificates provide the main idea of what they stand for, what attributes the standards cover, and their benefits.

ISO 14001 Certification: Environmental Management Systems in companies of all sizes and sectors of activity.
The standard aims to integrate environmental considerations into the overall management of organizations, providing a framework for the systematic management of environmental impacts and promoting environmental protection and pollution prevention. By implementing ISO 14001, companies can demonstrate their commitment to environmental responsibility, enhance their reputation among customers, and differentiate themselves from competitors.
Benefits: This standard is highly sought after due to its numerous benefits, such as reducing operating costs by promoting efficient resource use, improving profitability, enhancing corporate image, enabling companies to capitalize on market opportunities, reducing the risk of environmental incidents, and fostering long-term customer trust. [5]

ISO 5001 Certification: Energy Management System Certification.
This standard helps companies manage the energy aspects of their activity in an appropriate way and implement an energy policy. It provides a set of tools to identify which activities consume the most resources and to activate a plan to minimize energy expenditure. The aim is to make energy use more sustainable and efficient.
Benefits: Thanks to this standard, any organization can adopt processes to achieve energy efficiency.

ISO 9001 Certification: Quality Management System
This standard has a clear focus on continuous improvement. Customers are at the heart of the business, so organizations must properly manage their processes to ensure that they meet the quality requirements demanded by customers.
Benefits: Implementing this standard is a great strategy to differentiate companies from the rest, gaining positions in an increasingly competitive market. It improves the efficiency of processes.
The management must make a firm commitment to achieve the objectives and maintain a good working environment. [5]

Carbon Footprint Certification:
The carbon footprint is a measure of the total amount of greenhouse gases emitted, either directly or indirectly, indicating the extent of pollution emissions. This concept was developed to raise awareness among consumers about the environmental impact of companies, products, and services. The certification of carbon footprint is especially important for companies that must comply with legal limits on greenhouse gas emissions. The resulting values are typically given in kilograms or tonnes of CO_2 gases.
Benefits: The benefits associated with carbon footprint calculation and subsequent action plan for reduction or offsetting include reducing GHG emissions, economic savings, improving productivity, improving competitiveness, improving corporate image, active collaboration in climate change mitigation, raising awareness and disseminating respect for the environment, and responding to a market that is increasingly aware. [5]

Forestal Certification:
Forest certification is a process that ensures the sustainable management of forests. It involves monitoring various indicators and is commonly referred to as sustainable forest management.
The process of forest certification, and therefore of sustainability, goes beyond the forest and continues in the industry. In this way, any wood product forest land, reaches the end consumer with a certificate that guarantees that it belongs to a sustainably managed forest.[5]

Sustainable Forest Management (SFM):
The objective is to certify the forested land from which the raw material is extracted for further processing.[5]

Chain of Custody (CoC):
The objective is to ensure the traceability of sustainably sourced timber industry products from the managed forests to the end consumer.[5]

PEFC (Program for the Endorsement of Forest Certification):
It aims to ensure that the world's forests are managed responsibly, and that their multitude of functions are protected for present and future generations. [5]

FSC(Forest Stewardship Council):
The environmental management system of the EU consolidates diverse perspectives to ensure the environmentally sound, socially advantageous, and economically viable management of resources.[5]

Benefits: Forest sustainability certifications offer a range of benefits, including improved land organization and maintenance. Consumers are reassured that the products they purchase come from a company that is committed to forest conservation. This enhances the company's image and competitiveness, attracting new customers. Additionally, forest certification promotes sustainable harvesting practices, preventing overexploitation of forest resources. [5] **GRI Reports:**
The most widely recognized sustainability report is produced by the Global Reporting Initiative (GRI). GRI is an international organization that provides sustainability reporting standards to companies and organizations worldwide through its Sustainability Standards Board (GSSB).
By doing this, companies can increase transparency on their contributions to sustainable development. The Standards are also highly relevant to other stakeholders, including investors, policymakers, capital markets, and civil society. [6]

ESG Criteria:
ESG criteria are a set of Environmental, Social, and corporate Governance factors that investors consider when investing in a company. Although they have existed for several decades, they have become the industry standard for socially responsible investment in recent years. [7]

Action Plan:
The main objective of an action plan is to develop programming solutions for the near or far future. To achieve this, we aim to create a 2-year plan that drives Novia University forward with sustainable actions. This plan will include the development of various activities and initiatives that support our commitment to sustainability.

14.3 Long-term product Analysis

Products	Brand	Company	Cost
Computer	50 OptiPlex 5000 Small Form Factor	Dell OY AB	25500
Dynamometer	KORAHS00607 MULTI-TOPLINE	Wihuri Oy	16970
Monitor	9270000 MC6 MONITOIMIKALIBRAATTORI	Beamex	14765
Podbooth	Framery Q Meeting Mag.kääntöpöytä+2x sohva	Isku Interior Oy	11900
Podbooth	Framery Q Meeting Mag.kääntöpöytv+2x sohva	Isku Interior Oy	11900
Monitor	44 Monitors P2422H / BASE ,DIS ,MON ,P2422H ,EMEA	Dell OY AB	8756
Computer	16 OptiPlex 5000 Small Form Factor	Dell OY AB	8160
laptop	8 Dell Latitude 7430 XCTO	Dell OY AB	7200
Air conditioner	Korecktwinpro 12 ilmastoinnin huoltolaite	Wihuri Oy	5500
Dryer	05-20240 VENUS 4951 -55 amb. +140°C	PENTRONI C AB	5391.8

Table 1: Top 10 most expensive Long-Term products.

Table 1 is extracted from an Excel spreadsheet containing information on products purchased during the year 2022. The spreadsheet includes details such as the brand, company, and cost of each product. During the initial attempt to analyze the data, the team encountered multiple instances of repeated company names, indicating a significant impact on Novia's operations. The team also recognized the importance of considering the amount of money spent on each company. To address these issues, the team decided to focus on a detailed analysis of only 10 most expensive products, as determined during a meeting on April 11th, with a priority on Novia's sustainability and ecological impact. This means that 5 companies were analyzed on long-term products.

The team sorted the list of products by price, and then by company name, starting with Dell OY AB and ending with PENTRONI C AB. To ensure accuracy, the team excluded any repeated companies when conducting subsequent analyses. The total amount of money spent on each company was then compiled into the next table.

Company	Total Amount
Dell OY AB	56033.20
Isku Interior Oy	32857.29
Wihuri Oy	26350.00
Beamex	14765.00
Dustin Finland Oy	5626,70
PENTRONIC AB	5391,88
All In All IT-Solutions	3253,60
Elisa OYJ	2562,50
Sensorcell	1868,40
Safeaid Oy	1461,05
Caverion	999,00
AJ Tuotteet Oy Ab	705,00
MULTITRONIC-JNT OY AB	524,2

Table 2: Long Term Products sorted by the total amount of money spent

Table 2 provided presents the impact of various companies on Novia in terms of expenditure, arranged in descending order from the most cost to the least. Notably, Dell OY AB continues to have the greatest financial impact, as evidenced by their products being the most expensive in comparison to those of other companies listed in Table 1.

For the next analysis the team will include the following detailed information for the products listed on the first table:

- Name of the product selected.

Figure 36: OptiPlex 5000 Small Form Factor form dell

- Image of the product.
- The amount of products bought.
- Company
- Cost for the total amount products bought.
- Sustainable Actions
- Personal opinion/conclusion about their actions

At the end of every company analyses there will be commented how it is seen from teams' perspective. Hereafter, the team will examine the phrases and actions taken by the companies mentioned above to ensure that they achieve their objectives.

14.3.1 Computer: OptiPlex 5000 Small Form Factor

Quantity: 50
Company: Dell OY AB
Cost: 25500 EUR
Recycling Electronics components.
Dell OY AB, has some sustainability initiatives, policies, and programs so the company can reduce its environmental footprint. Here there are some positive aspects of Dell's sustainability efforts [8]

Dell Circular economy recycling part:
Dell provides a sustainable recycling solution for computers and IT equipment, where materials from recycled products are used to create new IT products. Dell has made a pledge to recycle the same amount of materials that they produce. Customers also have the option to trade in their discarded IT products. Moreover, Dell sources plastic waste from oceans and recycles them for their products. Since 2007, Dell has reused or recycled 1.1 billion kilograms of used electronics. [8]

Design for reuse and Design to recreate: Luna concept:
Luna is a concept to make components easily accessible. That means more efficient to repair and takes also less energy to recycle so less carbon. [9]

Dell wants to be carbon neutral in 2050
The carbon footprint information webpage is full filing. They are really working on it to reduce it so good as possible in a lot of different ways. This pdf is in the appendix. [10]

Alternatives/ future:
Dell is a company that is very much into being sustainable and paying attention to its carbon footprint. It is also very much into recycling and being circular. The conclusion the team gives for the products bought from this company is every time Novia buys products from Dell is a good decision that Novia buys products from this company and in the future, is recommend buying further Dell materials. [10]

14.3.2 Dynamometer: KORAHS00607 MULTI-TOPLINE

Quantity: No Data acquired
Company: Wihuri Oy
Cost: 16970 EUR
Information:

Wihuri Oy, also known as Frankly Wihuri, proclaims to have prioritized sustainability since its inception. The company takes measures to ensure that all associated companies adhere to similar sustainable objectives. For instance, the company aims to prioritize transparency, reliability, creativity, and profitability of its products.
Frankly Wihuri also operates based on four distinct pillars: Valued Partner, Extended Family, Roots, and Planet.
All their collaborators are required to be "responsibly sourced," which means that they must not have any negative impact and should ideally have a positive impact on people and the environment. [11]
Upon inspecting the packaging website, it was discovered that the company is a

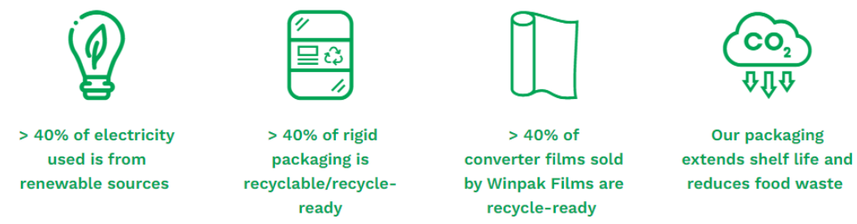

Figure 37: Image op Winpak process [12]

leader in producing packages for the medical and food supply industries in two continents. They have two prominent brands, WIPAK and WINPAK, operating in Europe and North America, respectively.

Figure 37 shows the company stands for sustainable actions.

Show Wihuri work in the same way as Frankly Wihuri as they are part of the same company. Here's bring the next point which is the family business, regards its employees are seen as part of their close community. Also expects their close community to be their best themselves in everyday work. Their community is to self-develop the company into care, growt and behaviour aspects they invest time and effort.

Wihuri and its community are committed to ensuring fair treatment of all those who contribute to the production and distribution of their products throughout the supply chain. Wihuri care about doing part to be environmentally responsible, both for current and future generations.

Another important commitment they focused on 3 of the 17 Sustainable Goals:
SDG 12: "Ensure sustainable consumption and production patterns"
In the supply chain they get friendly environmental packaging. Also they get focused on sustainable items in Food Service selection
SDG 8: Promote sustainability for supply chain, inclusive and sustainable economic growth, full and productive employment and decent work for everybody in order to stay motivated at work and feel self-satisfaction.
SDG 13: Take urgent action to combat climate change and its impacts by lowering the use of fossil fuels for energy and improving the energy efficiency by 10% by the next 2 years and also wasting reduction giving a second life to products.

Alternatives/ future: It is sure that Wihuri Group along with the other companies they own (Winpak and others) are going in the right path. They show transparency by showing their sustainable reports to their stakeholders. As for their products and projects, they've promised. They have also products for the circular economy which stands for the economy of the company.

14.3.3 Advanced Field Calibrator and Communicator: 9270000 MC6 MONITOIMIKALIBRAATTORI

Quantity: No Data acquired
Company: Beamex
Cost: 14765 EUR
Information:
Sustainability at Beamex. Their main purpose is the environmental impact. They claim the data they gather from their components can help medical measurements the quality of the food when it is transported but also the drinks. Along with this, the calibrations reduce world uncertainty.[13]

Their purpose is to make the world less dangerous and more accurate by using measurements in an environmental situation. All the data they gather is accurate, tracking the important aspects points of the calibrations.[13]

Three big pillars make sustainability in Beamex, Social, Economic and Environmental. As said before the calibration is the basis of the company. Machinery needs accurate measurements to enroll emissions controlling and license plant operations.[13]

Personal and group employee safety is a social factor that concerns all plants. They overlay employee health and safety. It has reduced harmful environmental emissions.[13]

Economic sustainability consists of convenient resources. It measures the level of the costs of the product It gives an example to prevent over millions of losses they monitor instruments to prevent insures. [13]
Environmental sustainability is not risk in the process of other pillars or harm the process by generating waste which cannot be controlled. [13] **Sustainable by design**

This aspect it attends to give the product to live longer than expected. With this tedious job not only this goal is the one they want to achieve so the product

needs to be repairable, maintain and up gradable.

If the decisions are not take properly in the design stage the impact is 10% lower then the 90% manufacturing decisions. **Circular economy** Products are made with sustainable design. With this product lifetime is longer rather than if these practices were not implemented. The goals can be achieved by these activities:

- Reliable
- Maintenance
- Repairable
- Compatible
- Upgradeable

Social Sustainability:

- Employee responsible
- Responsible Partner
- Responsible Neighbor

Environmental sustainability
Sustainable Sourcing
Standards and policies

- EcoVadis Gold Rating (Beamex EcoVedia Certificate)
- ISO Certifications
  - ISO 9001
  - ISO 17025
  - ATEX Directive
  - ISO 14001
  - ISO 45001
  - EcoVadis

These are the standards they accomplish. **ISO 9001** is set for the criteria out of the quality management system. **ISO/IEC 17025** is useful for any organization that performs testing, sampling or calibration and wants reliable results. The **ATEX Directive** defines the essential safety and health requirements and conformity assessment procedures, The one **ISO 14001** is the environmental management system certification. The **ISO 45001** Occupational health and safety management systems. EcoVadis is not a sustainable certification provided by the same Vadis Company. [13]

Alternatives/ future:
Beamex company is responsible with the community, their employees and environmentally committed as they used ISO 14001. They have integrated sustainability concepts into their job positions. For example they have used sustainability in their design besides their social sustainability either environmental certification. Among with this information they are not so transparency as they have not sustainable reports. The team further recommends Novia Vaasa to consume products because it is doing very well in terms of sustainability. [13]

14.3.4 Podbooth: Framery Q Meeting with Turntable +2x sofa

Quantity: 1
Company: Isku Interior Oy
Cost: 11900 EUR
Information: 90% of all wood materials come from Finland. That is good for the carbon footprint. It produces not a lot of carbon in the transportation of the wood. [14]

An external party conducted a study on the company's carbon footprint. The calculations are made according to the GHG Protocol Corporate Accounting and Reporting standard. The company has categorized its emission sources into three different categories.[14]

Scope 1 are the direct emissions. Could be Energy use of the vehicles.[14]
Scope 2 are the indirect emissions of the of purchased energy production. Can be the indirect emissions resulting from a company's acquisition of energy products, such as the purchase of electricity and thermal energy.[14]

Scope 3 also includes other forms of indirect emissions, including emissions related to a company's procurement of raw materials and services, as well as emissions from commuting. [14]

In figure 38 there is an overview of the results of the carbon footprint.
The carbon footprint in 2021 totalled 11,471.2 tonnes of CO2e. [14]

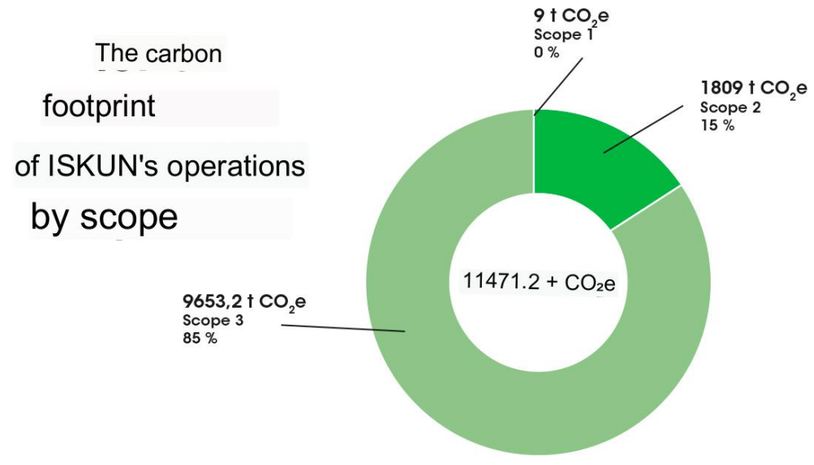

Figure 38: In this figure an overview of the results of the carbon footprint of Isku can seen.

