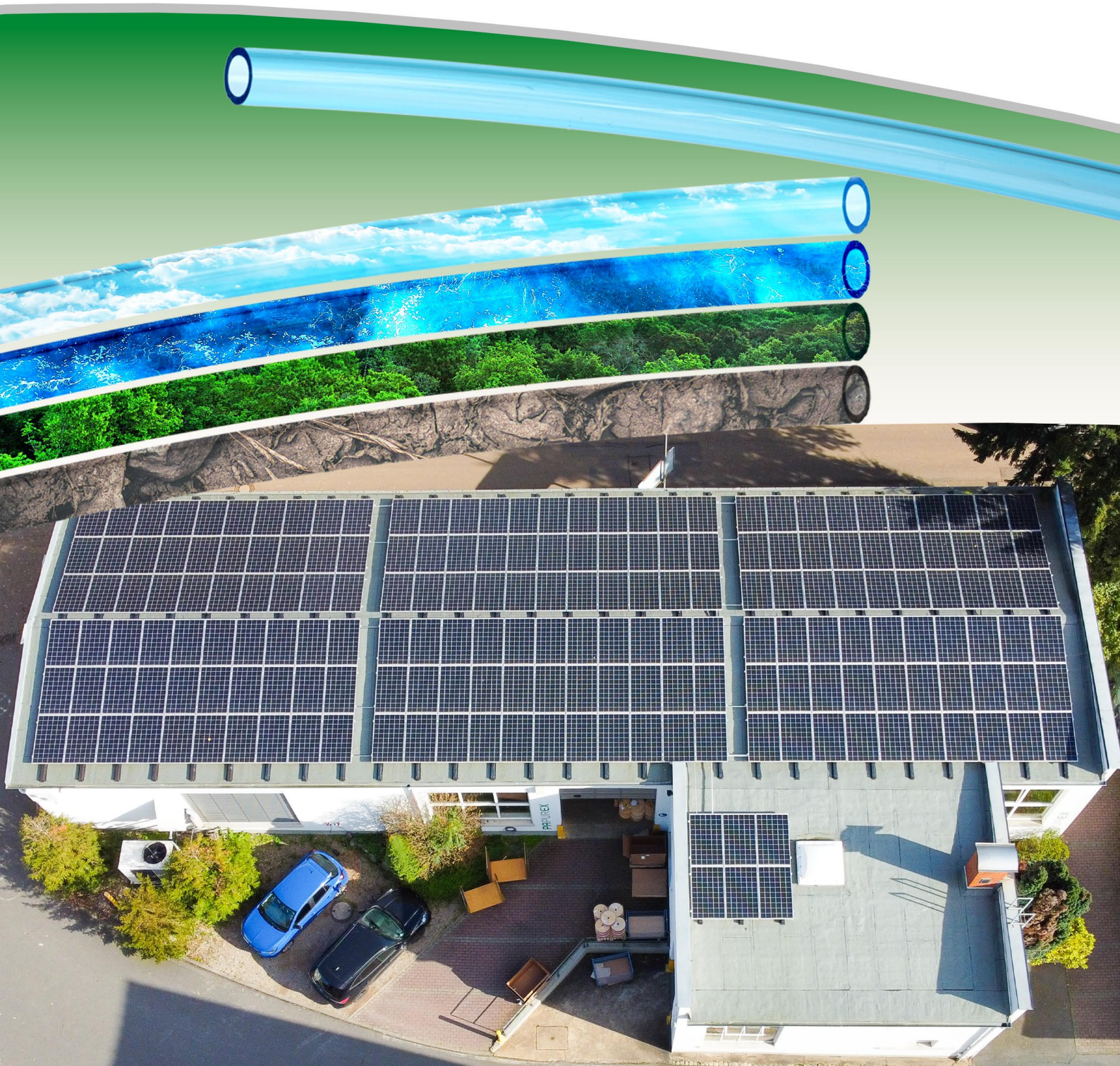
PAPUREX

Individual Tubing Solutions.

Environmental Statement 2025



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Environmental Statement

3rd, updated edition

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List of Abbreviations

B.A.	Bachelor of Arts
CCF	Company Carbon Footprint
EV	Electric Vehicle
EX	Extrusion
GHG	Greenhouse Gas
kg	Kilograms
NDA	Non Disclosure Agreement
PA	Polyamide
PUR	Polyurethane
km	Kilometers
tkm	Tonne-kilometers

1. Purpose of this Environmental Statement

Since its foundation in 1981, PAPUREX W. Büchner GmbH has been closely bound with the Odenwald region, the home of choice of the company's founder Werner Büchner. Because of that, it lies in the self-understanding of PAPUREX to take responsibility for humans and nature in the environment close to our production plant. Naturally, the measures to protect the environment are not limited to the Odenwald region but are set up to contribute to the global challenge of fighting climate change and preserving flora and fauna.

This document is meant to depict the current state and relevant developments of PAPUREX that impact the environment and make them understandable for all stakeholders. It serves as the foundation to make the supply chain transparent to our customers, and to make the impact of their jobs understandable for our staff at the same time.

All numbers, data, and calculations are based on the determined actual values of the business years 2024, 2023, and 2022 and thus allow a realistic view of the impact of PAPUREX on the environment. It is explicitly not the goal to only depict positive or in comparison seemingly positive values. The numbers and data of other companies do not influence the values presented in this document. The methods used during the creation of the statistics for this Environmental Statement are explained during the course of the document. Hereby, it is made sure that all readers are able to comprehend the sourcing of the mentioned data.

Last but not least, this Environmental Statement serves to determine the status quo for the people responsible at PAPUREX and thereby identify current trends and chances for improvement.

To be able to grasp the impact of PAPUREX on the environment better, the following chapter describes the history, the structure, and the products of the company in the first place.

2. This is PAPUREX

2.1 History

The company’s beginning can be dated back to 1977 when Werner Büchner founded a private partnership with extrusion (EX) of polyurethane (PUR) and polyamide (PA) as a key competence. The initial letters of these three elements build the company name that endures today. However, it took until 1981 for the business to receive its full company name PAPUREX W. Büchner GmbH. During the same year, the first product reached serial production: A PUR tube based on polyester polyurethane, suitable for plug-in-connectors. A complete novelty back then – a true classic in our product program today.

Five years later in 1986, PAPUREX already moved its production facilities to Mörlenbach, where they still are today. At that time, it was possible to count the whole team on two hands. Today, there are around 50 colleagues going about their daily work at PAPUREX. The company reached the plant’s capacity maximum several times, but solutions to stay were found each time.

In 1994, the first tube based on polyether polyurethane which is suitable for plug-in-connectors was introduced to the product program. This whole new material division showed a complementary strengths profile to the previous products and thus, enlarged the possible applications of polyurethane tubing significantly. Today, there are several variants of this material type in our product program.

Since 1996 our quality management has been compliant with the