Investment in domestic production: Last 6 years ISKUN invest 100 million euros in Finland. A renovation of the building automation system took place, the ventilation machines were modernised, the lighting was converted to LED lights and the extraction system was renewed. Year-on-year CO_2 emissions decreased by 500-600 tonnes compared to 2015 levels. [14]

In lahti, they have teamed up with the ISKU plant to create Finland's largest solar energy park. The Isku energy park will be about 2.8 MW in size and produce 2,500 MWh of clean renewable energy annually. It will reduce the size by about 355 tonnes. [14]

75 precent of materials are from Finland and 99% from EU-region. [14]

Almost all waste is recycled and reused. [14]

There is only one factory and largest subcontractor works in the factory where the reduction CO_2 reduces. In addition, transport of furniture to customers is done with lift trucks using renewable, fossil-free fuel. Using the new energy-efficient solutions at ISKU headquarters, the building's CO2 emissions will be reduced by as much as 90%. [14]

The company revamped its packaging, saving 20,000 kg of packaging plastic a year. [14]

Responsibly manufactured products: The furniture boards are PEFC and E1 certified. A forest that has been certified by PEFC adheres to the most rigorous environmental, social, and economic standards in its management practices. The wood origin tracking system provides reliable confirmation that the timbers used in the products come from sustainably managed forests. [14]

The company looks into the whole life cycle of the product. the company has a test centre to test whether the products adhere to EN and ISO standards. [14]

Alternatives/ future:

We very much recommend ISKU to buy further products from Novia in the future. The company is doing very well in terms of CO_2 reduction. There are clearer studies on it. These results are also visible. They also show what they have done and how many tonnes of CO_2 they have been able to reduce. They also work to make the life cycle as good as possible. They also have certain certificates such as the Nordic Swan that they are doing well in terms of CO_2 throughout the entire production process. In the future, it will only get better too. In addition, ISKU also won The European CEO's Company of the Decade in Sustainability in Finland. Which would be yet another reason why it is definitely a good idea to continue purchasing products here.

14.3.5 Dryer: 05-20240 VENUS 4951 -55 amb. +140°C

Quantity: 1
Company: PENTRONIC AB
Cost: 5391,88 EUR
Information:
PENTRONIC pretend that their biggest environmental benefit is that we constantly strive to reduce our customers environmental impact through our work. So they look more in how can the company can reduce the use of the products they are making. [15]

The company said that sustainability not only helps us continuously reduce our customers environmental impact, but also offers potential for creating new business opportunities and reducing our costs. They said that they do that with long term investments but they do not talk about the investments they have done. [15]

tHE company strives to be at the forefront of developing environmentally friendly

and energy efficient solutions for the customers.

The company has a certificate for Environmental Management System: ISO 14001. [15]

ISO 14001 environmental system certification can provide an organisation with many benefits, including improving environmental performance, enhancing credibility, cost savings, legal and regulatory compliance and promoting a culture of continuous improvement.

Alternatives/ future:

We do not recommend PENTRONIC for any future purchases of the same product by Novia. Although the company claims to prioritize sustainability by producing products that reduce the environmental impact of their customers, it is equally important that the product itself is sustainable. PENTRONIC only discusses the sustainability of the product during its use phase and not throughout its entire life cycle. Although the company holds an Environmental Management System certification, ISO 14001, we believe that there are better alternative companies to consider. [15]

The company that the team recommend for Novia in the future if they have to buy those kind of products is BEAMEX. BEAMEX is a company that you can buy the same kind callibration products. [15]

Sustainability is an important part in the design philosophy of BEAMEX. The products are design that they can be used for a long period of time, easy to maintian and that they are esay to repair and upgrade. They are working very good on the circular economy. In this way they can reduce the carbon footprint and conserve irreplaceable natural sources. [16]

The company has also been awared by EcoVadis with a gold rating for corporate social responsibility and supplier sustainability in 2022. [16]

'EcoVadis is the world's most trusted provider of business sustainability ratings. It's measered 7 management indicators, acros 21 sustainability criteria.' [17]

Company	Factory	Price	Certifications	Webpage	Report
Computer: OptiPlex 5000 Small Form Factor	Dell OY AB	25500	EN 149:2001 standard & ESG	Product Sustainability, Recycling, Inclusion, Volunteer Program, One of the World his Most Ethical Companies by the Ethisphere Institute	ESG
Dynamometer: KORAHS00607 MULTITOPLINE	Wihuri Oy	16970	ISO 14001 & FSC PEFC	Sustainable section at their website; 4R; Indications of performance, Climate Action, Circular design Carbon neutral by 2030	
Advanced Field Calibrator and Communicator: 9270000 MC6 MONITOIMIKALIBRAATTORI	Beamex	14765	ISO 9001 & ISO 14001 & National Environmental Policy Act (NEPA). Waste Electrical and Electronic Equipment (WEEE)	Sustainable section at their website; Report	Sustainability Policy
Podbooth: Framery Q Meeting with Turntable +2x sofa	Isku Interior Oy	11900	ISO 9001, ISO 14001, ISO 45001 & PEFC. CertiPUR	renewable energy to reduce CO2 emissions, carbon neutrality, carbon footprint. SDG sustainability based. circular economy	Sustainability Report
Dryer: 05-20240 VENUS 4951 - 55 amb. +140°C	PENTRONIC AB	5391.88	ISO 9001, ISO 14001, ISO 17025 & 3-A Sanitary Standards 74-07. IECEx/Atex	"Environmental Certificates", Environmental Certificates"	

Table 3: Long Term Sustainable products

The conclusions drawn from the long-term products are that while they may offer sustainable options, the company may not necessarily implement sustainable practices. It is important not to neglect either aspect. It is important to note that reports provide transparency for the company, and the more reports they have, the more competitive they can be in the market. However, a company that solely focuses on obtaining certifications may not be the best option.

Among with this Novia's long term products bought have been mainly bought from sustainable companies.

14.4 Short-Term product Analysis

Factory	Price
GRANDE	818,4
V Board Master Refill Pilot	427,81
Staedler Mars Lumograf	309,64
Ida	277,6
Priima	244,8
Erich Krause	232,86
Post-It	212,34
Lansas	209,58
Ekman System	153
Wega	145,31
Sidor Open	133,24
Calendar	97,2
Sharpie	81,02
Tesa Ecologo Easy Stick	79,2
U-29, Ultra Glide	75,78
Natura	74
LaserJet	66,72
Trio	64,52
IKH	62
Textsurfer Staedler	57,6
Scotch Magic	55,2
Tx 300	53,58
GUIDE	49,64
3M-1100	49,6
Navigator	38,1
Leitz 5008 NeXXt	35,77
Mirka	32,01
Stapler	30,38
Timex	25,78
Teknikkolehtiö	25,6
Makita	24,92
Durable	24,72
Minimap	22,71
Maxi	20,48
Krono	19,32
BNT	15,9
Dymo	15,16
Pilot Board Master	12,3
TEGERA	11,72
Casco	11,7
Unika	11,39
TextMark	9,46
WAHVA	9,16
Memo 14 2022	4,81
L&T	3,84
VECKODATUMVISARE	9,01

Table 4: Short term list factories sorted by the total price

Factory	Price
GRANDE	818,4
V Board Master Refill Pilot	427,81
Staedler Mars Lumograf	309,64
Ida	277,6
Priima	244,8
Erich Krause	232,86
Post-It	212,34
Lansas	209,58
Ekman System	153
Wega	145,31

Table 5: The 10 most expensive short term products

The table of contents presented displays the amount of money expended by Novia from the short-term products list in the year 2022. As seen in tables 5 & 4

As seen in table 5, the expenditure per factory does not exceed the budget of 1000 dollars per factory.

Following the summation of expenditures for each factory, the subsequent step is to evaluate the sustainability of each factory.

Companies with a top 10 largest spend are evaluated.

14.4.1 Grande Factory

Unfortunately, the manufacturer does not appear to have a website, thereby rendering it impossible to access a plethora of sustainability-related information. So ass a team the descision is made. The analysis will be made for the product instead of the company as there is no page found.

Products Protective equipment Respirators Grande respirator - FFP3 10 pcs Product code: Grande FFP3

Figure 39: Respirators Grande respirator - FFP3 10 pcs Product code: Grande FFP3

The description of the product: Particle and respiratory protection certified in accordance with EN 149:2001 + A1:2009. Filters out 99% of contaminants in the air. 10 pieces per packet.

EN149+A1 has introduced two new classes for the product's application. This certification specifies the standards, testing processes, and marking criteria for filtering half masks utilized as respiratory protective equipment against particles.

Disposable devices ('NR' product classification and labeling).

1. In advance of conducting the tests, the products undergo climatic conditioning with altered settings. Besides a novel efficiency test has been devised as a long-term extension of the previous penetration test. also elective test for clogging criteria is administered, which involves product categorization and the "D" designation. And a example of the marking is provided as follows: EN 149:2001+A1:2009 FFP2 NR D.

2. Reusable devices (product classification and 'R' labeling)

   - Conditioning under different settings prior to testing.
   - Prior to penetration tests, the product must undergo new cleaning and sanitation tests.
   - A new efficiency test has been developed as a long-term extension of the previous penetration test.
   - A new 24-hour post-exposure storage test has been developed.
   - A new penetration test will be performed after storage.
   - Clogging requirements mandatory test (product classification and "D" designation).
   - Marking example: EN 149:2001+A1:2009 FFP3 R D
   - The product marking must comply with EN149:2001, however it must also indicate whether the product is disposable (NR) or reusable (R).

Conclusion: This poduct Conforms to Health and Safety Regulation EN149:2001:2009 but there is no information about sustainability of the product or the company so the team do not recommend this company. The only possitive thing is that there is a possibility to reuse the masks. The team recommends to buy FFP3 mask from another company. The company that is recommended to Novia is Bryson. Bryson FFP3 Valved oulded Face Mask is the first in the UK construction industry to be provided in 100% Recyclable Box and Toxic Free Biodegradable Compostable Mask Bag. Bryson Way finds sustainability very important. The company is the leading in 3P sustainability strategy. The company is even the first negative supplier in the industry.

14.4.2 V Board Master Refill Pilot:

The organization is dedicated to acquiring products from suppliers who share its values and put sustainability, quality, and safety first. Environmental and health implications are among the selection criteria.[18]

Aside from these stipulations, the company endeavors to obtain eco-ratings and

certifications from its suppliers, as these certifications furnish crucial insights regarding the materials utilized and their ecological ramifications.[18]

Lastly, the organization acknowledges the significance of waste management in the pursuit of sustainability objectives.[18]

This are the Certifications that the company claims.[18]

- ISO 45001 : 2018 (Occupational Health and Safety Management System)
- ISO 9001 (Quality)
- ISO 14001 (Environment)
- Fulfills ISO 28762 (Vitreous and Porcelain Enamels Specification)
- Cradle to Cradle Certified Bronze
- Indoor Advantage Gold
- European Enamel Authority EEA 7.13-7.17
- Complies to Porcelain Enamel Institute PEI 1002
- Fulfills European Committee for Standardization EN 14434
- Lloyd's Register Quality Assurance to the following Management System Standards

The regulations established by V Board Company are the basis for the certifications displayed above. Of these certifications, the most crucial for the project is ISO 14001, which pertains to environmental friendliness. [18]

Conclusion: Novia made a good choice to purchase products from this company. The team finds this company very commendable and strongly recommends Novia to continue buying products from them. It is clear that this company excels in the field of sustainability. [18]

14.4.3 Staedler Mars Lumograf:

Staedler's objective is to prudently and prospectively manage the planet's resources. This is why efficiency occupies a pivotal position in their philosophy of sustainable action, particularly with respect to product production and logistics. The organization concentrates on the metrics that fall within their ambit and have an influence on the processes. Accordingly, the emphasis is placed on production techniques, materials such as plastic and wood, as well as the acquisition and transportation of raw materials.

Figure 40: This picture is made from upcycled wood:

The usage of wooden boards, which is common in traditional production techniques for pencils and colored pencils made from Upcycled Wood, is eliminated thanks to the company's superior production technology. Instead, wood chips from sawing and planing procedures in the woodworking sector are used. These wood chips are ground and upcycled using advanced procedures that allow even the smallest wood remains to be turned into high-quality pencils. [19]

The wood is sourced from PEFC-certified (PEFC/04-31-1227) forests, primarily in Germany, that have been managed in an ecologically, economically, and socially sustainable manner. So there is also a short-transport distance because all the wood comes from Germany. [19]

To enhance the durability of their products, Staedler has developed DRY SAFE technology, taking inspiration from nature. Numerous plants safeguard their fruits and leaves from desiccation by coating them with a layer of wax. Applying this same principle, the company has devised a solution that enables their pens to remain uncapped for extended periods of time without compromising their quality. [19]

The companies use also some labels for their products. As can be seen in figure 41.

Figure 41: Sustainability labels

- The company uses 100 percent green energy since 2021.
- ISO certifications of steadler: ISO 9001 and ISO 14001

Staedler is also the 2019 energy efficiency winners. In addition, the company wants to do a 70 percent reduction in emissions it emits by 2024. By 2024, that will be redirected to 80 percent. One also wants to use only renewable electricity generated by the company itself by 2030. [19]

Conclusion: Staedler has produced an exhaustive sustainability brochure that extensively discusses their initiatives in this area. As a team, we unequivocally endorse Staedler for future product procurement. The company exhibits an admirable level of commitment towards sustainability and is poised to make further progress in this regard.

14.4.4 IDA

In investigating this company, the team had some problems. They found no website or information about the company, which is very strange. Therefore the decision was made not to investigate IDA further.

14.4.5 Priima

The products obtained from this company consist solely of paper. Although they provide high-quality office supplies to their customers, they extensively employ hard plastics, posing environmental challenges within their paper industry. This information is detrimental to both their sustainability efforts and their company as a whole. [20]

Furthermore, it is worth noting that they lack a dedicated sustainable section, wherein they can discuss their actions and reports. While they have a program called "Prime Green" aimed at recycling, reducing, and achieving CO2 neutrality, for instance, it remains inadequate to address the overall sustainability concerns. [20]

Product Information: Considering that Priima manufactures many products in-house and transports others, assessing the sustainability of the entire company can be complex, as previously mentioned. However, upon analyzing the individual products themselves, it becomes apparent that there is a lack of information available when purchasing them. The paper used in their products does not carry any certification, further hindering the assessment of its sustainability. [20]

After conducting a thorough examination, it was determined that Priima's products do not hold any recognized sustainability certifications or labels, such as the Forest Stewardship Council (FSC) certification for paper products or other eco-labels for different types of goods. [20]

Furthermore, attempts to locate publicly available sustainability policies, goals, or reports from Priima proved unsuccessful. These documents would have provided valuable insights into the company's commitment to sustainability and their progress in implementing sustainable practices. [20]

In conclusion, it is not recommended to purchase products from this company due to their insufficient disclosure of sustainable practices, certifications, and reports. Although their individual products may possess certifications, the absence of comprehensive sustainable actions from the company raises significant concerns.

As an alternative the team recommends Novia the company Paperajuku Oy. This company stands for forest consumption reductions solutions for their paper productions.

"In the manufacturing process, a few deciliters of chemicals must be mixed into the paper pulp efficiently and quickly". As they comment it is understand that they use less chemicals for paper production which means less GHG and more environmentally friendly. [20]

14.4.6 Post-IT

Post-IT is a brand operated by 3M that is committed to prioritizing sustainability in its operations. The company sells a variety of Post-it Notes items made from recycled materials, demonstrating an exemplary commitment to resource conservation. However, it is crucial to note that, while highly practical, Post-IT Super Sticky Notes do not currently fit within the recycling category. Nonetheless, this product line contributes positively to CO2 emissions reduction. Notably, the company is a proud holder of the PEFCTM certification, which guarantees that its paper-based goods are sourced from renewable and responsibly managed forests. This certification demonstrates Post-IT's commitment to environmental stewardship and sustainable forestry practices.[21]

3M, on the other hand, has established itself as a forerunner in addressing the difficulties and capitalizing on the opportunities posed by climate change and energy conservation. The company's complete global report is 156 pages long and demonstrates its dedication to sustainability. Notably, 3M has successfully achieved a stunning 37.5 percent reduction in CO2 emissions as of 2019. Furthermore, the company has made considerable efforts in boosting its use of renewable electricity, with a stunning 51.9 percent increase, as well as a commendable 13.1 percent improvement in energy efficiency. 3M's commitment to sustainability is further demonstrated by the receipt of certifications such as ISO 50001 and SEP50001TM. [21]

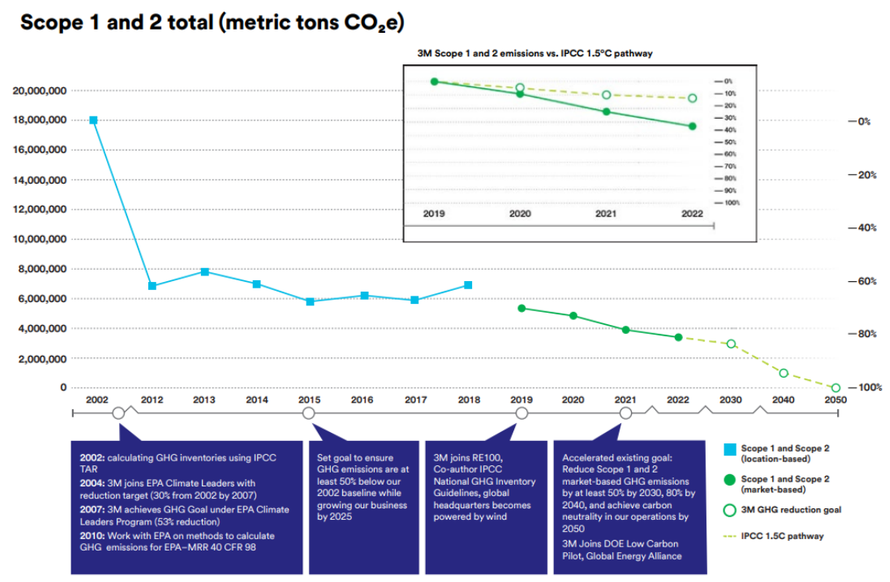

Figure 42: 3M's sustainability initiatives:

Conclusion: The Novia team wholeheartedly recommends Novia, 3M as a company for further product procurement. The company has demonstrated exemplary performance in sustainability practices. However, the team suggests reevaluating the usage of Post-Its and encourages minimizing their usage whenever possible. It is worth considering more sustainable alternatives to Post-Its. During brainstorming sessions, Post-Its are commonly employed, but there are viable substitutes available. For instance, Baptiste who is studying product development, utilizes the website Miro as a Post-It alternative. Miro offers a collaborative online whiteboard where teams can create virtual Post-Its. Baptiste has utilized this platform for brainstorming sessions, and below is an example of a board he created:

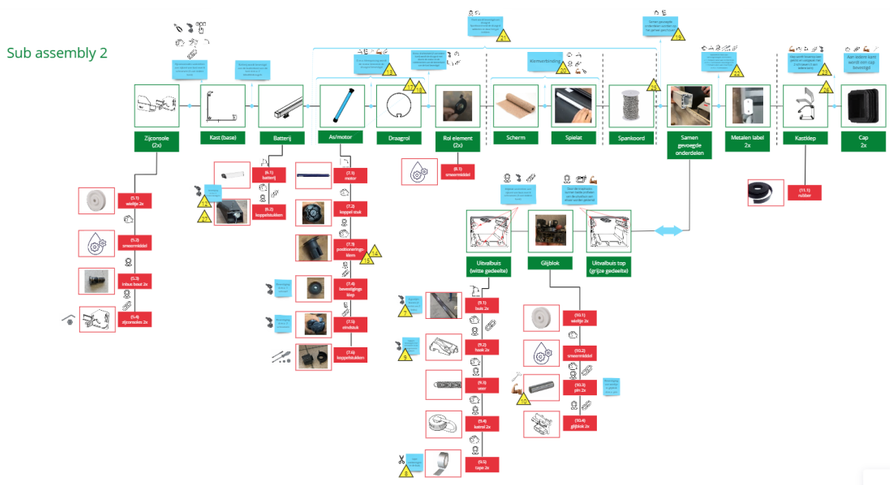

Figure 43: Baptiste his board

By exploring such alternatives, Novia can reduce its reliance on traditional paper-based Post-Its and contribute to a more sustainable approach to collaboration.

14.4.7 Etra OY

Etra OY is a Finnish technical trade specialist that provides a diverse range of industrial products and services to its customers. As a supplier and producer of industrial goods, their goal is to serve as a comprehensive partner by offering a wide array of products and services from a single source. They strive to foster strong relationships with both customers and suppliers, emphasizing mutual trust and collaboration. Etra OY believes that partnership involves developing operations and processes together, working towards shared interests and common goals. [22]

The company has a certificate for ISO 9001:2015 which it stands for quality and it has a report for this certification:

They also provide more certifications to be environmentally friendly as they have used the ISO 14001: 2015 Certification. The practices they implement are the following:

- Adherence to all applicable laws, standards, and regulations to ensure compliance.
- Take a closely monitoring of the amount of packaging waste and take measures to minimize its environmental impact.
- Investing in self solar power plants to increase the proportion of renewable energy in their operations.
- The company is dedicated to reducing CO_2 emissions by promoting virtual meetings, prioritizing low-emission vehicles, and ensuring regular maintenance of their partnership.

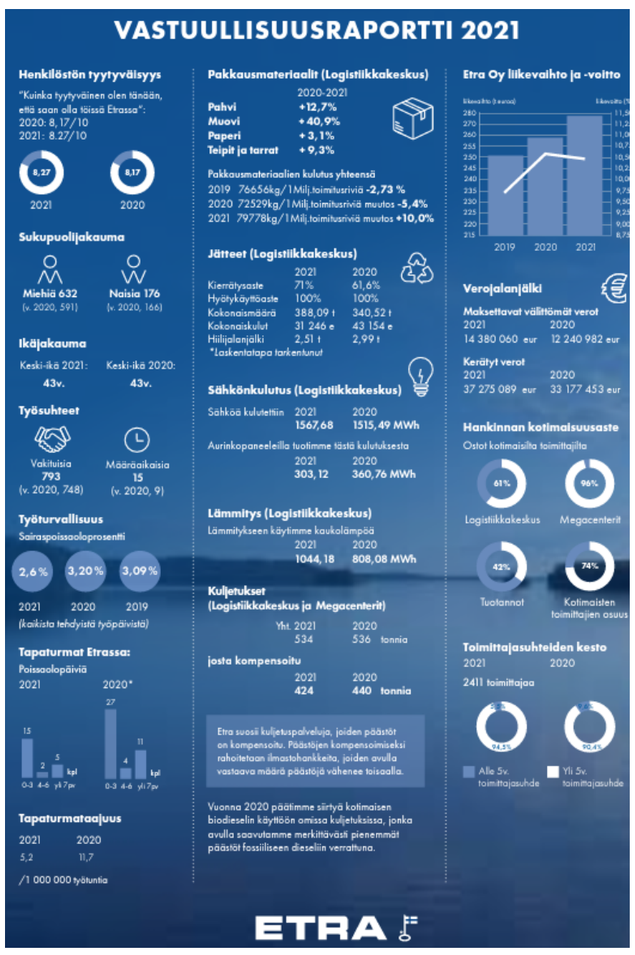

Figure 44: ETRA Sustainability Report

They also attend to Responsible Reporting and sustainability shown before including their CO_2 emissions, their consumption on their factories and other information. [22]

Conclusion: the company try to do their best in order to get a better world. As they have many reports about sustainability and the team recommend it to work further with this company doing good on those parts.

14.4.8 Erich Krause

On their webpage, there is no sustainable section available. The products manufactured by Erich Krause are renowned for their advanced technology and high quality worldwide. Many of the manufacturing locations are located in Hong

Kong, Panama, Finland, Spain, Bulgaria, Romania, Latvia, and Russia. [23]

The company values focus on their continuous development and designing products that enhance the consumer experience. Their main objectives include improving the quality of the final product and ensuring its environmental friendliness.

Erich Krause is deeply committed to prioritizing ecology and environmental protection in the design and creation of its products. The company actively advocates for the preservation of rainforests and other natural habitats, recognizing their crucial role in maintaining the health of our planet's ecosystems. To support this commitment, Erich Krause sources renewable cultivated wood from artificially planted trees for the production of various products, including pencils. [23]

Furthermore, the company actively seeks innovative eco-friendly materials and implements non-waste technologies to minimize environmental impact. They also demonstrate their dedication to sustainability by utilizing recycled materials for a significant portion of their packaging. [23]

Despite this information available on their website, there is no evidence of legal compliance. Additionally, they do not publish sustainability reports, which would provide insights into their environmental, social, and governance (ESG) practices and initiatives. [23]

In summary, Erich Krause does not seem to implement any sustainable actions in their company, indicating a lack of commitment to sustainable practices.

14.4.9 Lansas

Lanses is a Finnish company which is already positive because this means low emissions already go to transport. According to the company, their products are environmentally friendly. But just because a product is environmentally friendly does not mean it is sustainable and consumes little $C0_2$. [24]

Regrettably, the company's website does not provide any comprehensive reports regarding their sustainability initiatives or annual reports. Only a brief paragraph is found on their website, offering limited details about the company's environmental friendliness. However, it is worth noting that their products feature the ETRA ECO pictogram, indicating that they adhere to environmental friendliness standards. While the website lacks extensive information about their sustainability activities, the presence of the ETRA ECO pictogram implies a commitment to producing environmentally friendly products. [24]

Conclusion: As a team, it is our recommendation that Novia refrains from choosing Lansas as their supplier due to the insufficient amount of information available about the company. Consequently, an alternative company was sought to fulfill the requirement for biodegradable cleaners. After careful evaluation, our team highly recommends Biosolv as a suitable option for Novia's procurement needs.

Biosolv, the company makes carbon neutral solvent. The solvent was created as an environmentally safe solvent that would meet the stringent performance. The company is working hard on sustainability. [24]

14.4.10 Ajasto

There is not much information about it. On their website it shows at the bottom of their website that they have FSC certificate only. No further information other than this. aevertheless

Factory	Price	Most product bought	Certification	Webpage
GRANDE	818,4	Face Masks	EN 149:2001 standard	
Pilot	415,51	Pencils	ISO 14001 & EMAS	Sustainable section at their website; 4R; Indications of performance
Staedler Mars Lumograf	344,06	Pencils	ISO 9001. ISO 14001 & FSC. PEFC	Sustainable section at their website; Report
Ida	277,6	Notebook		
Priima	232,3	Paper	ISO 9001 & ISO 14001	"Environmental Certificates", Environmental Certificates"
Post-It	180,24	Post-It	ISO 9001. ISO 14001 GT. PEFC	Sustainable section at their website; Indications of performance; Video
Ekman System	153	Box	ISO 14001	Sustainable Actions
Wega	145,31	Calendar		
Sidor Open	114,64	Plastic Folder		
3M	110,4	Stationer Products	ISO 9001. ISO 14001 & ECO-VADIS. FTSE4Good. ISS ESG	Sustainable Section; Sustainable Actions

Table 6: 10 Most Expensive Short Term Products Factories

14.5 IT-discarded products

The IT-discarded products were not very easy to gain data for it. The first mail was sent to all the members of the IT-team of the University of Novia Vaasa on the 24 of February there still was no reply. Subsequent emails were sent on March 7th, March 13th, and March 17th of 2023, but the team still did not receive a reply.

March 24, the decision was made to visit the IT department in the building. The team had a good and interesting talk with one of the members of the IT department. The man explained what was happening with Novia's discarded IT products.

Every six years, the classrooms in the building undergo a complete overhaul, resulting in a significant amount of discarded IT products. While some of these products are donated to students and staff members who can still use them, approximately 30 computers are discarded each year. These IT products are subsequently stored in steel boxes located in a classroom adjacent to Novia's dining hall.

Figure 45: Picture of discarded products

The images depicted at the top exhibit the storage boxes utilized for housing the discarded IT products. Annually, the boxes are collected by the company Kuusakoski, prompting the team to conduct research on the procedures implemented by the aforementioned organization in handling the products. The ensuing paragraphs expound on the pertinent findings regarding the company. Recycling Company

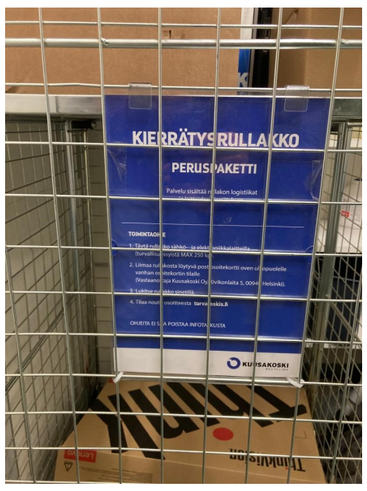

Figure 46: Picture of discarded products

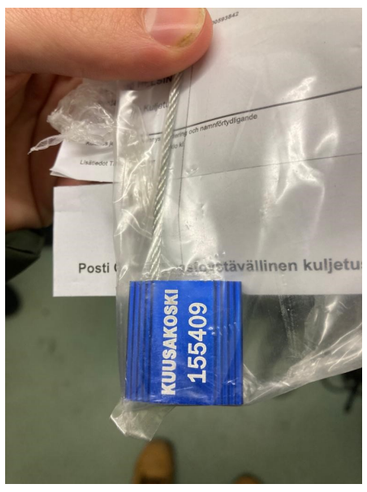

Figure 47: Picture of discarded products

The first step in the butterfly model is reusing the products before they are recycled. This is also something Kuusakoski does. The products that still work are reused. The person or company receives compensation for these products. In addition, all data from that product are carefully removed so that no privacy issues can arise. [25]

Even for the products being destroyed, care is always taken to ensure that the dates of the appliances are safely destroyed. [25]

For the broken IT products, both coated metal fractions, production sediments and precious metals are recycled. Thus, precious metals such as gold, silver, palladium, platinum and rhodium are manufactured from liquid and solid materials into a recycled raw material and sold to customers. [25]

Research has shown that Kuusakoski is a very good company to recycle discarded electronic products. So Novia is doing very well to cooperate with this company. [25]

It was decided with the team that the discarded products will not be looked into too deeply and will not look too much for a strategy for Novia because it is already being done really well. [25]

A recommendation for the university is to consider incorporating the utilization of discarded products in its educational practices. One feasible approach would be to organize practical classes encompassing various disciplines such as product design, economics, electrical engineering, and mechanics. Through collaborative teamwork, students would explore innovative ways to repurpose components and reconstruct them into new products. This interdisciplinary approach not only promotes cooperation among students from diverse backgrounds, but also fosters cross-disciplinary learning. Moreover, implementing such practices would contribute positively to Novia University's carbon footprint by reducing CO2 emissions. Additionally, Novia students, regardless of their respective fields of study, would gain insights into the principles of the circular economy. By incorporating discarded IT-products into educational activities, these items can be either refurbished or repurposed in a meaningful manner. It is suggested that this initiative be offered as an optional subject to provide students with the opportunity to actively participate in this educational endeavor.

15 Travel information

The acquisition of travel information posed a challenge. The team was only provided with data from 26/04/2022, which included the total number of trips made by the University of Novia in Vaasa, as well as the corresponding cities. These journeys involved personnel from Alere, Technobothnia, and W33 in Novia, Vaasa.

However, the team lacked information on intermediate stops taken en route to the final destination, except for travel to Zambia and Villa Nova. Although the team requested additional information on the matter, no response was received. Consequently, an alternative method, namely Google flights, was used to identify intermediate stops by selecting flights with minimal stopovers. It is uncertain whether the travellers utilized this method, but decisions had to be made.

Another crucial piece of information that remains uncertain is whether the travelers used a train or a plane to travel from Vaasa to Helsinki. To address this, the team will initially compute the emissions resulting from traveling between Vaasa and Helsinki via train, plane, and bus.

Calculations always include the return trip. The calculations are made with this website [26]. A website was recommended by Biniam, the team coach in this project. For aircraft, airports had to be selected and the calculator then indicated how much emission it took. For trips done by bus or train, it was needed to give the number of km between the two places. The number of km was found via Google Maps.

Figure 48: European travels places that Novia Vaasa has done in 2022. In the link below there is a possibility to see all the destinations of the Novia Vaasa travels in 2022.

https://www.google.com/maps/d/edit?mid=1Yu9g4LobKCMM5SZtFRjLT4V2hMpjUoI&ll=2.2466978448623465%2C0&z=2

Vaasa – Helsinki plane

0.10 tonnes:	Economy class direct return flight from VAA to HEL

Vaasa – Helsinki Train

0.03 tonnes:	880 km travelled by national rail

Vaasa – Helsinki bus

0.08 tonnes: :	880 km travelled by bus

Different between train and plane from Vaasa to Helsinki
The plane to Vaasa takes more than 3 times more CO2 than a train.

15.1 23 Trips to Sweden

For transport to Stockholm, there were two options: bus and ferry or train and ferry (via Turku). Meanwhile, the journey to Umeå was made by ferry. As part of the analysis, the feasibility of using both trains and buses for transport to Stockholm will be investigated.

It was not possible to use [26] to calculate CO_2 emissions for ferry trips, as there were no specific calculations available. Consequently, finding the correct CO2 emissions for ferry travel was challenging. Initially, the team attempted to utilize the Excel document 'Slutlig fil NOVIA AMKin hiilijalanjälkilaskuri-2021' received on March 3, 2023, which contains CO2 calculations for the entire Novia

University for 2021. The sheet 'Matkustaminen' in the document provides information on how they compute ferry travel. However, the calculations based on this method resulted in odd outcomes.

It's 192 km to go from Vaasa to Umeå and back

Time travel ferry: 4h 17 minutes -> 4,28 h

-> need in hkm: 4,28h *192 km= 821.76 hkm

-> 2 going and returning: 1643,52 hkm

Then the data was put into the excel -> result: 0.284 tonnes

It's more than plane what is not possible.

This is the data that is needed to make the calculation

So the team made a decision to look for another way to calculate the Ferry CO_2. The team will do the next calculations based on way that comes from trustcarbon.com. This is a website made by the government of the UK where there is information that shows how to calculate ferry trips written by Ellen West.

This are the steps:

1. First there will be look for the distance that the ferry has to do. The boats never go in a straight line. To know the specific website the team used [27]. So the team can find the specific distance the boat did in nautical miles.

2. Convert miles into km

3. Multiply with 0.01874 kg

The calculations in Sweden can be seen below.

3 destinations via ARN: 1.73 tonnes

3 destinations via HEL: 1.87 tonnes

-> **Skellefteå:** 3 Via ARN: 0,85t Via HEL: 0,73t

-> **Kalmar:** 3 Via ARN: 0,65t Via HEL: 0,84t

-> **Borås:** 1 Via ARN: 0,23t Via HEL: 0,32t

-> **Stockholm:** 7

Total: Train+ Fery situation: 2.139 tonnes

Total: bus + fery situation: 2.419tonnes

Train: Vaasa -> Turku: 330 km

0.01 tonnes:	330 km travelled by national rail

Bus: Vaasa -> Turku: 330 km

0.03 tonnes:	330 km travelled by bus

Turku -> helsinki by ferry

1. looking how many miles it is from Vaasa to Umeå with the website: 175 nautical miles
2. 78 nautical miles = 281.6 km
3. 2 times because traveler have to return: 563.2 km

563.2 Km* 0.01874 kg = 10.55 kg= 0.0155 tonnes

The data and how the ferry calculations were done were shown to the team coach at a weekly meeting. It was advised to look for more specific information. The team called Viking line and also sent an e-mail to them with the aim of knowing the CO2 emissions of trips from Turku to Stockholm. At the meeting afterwards, the decision was taken with the team coach that the results from before will used ass final result, namely 0.0155 tonnes.

-> Umeå: 9–> 0.486 tonnes
Calculation:

1. looking how many miles it is from Vaasa to Umeå with the website: 78 nautical miles
2. 78 nautical miles = 125,5 km
3. 2 times because traveler have to return: 251 km

251 Km* 0.01874 kg = 4.70 kg= 0.0047 tonnes

9 times to Umeå: 0.0423 tonnes

As already discussed, the team started looking for more specific information on the recommendation of the team coach. This included calling Wasaline and sending an e-mail. Wasaline did help well, it sent an email back a few days with the to CO_2 emissions for a trip from Vaasa To Umea. This was 0,006 tonnes, it is a litle bit more then the calculations but quite close.

=0,006 tonnes

9 times to Umeå * 0.054 tonnes= 0.486 tonnes

15.2 9 to Germany –> Total CO_2 from Helsinki to: 6.4 tonnes

15.2.1 -> Wismar 2

Helsinki -> Hamburg:

0.66 tonnes:	2 x Economy class direct return flight from HEM to HAM

Hamburg -> Wismar: 130 km

0.02 tonnes:	520 km travelled by national rail	2 x return Hamburg Wismar

Total: 0.68 tonnes

15.2.2 -> Bremen

Helsinki -> Hamburg

0.33 tonnes:	Economy class direct return flight from HEL to HAM

Hamburg -> Bremen: 119 km

0.01 tonnes:	238 km travelled by national rail

Total: 0.34 tonnes

15.2.3 -> Kiel

Helsinki -> Hamburg

0.01 tonnes:	238 km travelled by national rail

Hamburg -> Kiel : 108 km

0.01 tonnes:	216 km travelled by national rail

Total: 0.34 tonnes

15.2.4 -> Aachen: 2

Helsinki -> Dusseldorf

0.85 tonnes:	2 x Economy class direct return flight from HEL to DUS

Dusseldorf -> Aachen :100 km

0.02 tonnes:	400 miles travelled by national rail

Total: 0.87 tonnes

15.2.5 -> Berlin: 3

Helsinki -> Berlin

0.97 tonnes:	3 x Economy class direct return flight from HEL to BER

Total: 0.97 tonnes

15.3 4 to Denmark –> Total CO_2 from Helsinki to: 1.03 tonnes

15.3.1 -> Odense 3

Helsinki -> Kastrup (Copenhagen airport)

0.75 tonnes:	3 x Economy class direct return flight from HEL to CPH

Kastrup-> Odense: 164 km

0.03 tonnes:	984 km travelled by national rail	3 times

15.3.2 -> Copenhagen

Helsinki -> copenhagen

0.25 tonnes:	Economy class direct return flight from HEL to CPH

15.4 4 to Norway –> Total CO_2 from helsinki to: 0.89 tonnes

15.4.1 -> Oslo

-> Helsinki-> Oslo: 4

0.89 tonnes:	4 x Economy class direct return flight from HEL to XZO

15.5 3 to Austria –> Total CO_2 from helsinki to: 1.28 tonnes

15.5.1 -> Wels 3

Helsinki -> Vienna

1.23 tonnes:	3 x Economy class direct return flight from HEL to VIE

Vienna- > Wels: 214 km

0.05 tonnes:	1284 km travelled by national rail	3 times

15.6 3 to UK –> Total CO2 from helsinki to: 2.48 tonnes

15.6.1 -> Glasgow 3

Helsinki -> London

1.65 tonnes:	3 x Economy class direct return flight from HEL to LCY

London -> Glasgow

0.83 tonnes:	3 x Economy class direct return flight from HEL to LCY

15.7 3 to Spain –> Total CO_2 from Helsinki to: 2.32 tonnes

15.7.1 ->Valencia

Helsinki -> Berlin

0.32 tonnes:	Economy class direct return flight from HEL to BER

Berlin -> Velencia

0.50 tonnes:	Economy class direct return flight from GWW to VLC

Total travel: 0.82 tonnes

15.7.2 -> Lleida

Helsinki -> Barcelona

0.74 tonnes:	Economy class direct return flight from HEL to BCN

Barcelona -> LIeida: 157 km

0.01 tonnes:	314 km travelled by national rail

Total: 0.75 tonnes

15.7.3 -> Vilanova i la Geltrú

Helsinki -> Barcelona

0.74 tonnes:	Economy class direct return flight from HEL to BCN

Barcelona -> Vilanova i la Geltrú: 35.8 km

Total: 0.74 tonnes

15.8 2 to Belgium –> Total CO2 from helsinki to: 0.93 tonnes

15.8.1 -> Brussels

Helsinki -> Brussels

0.93 tonnes:	2 x Economy class direct return flight from HEL to BRU

15.9 2 to Portugal –> Total CO_2 from helsinki to: 1.91 tonnes

15.9.1 -> Lisbon

Helsinki -> Lisbon

1.89 tonnes:	2 x Economy class direct return flight from HEL to LIS

Lisbon -> Leiria: 126 km

0.02 tonnes:	504 km travelled by national rail

15.10 2 to Latvia Total CO_2 from helsinki to: 0.22 tonnes

15.10.1 -> Riga

Helsinki -> Riga

0.22 tonnes:	2 x Economy class direct return flight from HEL to RIX

15.11 2 to Netherlands total CO2 from helsinki to: 0.86 tonnes

15.11.1 -> Breda

Helsinki -> Amsterdam

0.42 tonnes:	Economy class direct return flight from HEL to ZYA

Amsterdam Schiphol -> Breda :110 km

0.01 tonnes:	220 km travelled by national rail

Total: 0.43 tonnes

15.11.2 -> Enschede

Helsinki -> Amsterdam

0.42 tonnes:	Economy class direct return flight from HEL to ZYA

Amsterdam Schiphol -> Enschede: 173 km

0.01 tonnes:	346 km travelled by national rail

Total: 0.43 tonnes

15.12 1 to Chile total CO2 from helsinki to: 4.46 tonnes

15.12.1 -> Punta Arenas

Helsinki -> Madrid

0.83 tonnes:	Economy class direct return flight from HEL to MAD

Madrid -> Santiago

3.02 tonnes:	Economy class direct return flight from MAD to SCL

Santiago -> Punta Arenas

0.61 tonnes:	Economy class direct return flight from SCL to PUQ

15.13 1 to Italy total CO2 from Helsinki to: 0.71 tonnes

The top 4 fights on Google flight are Helsinki -> Munich -> Bari

So there is a very big chance that this happened.

Helsinki -> Munich

0.45 tonnes:	Economy class direct return flight from HEL to ZMU

Munich -> Baria

0.25 tonnes:	Economy class direct return flight from ZMU to BRI

Baria -> Foggia: 125 km

0.01 tonnes:	250 km travelled by national rail

15.14 1 to France total CO_2 from Helsinki to: 0.54 tonnes

Helsinki -> Paris

0.54 tonnes:	Economy class direct return flight from HEL to PAR

15.15 1 to North Macedonia total CO2 from Helsinki to: 0.95 tonnes

For this travel there are more possibilities but the biggest chance is that the traveler took this trip because it is the only trip with only one flight stop. The other possible flights has more stops.

Helsinki -> Frankfurt

0.45 tonnes:	Economy class direct return flight from HEL to HHN

Frankfurt -> Skopje

0.40 tonnes:	Economy class direct return flight from HHN to SKP

15.16 1 to Zambia total CO2 from Helsinki to: 1.86 tonnes

Going Helsinki -> Doha ->Lusaka

Going back Lusaka -> Doha-> Copenhagen -> Stockholm -> Helsinki

Going

Helsinki -> Doha

0.62 tonnes:	Economy class direct one way flight from HEM to DOH

Doha -> Lusaka

0.73 tonnes:	Economy class direct one way flight from DOH to LUN

Going: 1.35 tonnes

Going back:

Lusaka -> Doha

0.73 tonnes:	Economy class direct one way flight from LUN to DOH

Doha -> Copenhagen

0.65 tonnes:	Economy class direct one way flight from DOH to CPH

Copenhagen -¿ Stockholm

0.07 tonnes:	Economy class direct one way flight from CPH to STO

Stockholm -> Helsinki

0.06 tonnes:	Economy class direct one way flight from STO to HEL

Going back: 1.51 tonnes

15.17 1 to Lithuania total CO2 from Helsinki to: 0.27 tonnes

Helsinki -> Vilnius

0.26 tonnes:	Economy class direct return flight from VAA to KUN

Vilnius -> Kaunas: 103 km

0.01 tonnes:	203 km travelled by national rail

15.18 1 to Indonesia total CO_2 from Helsinki to: 1.824 tonnes

Helsinki-> Banjarmasin

This is a long trip with a lot of different possible ways. On Google flight there are more than 10 alternatives. On google maps it's possible to see how many CO_2 every trip takes. So for this situation the team will calculate this in another way. The CO_2 for one trips to Banjarmasin is always between 800 and 1060 kg CO_2. Here, the team decided to work with the average.

Calculation: (801 kg CO_2 + 1060 kg CO_2+ 1060 kg CO_2 + 845 kg CO_2 + 900 kg CO_2 + 819 kg CO_2 + 949 kg CO_2 + 878 kg CO_2 + 976 kg CO_2 + 911 kg CO_2) / 10 = 919.9 kg CO2 = 0.912 tonnes

That means if you look for the returning to 1.824 tonnes

15.19 TOTAL CO2 travels in different situations

Total CO_2 from travels that took planes from Helsinki: 28.934 tonnes

There are in total 41 trips from Vaasa to Helsinki

41 planes with return to Vaasa -> <- Helsinki: 0.1 * 41 = 4.1 tonnes

41 buss with return to Vaasa -> <- Helsinki: 0.08* 41 = 3.28 tonnes

41 Trains with return to Vaasa -> <- Helsinki: 0.03* 41 = 1.23 tonnes

If all those travels would be by plane: 33.034 tonnes -> 12.4 % Helsinki -> <- Vaasa in comparing with the total emission

If all those travels would be by bus: 32.214 tonnes -> 9.82 % Helsinki -> <- Vaasa

If all those travels would be by train: 30.164 tonnes -> 4,08 % Helsinki -> <- Vaasa

The reasons the Swedish trips are excluded from the other trips is because all the other trips have taken planes from Helsinki and with Sweden it is all a bit more complicated. The Swedish calculations show 2 different totals. There were lots of different options, so the decision was made that there is a total of the lowest number of emissions added up and one of the highest number of emissions added up.

Highest possible emissions Sweden is 4.915 tonnes

Lowest possible emissions Sweden is 4.235 tonnes

15.20 Recommendation travel emissions:

In order to mitigate the impact of travel emissions, the university must implement measures to raise awareness among employees who frequently travel, regarding the significant contribution of CO_2 emissions to the environment.

Hence, the team has taken the decision to create a poster that presents a visual representation of travel-related CO_2 emissions in 2022, highlighting the differences in emissions by bus, train, ferry, and plane. Currently, employees have limited knowledge regarding the variance in emissions and the poster aims to enhance their awareness on this topic. The posters can be displayed within universities as an educational tool.

A second recommendation is that Novia can make a rule if it's more than a certain number of tonnes of emissions that the employee has to try to do the work that he is supposed to do in the country online from Vaasa. Because of covid everything is much easier to it online.

A third recommendation is that the university can develop a website to organise the trips. On this website, employees would input their desired destinations and the website would present multiple travel options for consideration. The travels can be a combination of train, bus, plane, fery. The options presented would include information on the estimated travel time, as well as the associated CO_2 emissions. Once the options have been evaluated and the desired trip has been selected, the website would display the total amount of CO_2 emissions for the selected itinerary. Additionally, an alternative itinerary with lower CO_2 emissions would be presented alongside the selected option, to encourage travellers to consider making more sustainable choices. This tool would help to raise awareness about the impact of travel-related CO_2 emissions and encourage employees to make more environmentally friendly travel decisions.

Here there is a visible example

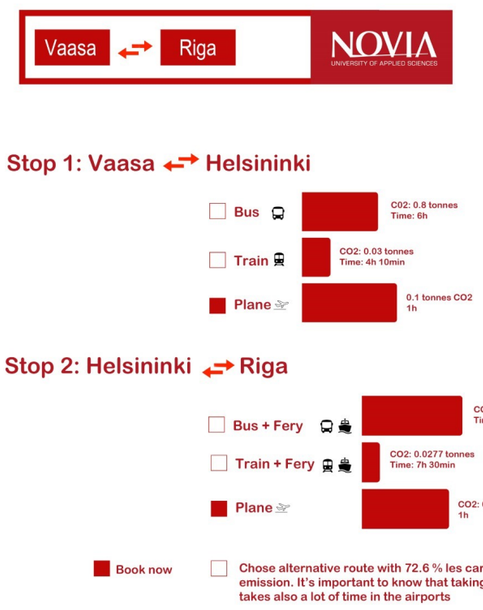

Figure 49: Example of a website that the team made

16 The model

16.1 Introduction

One of the goals of this project is making a model for the Wolffskavägen 33 building. To look for more sustainable solutions. This model should be simple enough so any employees at Novia could use it to calculate possible energy solutions on Novia its path to sustainability. The model will use data from February 2022 to February 2023 and will both look at the electrical and Heat consumption of Novia.

16.2 Energy consumption

One of Novia its goals is to be carbon neutral by 2030. Based on the energy consumption of the time period from February 2022 to February 2023 the model should be able to calculate possible energy solutions to decrease Novia its carbon footprint. To realise this, energy consumption form both heating and electricity are required. Also, the outside temperatures are required to calculate the effect of temperature on heating and to calculate possible heat pump efficiencies. To calculate the effect of solar panels the solar irradiation per square meter is required. It was decided to only look at this time frame because this should be the most recent corona-free year.

16.2.1 Energy Chart

The energy chart is in the shape of a Sankey diagram. Is a tool to visualise where the energy is coming from and what is using it. For this the sources of the energy that Novia is consuming are needed. Together with the products that are consuming the electricity of Novia. This last bit should be the most difficult part. Because this probably requires a lot of data comparisons.

16.2.2 Model

The model will look at a year of energy consumption at Novia. Then the model will make a calculation based on weather data and data from manufacturers of energy systems that are fit for Novia. This way the energy consumption, cost and emission of Novia should be calculated by investing in a certain energy system. Energy system that should be calculated by the model are: Heat pumps, solar panels and geothermal energy. Based on this information Novia could make better choices about where to go in the future.

To be able to make the model not only data such as outside temperatures, heating, electrical energy and irradiation data are required. But also technical information about sustainable energy systems from manufacturers. This is needed to calculate the expected energy savings of these sustainable energy systems.

16.3 Data received

16.3.1 Heating data

The heating data that was received is from the 1st of January 2018 at 00:00 until the 19th of February 2023 23:00. This is data from Wolffskavägen 33 building.

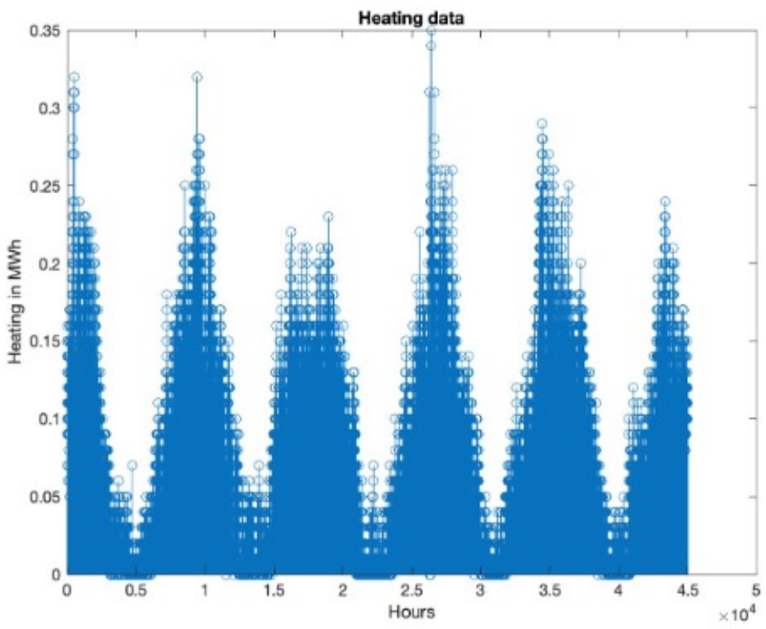

Figure 50: In this figure all the heating data that was received is shown

16.3.2 Electricity data

The electricity data that was received is from the 1st of January 2020 at 00:00 until the 20th of February 2023 at 03:00. But there are 80 hours of data missing. The missing data has been found and filled in with data of similar days.

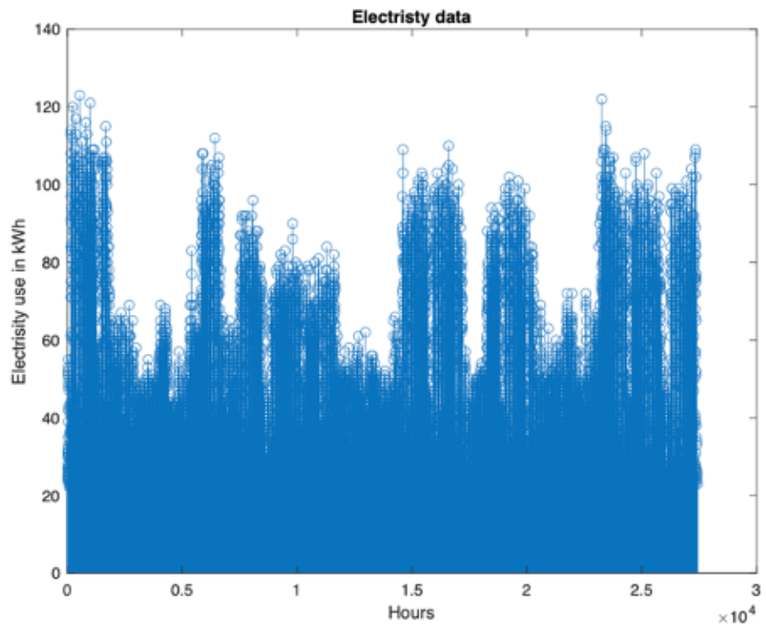

Figure 51: In this figure all the electric data that was received is shown

a scheduling of the one air filtration system machine was received. So, an evaluation of how much energy gets used up by the air system could be made, but what this air filtration unit consumes was not bet received. An interview to find out the scheduling of the kitchen was held. Cooking starts at 7:00-7:30 and stops between 12:00 and 14:30. This information could be used to analyze the energy usage of Novia.

16.3.3 Solar data

The solar irradiation data was downloaded from the Finnish Meteorological Institute [28] from the Jokioinen Ilmala station. Because Jokioinen Ilmala station seems to be within the region with similar solar irradiation as Vaasa. As gathered from articles about solar potential [29].

16.4 Model calculations

16.4.1 Solar panels

To do the proper calculation for solar panel output first the sun Angle should be calculated. After this is done it can be combined with the solar irradiation data from the Finnish meteorological center. The roof of the W33 building is 470 square meters. This information was gathered form the floor plans of the building.

The information about the solar panels it self are from the data sheet of LR554HABD solar panel of the company Longi [30]. This solar panel cost 269 euro [31].

16.4.2 Sun angle

$$LSTM = 15^{\circ}\Delta T_{GTM} \tag{1}$$

First the Local Standard Time Meridian is calculated as can be seen in equation 1. 15 degrees is the degree the sun shift every time zone. ΔT_{GTM} is the difference in between the Local Time (LT) to the Greenwich Mean Time (GMT) [32].

$$EoT = 9.87\sin(2B) - 7.53\cos(B) - 1.5\sin(B) \tag{2}$$

Where

$$B = \frac{360}{365}(d - 81) \tag{3}$$

In equation 2 the Equation of Time (EoT) is calculated as a function of B. B is calculated in equation 3 and it is dependent on d which is the day of the year with January 1st being d=1 [32].

$$TC = 4(Longitude - LSTM) + EoT \tag{4}$$

The Time Correction (TC) factor is calculated with equation 4. This is used to account for variation in Local Solar Time (LST) within a certain Local time zone. Where the 4 accounts for 1 degree of sun movement per 4 minutes [32].

$$LST = LT + \frac{TC}{60} \tag{5}$$

With equation 4 and the Local Time (LT) the Local Solar Time (LST) can be calculated. This is shown in equation 5 [32].

$$HRA = 15^{\circ}(LST - 12) \tag{6}$$

With LST determined the Hourly Time (HRA) can be calculated as shown in equation 6. The Hourly Angle is by definition 0° in the solar noon. The sun is moving away from the solar noon by 15° per hour. The (HRA) is negative in the morning and in the afternoon it becomes positive [32].

$$\delta = 23.45^{\circ}\sin[\frac{360}{365}(d - 81)] \tag{7}$$

Before the Azimuth can be calculated, the declination angle (δ) should be determent. This can be done with equation 7 [32].

$$\Theta = \arccos(\frac{\sin\delta\cos\phi - \cos\delta\sin\phi\cos(HRA)}{\cos\alpha}) \tag{8}$$

Now the azimuth (Θ) can be calculated with the elevation angle (α) from equation 9, the latitude ϕ and the declination angle (δ) form equation 7. This is can be seen in equation 8 [32].

$$\alpha = \arcsin[\sin\delta\sin\phi - \cos\delta\cos\phi\cos(HRA)] \tag{9}$$

$$S_{module} = S_{incident}[\cos\alpha\sin\beta\cos(\Psi - \Theta) + \sin\alpha\cos\beta] \tag{10}$$

Finely the solar irradiation that falls on the solar panel in W/m^2 can be calculated with equation 10. Where α is the elevation in degrees of the sun as calculated in equation 9. Where Θ is the azimuth of the sun in degrees as calculated in equation 8. β is the tilt of the solar panel which is the angle with the ground. and Ψ is the panels azimuth which is the direction the solar panel is pointed. [32].

$$P = n\eta AS_{module} \tag{11}$$

When the solar irradiation is determent the actual electricity output of the solar panel can be calculated with equation 11. Where (A) is the surface of the solar panel in m^2 and (η) is the efficiency of the solar panel. (n) is the number of solar panels.

16.4.3 Heat pump

$$COP = \frac{1}{1 - T_L/T_H} \tag{12}$$

As can be seen in equation 12 the Coefficient Of Performance (COP) is dependent on how high/low the source heat (T_L) and the wanted temperature (T_H). Equation 12 is for a completely reversible heat pump [33]. In practice no heat pump will be completely reversible because there are almost always processes where energy is lost. Luckily most manufacturers of heat pumps should have experimentally determent the COP values, an example can be seen in figure 52. Together with the COP the TC (Total Capacity) is also given.

◆ **ZHBW166A1 [HM161MR U34] / ZHBW168A1 [HM163MR U34]**

Outdoor Temperature [°C DB]	Water flow rate 46.0 LPM								Water flow rate 28.8 LPM				Water flow rate 23.0 LPM			
	LWT 30 °C		LWT 35 °C		LWT 40 °C		LWT 45 °C		LWT 50 °C		LWT 55 °C		LWT 60 °C		LWT 65 °C	
	TC	COP	TC	COP	TC	COP	TC	COP	TC	COP	TC	COP	TC	COP	TC	COP
-25	10.50	1.96	10.50	1.84	10.50	1.72	10.50	1.60								
-20	13.25	2.48	13.25	2.32	13.25	2.15	13.25	1.98	12.59	1.82						
-15	16.00	2.71	14.40	2.45	14.40	2.41	14.40	2.37	13.68	2.16	13.68	1.94				
-7	16.00	3.46	16.00	3.27	16.00	3.13	16.00	2.98	16.00	2.70	16.00	2.41	16.00	2.12		
-4	16.00	3.75	16.00	3.58	16.00	3.40	16.00	3.22	16.00	2.90	16.00	2.58	16.00	2.27	16.00	1.95
-2	16.00	4.16	16.00	3.78	16.00	3.58	16.00	3.38	16.00	3.05	16.00	2.72	16.00	2.38	16.00	2.05
2	16.00	4.57	16.00	4.19	16.00	3.95	16.00	3.71	16.00	3.35	16.00	2.98	16.00	2.62	16.00	2.25
7	16.00	5.08	16.00	4.70	16.00	4.41	16.00	4.13	16.00	3.72	16.00	3.31	16.00	2.91	16.00	2.50
10	16.00	5.67	16.00	5.24	16.00	4.80	16.00	4.37	16.00	3.94	16.00	3.51	16.00	3.08	16.00	2.65
15	16.00	6.20	16.00	5.73	16.00	5.26	16.00	4.79	16.00	4.32	16.00	3.84	16.00	3.37	16.00	2.90
18	16.00	6.52	16.00	6.03	16.00	5.53	16.00	5.04	16.00	4.54	16.00	4.04	16.00	3.55	16.00	3.05
20	16.00	6.74	16.00	6.23	16.00	5.71	16.00	5.20	16.00	4.69	16.00	4.18	16.00	3.66	16.00	3.15
35	16.00	8.35	16.00	7.71	16.00	7.08	16.00	6.44	16.00	5.81	16.00	5.17	16.00	4.54	16.00	3.90

Figure 52: COP table with out door temperatures and LTW (Leaving Temperature Water) [34]

This data can be fitted with multi polynomial regression to equation 13 for further calculation. Then the COP value dependent on the outside temperature and Leaving Temperature of the Water can be determent. Together with the outside temperature this should be enough to estimate how well heat pump preforms in the conditions from Feb 2022 to Feb 2023.

$$b_1 + b_2 T_{outside} + b_3 LTW + b_4 T_{outside}^2 + b_5 LTW^2 + b_6 T_{outside} LTW \tag{13}$$

16.4.4 Battery

In the case that there is too much energy generated from the solar panels. A battery could be used to store this electricity. This would not only make sure that the electricity that is consumed will be from any source that does not produce any CO_2 emission. But also will you do not need to sell and buy back the electricity at a negative rate. So there are also economic reasons.

To make sure that the data model is correct for any input an example battery was chosen to calculate with. This is the Tesla PowerWall. This battery has 13.5 kWh of storage, a 0.90 round trip efficiency and a maximum charging/discharging rate of 5 kWh [35].

If and else statements were used to simulate the battery performance. These if and else statements make sure that the maximum amount of in/outgoing electricity is not overtaken. And that the battery does not store more energy then its maximum capacity. The battery should also work as a battery is supposed to work. So the battery should have a certain efficiency and it should charge when there is more electricity available then is consumed and discharge when there is electricity needed.

16.4.5 Cost analysis

Electricity cost
Because electricity has different costs depending on when it is consumed. Between the 7:00:00 to 21:00:00 the cost is 12.71 cents per kWh. From 22:00:00 to 06:00:00 the cost is 11.13 cent per kWh. Also the investment cost is taken into account. These are added in the first hour of the new situation.

Heating cost
The cost of heating is 58.48 euro/MWh this is not dependent on time. This is with tax. This is also, with the green option, which makes is more expensive. This option is makes the heating emission 0 g/kWh.

16.4.6 Carbon emissions

Here the data that is used to estimate the emission form heating and electricity use are given.
Electricity emissions
The emissions of the electricity is 148 g/kWh [36].

Heating emissions
The emissions of the Heating are a bit more difficult to evaluate. Because Novia has a contract with the green option. This would mean that the heating would have an emission of 0 g/kWh. But how can a company assure that a kW of energy is truly 100% green with no emission. That depends on the source of the heating energy. And the emissions caused by the company per kWh is 109 g/kWh [37]. This number is taken because that is the more accurate number to evaluate.

16.5 Result

In this section the results from the model are shown.

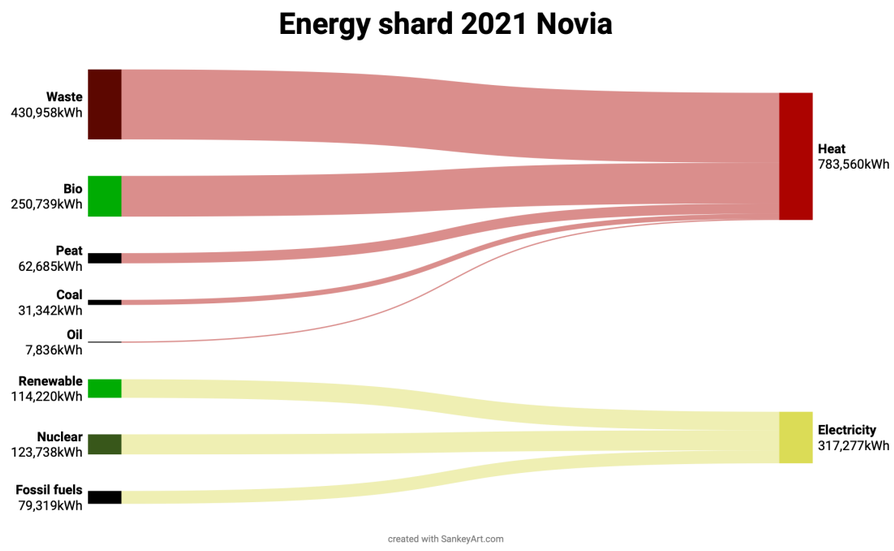

Figure 53: Sankey diagram of where the energy of Novia comes from

In figure 53 the sources of the Novia's energy can be seen.

16.5.1 Solar power

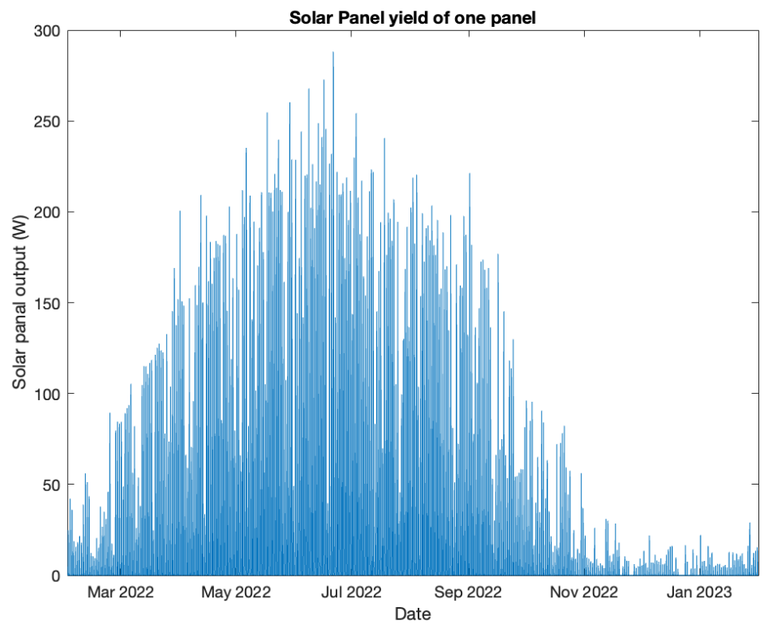

Figure 54: This is the power output of one solar panel in one year with a 45 degree tilt

In figure 54 and in figure 55 the solar yield in a year of a solar panel are shown. This is with a tilt of 45 and 30 degrees respectfully. The panels azimuth are both 180 degrees (pointing south). The difference in the figure are quite small. Only when making a summation of the in tire year the power gain of the solar panel can be seen.

$30° = 49\ 515\ 000$ (W/year)

$35° = 50\ 331\ 000$ (W/year)

$40° = 50\ 788\ 000$ (W/year)

$45° = 50\ 908\ 000$ (W/year)

Because Vaasa is so far north an option to put the solar panels on a 90 degree tilt might actually be economically feasible. First, the degree to which the walls are pointing where measured with a mobile phone. these where South western wall point to 239 degrees azimuth. And the south eastern wall point to 132 degrees azimuth. Putting this into the model the figures 56 & 57. As can be seen in the figures the south-eastern wall has a better Solar power output. It is about 4 times higher then the northern wall outputs. Also the solar power output in the autumn and spring are a bid higher then the solar panel that is pointing exactly south and a 45 degree Tilt (figure 54).

16.5.2 Heat pump

First the multi-polynomial regression was done on the COP value gained from figure 52. Because there is data missing from the figure from LWT values that exceed 50 degrees Celsius. It was decided not to include those data point. In figure 58 the evaluated line are shown together with the data points. b_1 to b_6 are shown below.

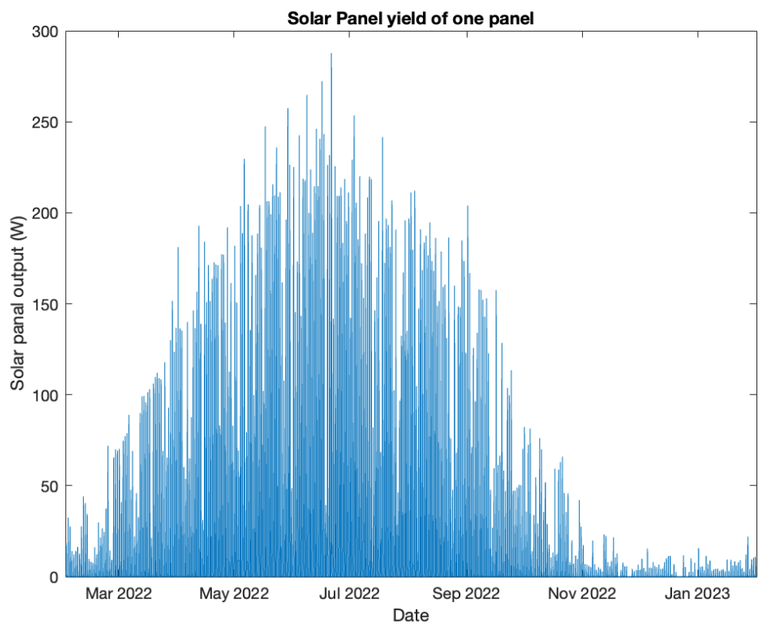

Figure 55: This is the power output of one solar panel in one year with a 30 degree tilt

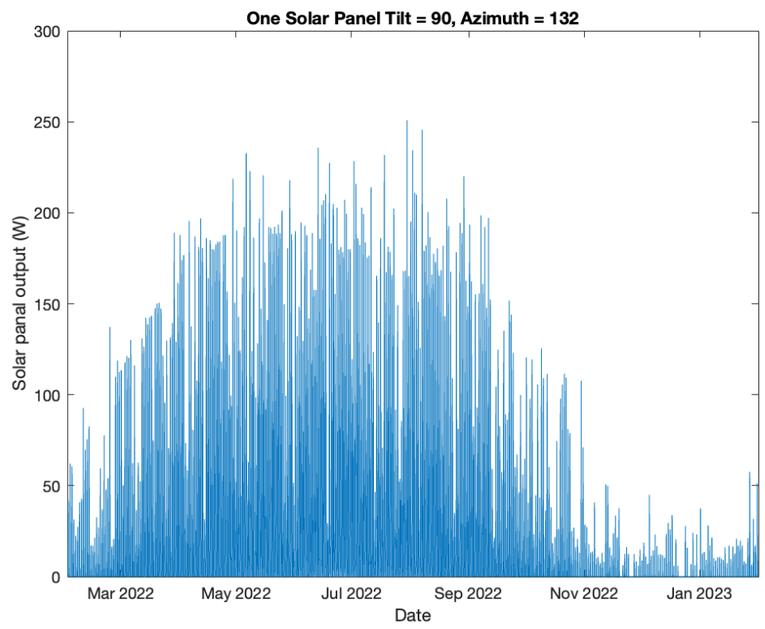

Figure 57: Solar Panel output if the solar panel is on a 90 degree tilt and on the south-east wall

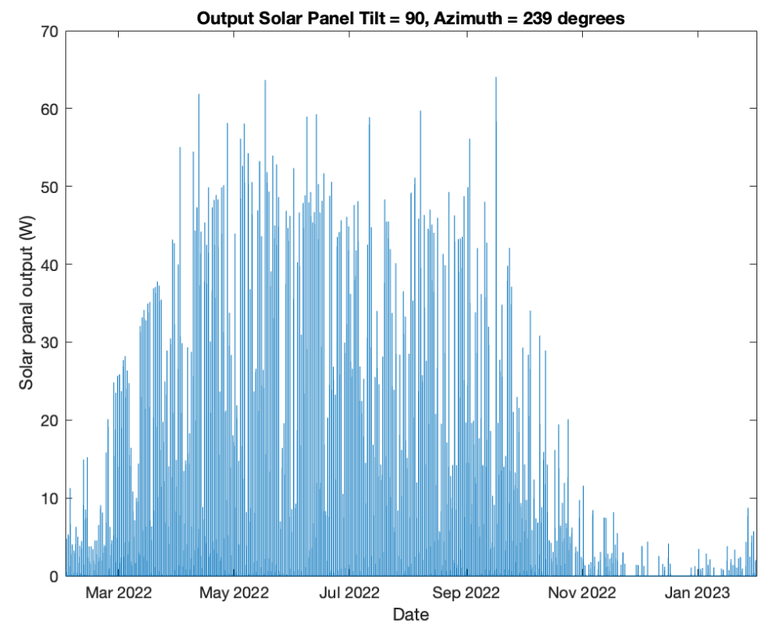

Figure 56: Solar Panel output if the solar panel is on a 90 degree tilt and on the south-west wall

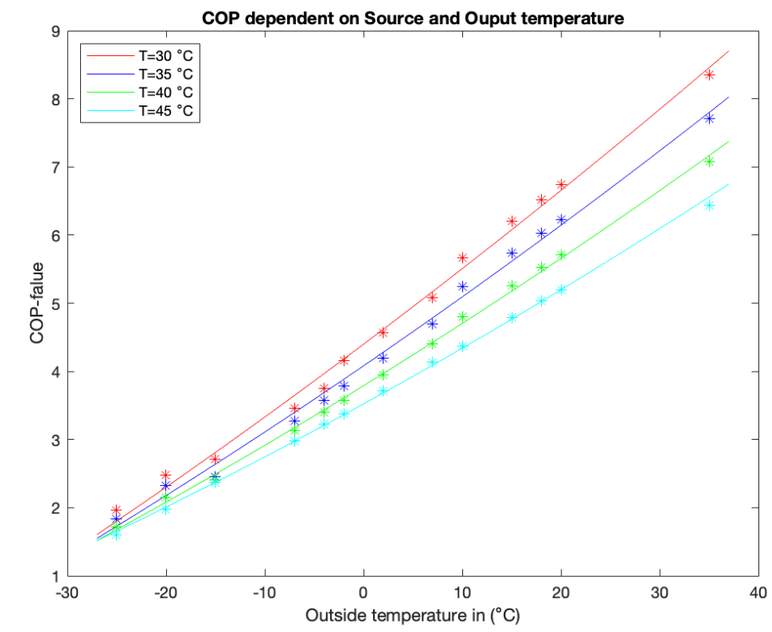

Figure 58: Here the data point together with the evaluated function are shown.

b_1 = 6.8362

b_2 = 0.1671

b_3 = -0.0965

b_4 = 0.0002

b_5 = 0.0005

b_6 = -0.0019

In figure 59 the difference in heating cost is show. In red is the heating from the heating network and in blue the electrical energy from the heat pump is shown. Novia would need 9 heat pumps to fully heat the W33 building with heat pumps.

16.5.3 Battery

To test if the battery does what it is supposed to. The number of solar panels was set to 3000 so there was way too much electricity generated. The battery number was put to 50. This means that there is a total capacity of 50 times 13.5 is 675 kWh. This should mean that there is no electricity consumed from the electricity network and only exes electricity. This can be seen in figure 60. There is no energy consumed because the battery will discharge at night. In the day when there is a huge access the electrify consumption is negative.

To check if the battery is operating as it should a plot was made of the capacity of the battery in time. With 3000 solar panels for electricity generation. The plot is shown in figure 61. As can be seen the data point at 5 kWh and 10 kWh is from the maximum charging rate when it charging. The battery will go from 0 kWh charge to 5 kWh. Or go from 5 kWh to 10 kWh. There are also a lot of data points at 13.5 kWh. This is to be expected because this is the maximum capacity of the battery. At 3.5 kWh and 8.5 kWh there are many data points because this is from the discharging of the battery. Figure 61 shows that the battery abides by the batteries limitations.

One of the questions is how can Novia be CO_2 neutral. One way of doing this is solar panels with batteries and heat pumps. But how many of these would Novia need? Novia would need to have 2260 solar panels at 45 degrees Tilt pointing south to produce more electricity than that it consumes. Together with 18346 batteries. This is not feasible. There is most likely not even enough space in the in tire building to fit more then 18000 battery.

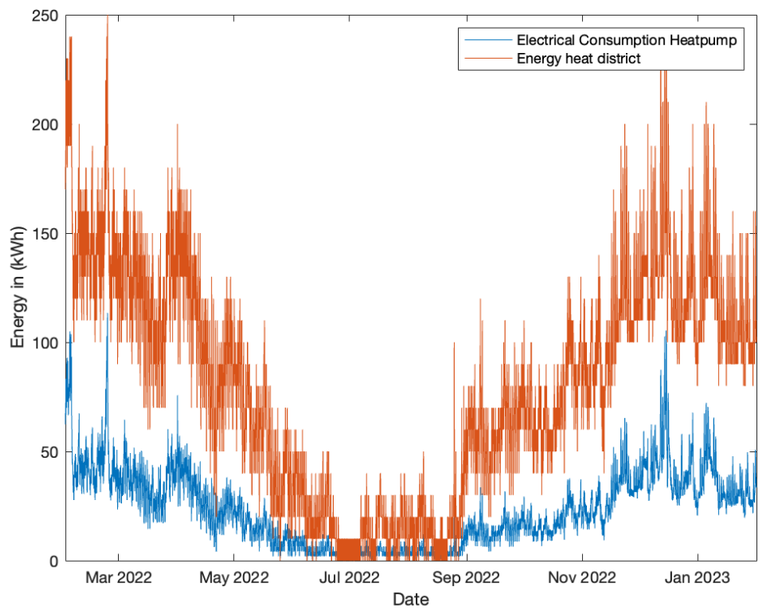

Figure 59: Here the difference of the consumption between the heat pump and the district heating.

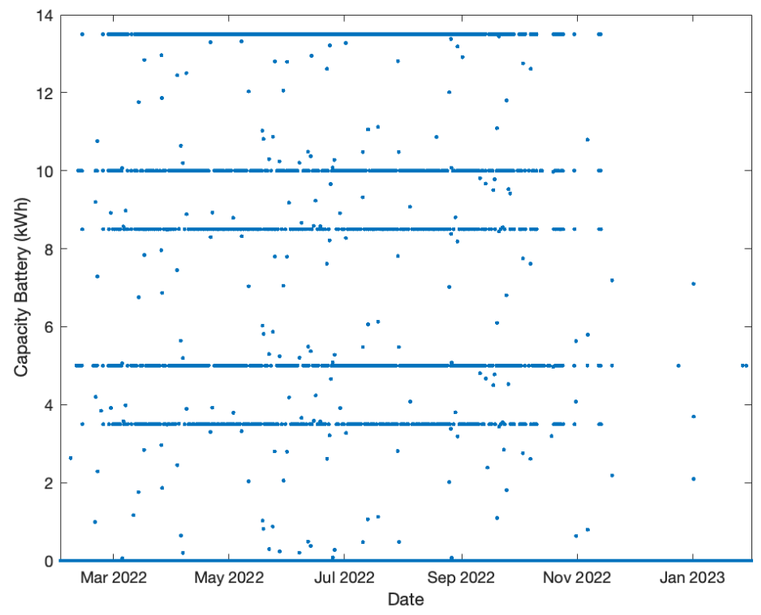

Figure 61: Here the capacity of the battery is shown on every hour of every day

Figure 60: Here the electricity consumption with 3000 solar panels and 50 batteries are shown.

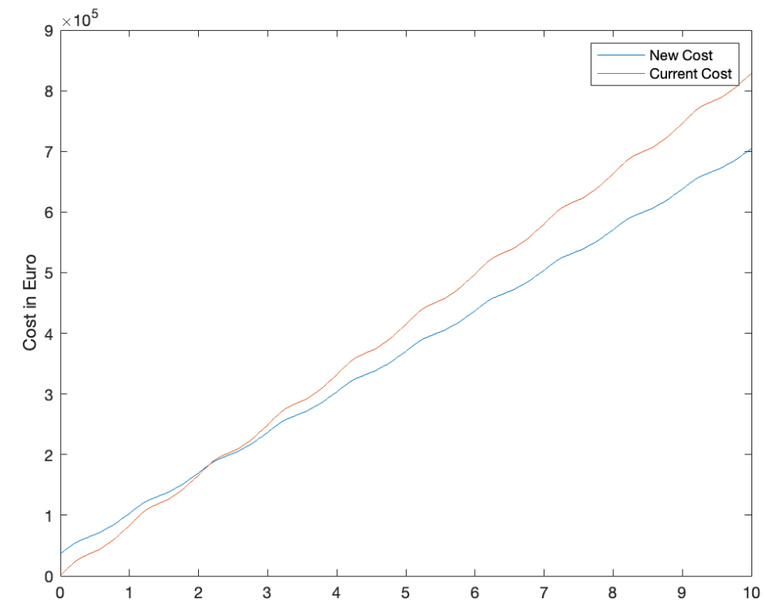

Figure 62: Caption

16.5.4 Cost

In figure 62 the payback time can be seen if Novia would invest in 9 heat pumps. The payback time would be about 2 years.

In figure 63 the investment cost and savings of 50 solar panels with 90 degree tilt and a azimuth of 132 degrees are shown. As can be seen this does not seem to be a great investment. The solar panels with a 45 degree tilt pointing south do not preform much better.

When 5 batteries with 200 solar panels the payback time seems even worse with it also not paid back in 10 years (figure 64). Here the solar panels at a tilt of 45 degrees and azimuth of 180 degrees were chosen because these is the most effective angles for solar panels with the highest yield. So the battery has more chance to save excess electricity.

16.5.5 Emissions

The emission from the heating pump relative from the emission from the district heating. In figure 65 the emission caused by the heating district and the heating pump is shown. As can be seen the heat pump causes less CO_2 emissions.

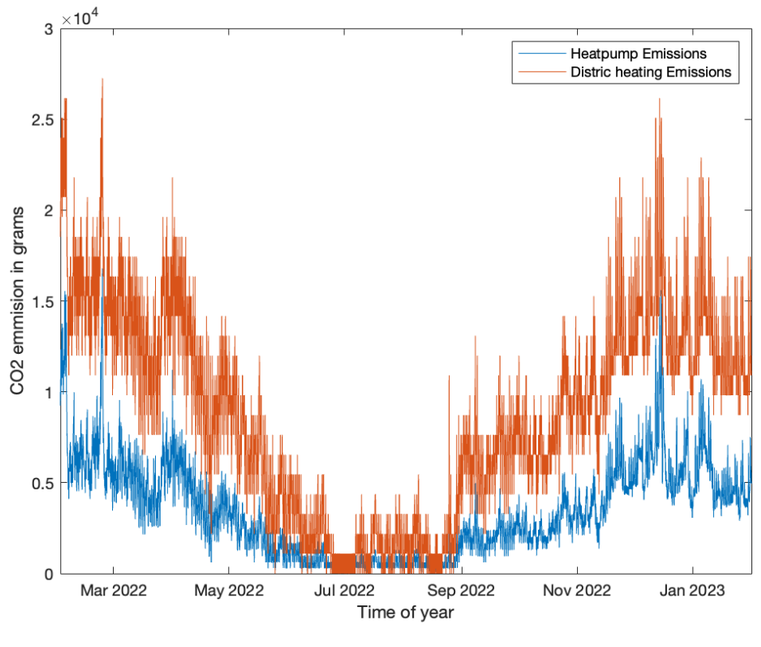

Figure 65: Here the emissions of the heat pump together with the emission with the district heating are shown

In figure 66 the emission saving from solar panels are shown without any emissions that the solar panel production and installation might cause. With 50 solar panels Novia would save about 1500 kilograms of CO_2 emissions.

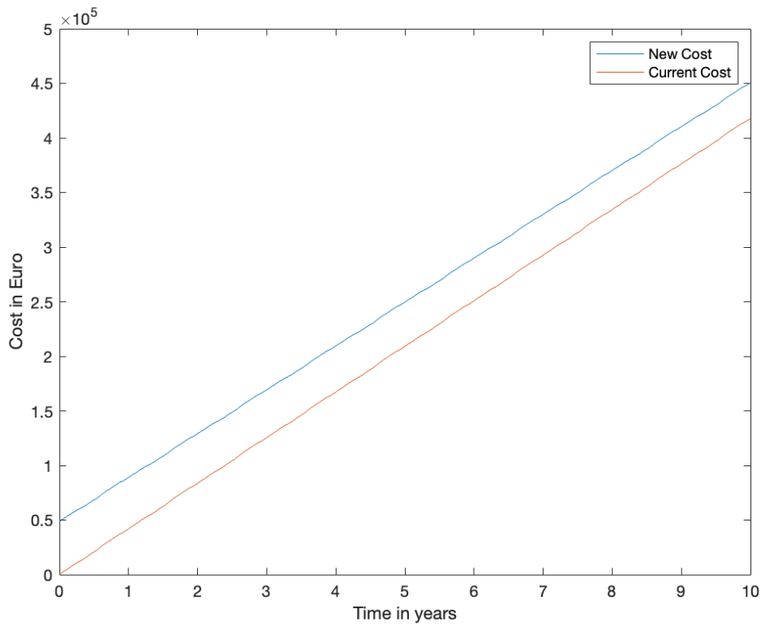

Figure 63: Here the cost of 50 solar panels is shown.

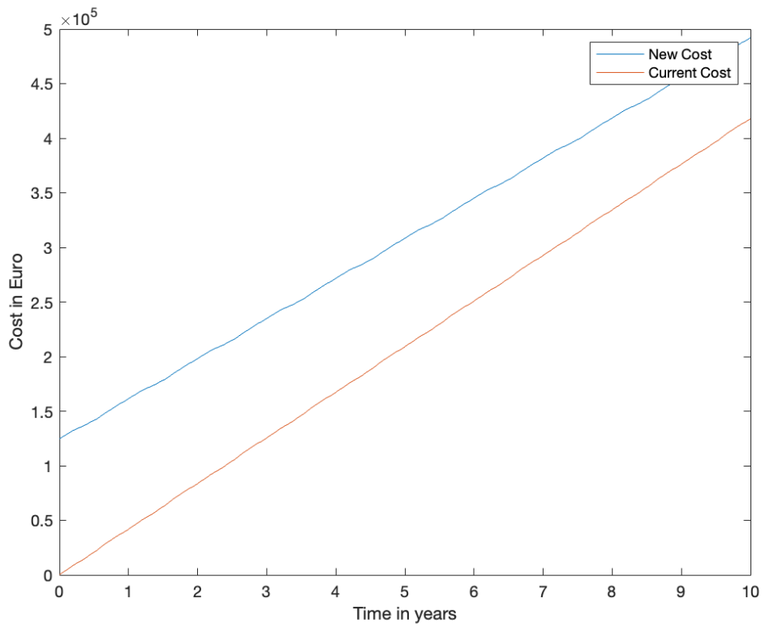

Figure 64: Here the Savings of 5 Batteries together with 200 solar panels wilt a 45 degree tilt and pointing to the south.

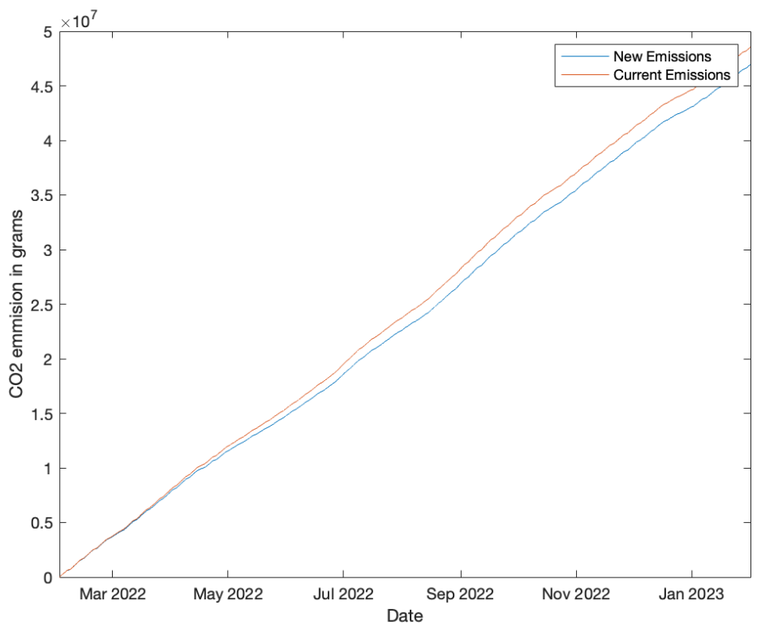

Figure 66: Here the emission saving from 50 solar panels with 50 degree tilt and a 132 degree azimuth

The emissions that can be saved by investing in a battery are more difficult to calculate. Because what it does is save solar energy that can be used at a later date. But providing solar energy to the electricity grid will reduce CO_2 emissions of other people. Which makes sure that a fossil fuel electricity generator does not have to run as fast. This model however looks at Novia's emissions. This means that holding to the electricity saves Novia CO_2 emissions. In figure 66 the emissions are shown. This configuration would save about 6000 kg of CO_2 emissions per year.

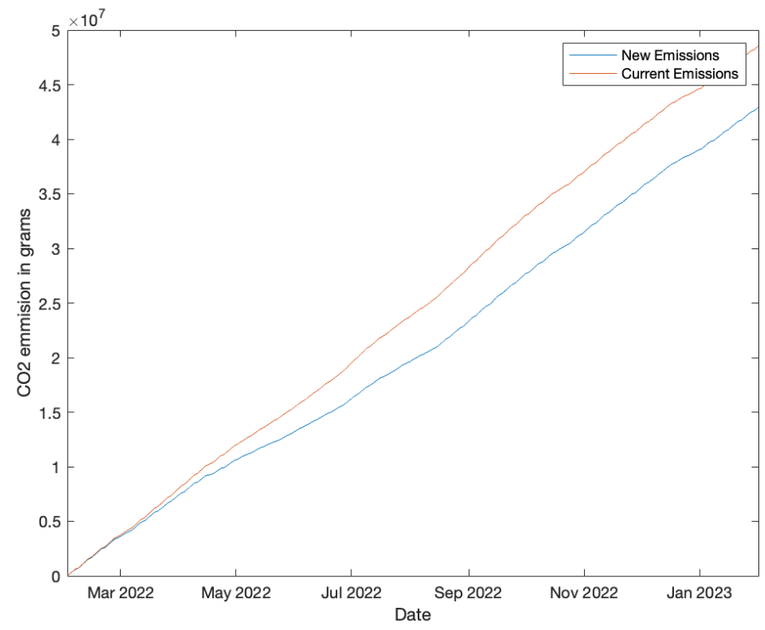

Figure 67: Here the Emission of 5 Batteries together with 200 solar panels wilt a 45-degree tilt and pointing to the south

16.6 Discussion

For the heating energy, Novia has a contract with the green option. Vaasan sähköverkko says that this will ensure that the heating Novia uses will be with 0 g/kWh. But how can Vaasan sähköverkko say this if the heat from the network will be the same heat someone with regular option uses. That is why in this report the 109 g/kWh is used as reported by Vaasan sähköverkko emission report[37].

The calculations for the heat pump were made with the year from February 2022 to February 2023. This winter was relatively warm. A colder winter would make the heat pump less efficient and therefore more expensive and would produce more emissions .

The solar data is not from a weather station in Vaasa. This means that the accuracy is questionable. However it should be similar as the weather station is in a similar solar radiation zone within Finland [29].

Possible inverters needed with the solar panels and battery were not calculated in the cost analysis.

The emissions from electricity are 148 g/kWh this data is from the year 2021. The data of 2022 was not jet published when this report was written.

Also the surrounding temperature is not taken into account with calculating the solar penal data. Because low temperatures tent to make solar panel more efficient this could make the solar panel yield a bid higher.

Because the heat pump is the best financial options. It could be wise to add heating storage to the simulation. This might lead to not needing as much heat pumps.

Because of time restraint there where no calculation made for geothermal heating. This could be a good option or part of the solutions.

16.7 Conclusion

Solar panels and batteries are not financially viable. This is because of the low electricity price. However these do reduce the emissions.

The heat pumps is the financially viable and will also reduce emissions.

16.8 Recommendations

Add geothermal heating to the simulation. This is harder then originally thought.

Add heating storage to to simulation.

17 Solutions

The team came up with the idea to provide Novia with the solutions gathered from the product research, heating and energy simulations as well as travel alternatives and not to forget about the IT discarded products solutions.

For the product section, the team aims to enhance NU's purchasing of more sustainable, ecological, and environmentally friendly products. For this section, Novia needs to find Brands that have Sustainability Criteria to create their products. The teams did research for both products and brands that were not sustainable and found alternatives. If Novia wants to buy a product the team recommended that it first look on the website of the company from which Novia is going to buy it product. The most important certificates that Novia needs to look for are the ones explained in section 15.2 Product Analysis. Some companies show their Global Reporting Initiative (GRI) which indicates transparency. If this is the case that they have it is good to look at it so it is easy to see if the company is sustainable.

The solutions to reduce travel emissions are as follows. The first solution that the team recommends to the university is to create a poster that depicts travel-related CO_2 emissions in 2022 of Novia, Vaasa, emphasizing the disparities in emissions by bus, train, ferry, and airlines. The posters can be used as a teaching tool in Novia, so Employees have more knowledge of the variation in emissions. The second solution for reducing travel emissions is the website that Novia can develop, and a third solution could be a CO_2 quotum in traveling for the employees. Those solutions are mentioned more specifically in the part of the travel information of the paper.

The IT-discarded products did not really need to be looked at because everything is very well recycled by the company, named Kuusakoski. However, the team does recommend Novia making an option subject for certain students studying at the university. These students can work in teams from different study fields to try to recover discarded products. More information is available at the end of the IT-discarded product part.

Also the team wanted to create a 2-year plan to drive NU(Novia University) forward as a competent and prosperous Vaasa, which requires a systematic approach that addresses sustainable actions for NU.

Hence, the plan focuses on better connections between sustainable actions, carbon footprint, and student awareness.

By implementing these activities, NU can increase its appeal to students and graduates and create a better connection between the working life academia and young talents in the Vaasa area.

Also, the 2-year plan is to implement one of the 4 objectives so in order to achieve carbon neutrality means in fact to be a 8-year plan because in its implementation part, it consists of one-only implementation program out of the 4 objectives. This plan involves students, Novia University teachers and staff as well as companies associated with Novia.

Plan for Novia to achieve Carbon Neutrality in 2030

Framework

This plan is generated for Novia University in Vaasa, Finland as a subject for students, to achieve Carbon Neutrality by the year 2030 by setting out realistic objectives:

- Energy and Product Consumption, IT discarted Product
- Carbon Footprint Reduction
- Reduce Discarted Products, Energy Consumption
- Carbon Handprint augment

These objectives have been set within the customer needs as well as the University's goals in the project framework. The SDG project focuses on 1 of the 17 UN Sustainable Goals: **Goal 13**: Climate action.

This plan has been brainstormed with the idea of meeting Novia's needs by performing sustainable actions to achieve carbon neutrality. There will be random factors that Novia cannot directly affect, such as nullifying their carbon footprint to the value of 0 tons, as it is not a realistic and achievable objective.

Continuous framework and evolution checking for the plan need to be done for Novia's personnel and expertise part. This operation ensures the plan stays on its path and keeps evolving.

This approach will allow stakeholders, collaborators, and external personnel to continually contribute to the plan and its actions. As this plan has been prepared for NU, it can be applied to many universities or institutions as long as the objectives match this framework and its needs.

As this plan as it is for Novias' students, it will be considered as a subject in order to get credits for them as well as a grade.

1st Year

Apprenticeship

In this section, the main goal is to make NU (Novia University) and students aware of the concepts that involve sustainability and the challenges companies face when implementing sustainable projects. The companies that NU works with are the ones that has been working every since.

- Establish a Sustainable Ambasor Programm

Definition

This program will offer students core knowledge and skill training to become Sustainability Ambassadors. Although this should be a year-long program, it will last less than a year. The main objective is to start implementing all the techniques learned as early as possible. In the middle of the end of the program, it will develop Culturized Students in Sustainability and awareness as they will provide Novia with sustainable actions.

At the end of the program also, with the objective to improve Novia's Sustainability Visibility and Outreach, NU will take initiatives and conduct short R&I (research for innovative) projects.

Implementation

It will consist of studying sustainable concepts, such as SDG bases, energy usage to prevent energy waste and improve energy efficiency, and IT waste management. This information will be provided by associated NU companies who will give classes and practical information and guidelines to students.

Active Practices

Internships in Novia and companies, as well as development projects in NU, will be offered to students.

- Organize Networking Events

Definition

It consists of connecting NU with companies, creating deeper connections with them, and promoting sustainable actions in their companies and within NU. Students and teachers from NU will take part in the events and learn from companies. Additionally, Novia will start a project based on the companies' challenges using their expertise.

Implementation

It will involve the interaction between the university and companies. Companies will provide expertise and engage in discussions with students and teachers who will help by providing ideas for future projects.

- Project Definition

Definition

The content of this project is carefully chosen based on companies' needs and challenges. A representative from the company will take responsibility for selecting a topic from the Novias Objectives that address the company's specific needs.

The project will then be developed by students who will proceed with an internship either at that company or at Novia. At the end of their internship, which concludes at the midpoint of the second year, solutions and conclusions will be provided to both the company and NU.

Implementation

The university, in collaboration with the companies, will decide on the specific company challenge to be developed. Afterwards, students will have the opportunity to choose their preferred challenge and corresponding company for their internship. As students progress with their projects, they will need to create a program for Novia that is closely related to the topic of their chosen company.

2nd Year

Apprenticeship

The main objective during the second year is to implement all the information gathered after the project resolution and put into action some of the recently developed programs. It should be noted that not all the programs offered to

Novia will be achievable, so a selection will be made from the previous options to determine which ones to implement.

In this part of the project, the company does not directly participate in the Sustainable Novia Project, although they will be kept updated.

- Execution Strategies

Definition

The selected program, provided by companies to NU and students, will be developed by them, with teachers providing guidance and advice. The development of the program will depend on Novia. The program will be translated into sustainable actions, such as creating a Sustainable Report and improving the relationship between the university and companies by involving external stakeholders apart from project participation.

Implementation

Simultaneously, the project must be visible, and students and staff members should utilize all necessary resources to implement sustainable actions for Novia throughout the rest of the year. There should be an increased focus on research and innovation to streamline and optimize the program's topics. Each year, the program can be adapted and modified to explore various possibilities.

Figure 68: Proposed plan for 2024 and 2025.

References

[1] "Course book for eps autumn semester 2022 - novia.fi," 2022. [Online]. Available: https://www.novia.fi/assets/Projectsites/EPS/EPS-Course-book-Autumn-2022.pdf

[2] "Sustainable development goals." [Online]. Available: https://www.novia.fi/en/about-us/sustainable-development-goals

[3] [Online]. Available: https://sdgs.un.org/partnerships

[4] V. K. Doorsselaer, D. E. Bois, and S. D. Meulenaer, *Ecodesign: Ontwerpen voor een duurzame en circulaire economie*. Academia Press, 2018.

[5] Jun 2020. [Online]. Available: https://www.normas-iso.com/

[6] 2023. [Online]. Available: https://www.globalreporting.org/standards/

[7] C. Álvarez, "¿qué son los criterios esg ('environmental, social and governance')?" Nov 2022. [Online]. Available: https://www.bbva.com/es/sostenibilidad/que-son-los-criterios-esg-environmental-social-and-governance-y-por-que-son-importantes-para-los-inversores/

[8] 2023. [Online]. Available: https://www.dell.com/fi-fi/dt/corporate/social-impact/advancing-sustainability/electronics-recycling/what-happens-to-recycled-electronics.htm?hve=wat+gebeurt+er+met+gerecyclede+apparatuur#pdf-overlay=//www.delltechnologies.com/asset/fi-fi/services/cross-portfolio/briefs-summaries/dell-takeback-recycling-process.pdf

[9] 2023. [Online]. Available: https://www.dell.com/en-us/dt/corporate/social-impact/advancing-sustainability.htm

[10] 2021. [Online]. Available: https://www.dell.com/en-us/dt/corporate/social-impact/advancing-sustainability/climate-action.htm#pdf-overlay=//www.delltechnologies.com/asset/en-us/solutions/business-solutions/briefs-summaries/dell-netzeroinfographic.pdf

[11] [Online]. Available: https://www.sedex.com/blog/what-is-responsible-sourcing/

[12] [Online]. Available: https://www.winpak.com/sustainability

[13] H. Laurila, 2019. [Online]. Available: https://blog.beamex.com/how-calibration-improves-sustainability

[14] [Online]. Available: https://www.isku.com/fi/fi?gclid=CjwKCAjw__ihBhADEiwAXEazJqJozjK6gS4Qm2d1TEMEFbvOHIsokAD2X0Eo7XxBZn82gn_jumg08BoCLSEQAvD_BwE

[15] [Online]. Available: https://www.pentronic.se/om-pentronic/kvalitet-och-hallbarhet/

[16] [Online]. Available: https://www.beamex.com/beamex-calibration-ecosystem/

[17] [Online]. Available: https://ecovadis.com/

[18] [Online]. Available: https://www.pilotpen.eu/en/the-pilot-spirit-about-pilot-company-profile/writing-for-the-environment/begreen-the-pilot-recycled-products-range.html

[19] [Online]. Available: https://www.staedtler.com/uk/en/company/about-staedtler/sustainability-at-staedtler/

[20] 2016. [Online]. Available: https://www.priima.com/site/yrityksesta

[21] 2023. [Online]. Available: https://www.3m.com/3M/en_US/sustainability-us/environmental/climate-and-energy/https://www.post-it.com/3M/en_US/post-it/products/~/Post-it-Products/Notes/Super-Sticky-100-Recycled-Content/?N=4327+5927575+8704355+3288059979+3294529207+3294857497&rt=r3

[22] Aug 2012. [Online]. Available: https://www.etra.fi/media/mageworx/downloads/attachment/file/i/s/iso9001_eng_122022.pdf

[23] E. K. Finland OY, 2023. [Online]. Available: https://www.erichkrause.com/en/company/values/

[24] A. Tech, "Sustainability in biosolv," 2023. [Online]. Available: https://greenacetone.com/

[25] "kuusakoski." [Online]. Available: https://www.kuusakoski.com/fi/finland/?gclid=CjwKCAjwx_eiBhBGEiwA15gLNyKjqWkhn9hO2ep9EFd-jpiDqs1emZ2jowxmGMnlpfxfZjoo6kin8RoCbakQAvD_BwE

[26]

[27] Dec 2019. [Online]. Available: http://www.shiptraffic.net/

[28] 2023. [Online]. Available: https://en.ilmatieteenlaitos.fi/download-observations

[29] E. Pihlakivi, "Potential of solar energy in finland," Turku University of Applied Sciences, Tech. Rep., 2015. [Online]. Available: https://www.theseus.fi/bitstream/handle/10024/104483/Emma_Pihlakivi.pdf?sequence=1

[30] 2023. [Online]. Available: https://static.longi.com/Hi_MO_5_LR_5_54_HABD_395_420_M_71e8ada419.pdf

[31] [Online]. Available: https://evxstore.com/fi/aurinkopaneelit/longi-hi-mo5-lr5-54hpb-405w-full-black-mono-aurinkopaneeli

[32] C. G. Honsberg and S. G. Bowden, "The sun's position," 2019. [Online]. Available: https://www.pveducation.org

[33] Y. A. Çengel, J. M. Cimbala, and R. H. Turner, *Chapter 6*. McGraw-Hill Education, 2017, p. 259–260.

[34] LG, "Www.irishellas.com," Mar 2022. [Online]. Available: https://www.irishellas.com/files/Engineering-Product-Data-Book_Monobloc_Gen.2_R32_50Hz_MFL66101126_5BPM5-01C-Mar.2022-.pdf

[35] 2023. [Online]. Available: https://www.tesla.com/sites/default/files/pdfs/powerwall/Powerwall_2_AC_Datasheet_EN_NA.pdf

[36] 2021. [Online]. Available: https://www.vaasansahko.fi/sahkon-alkupera/

[37] 2022. [Online]. Available: https://www.vaasansahko.fi/lammon-alkupera/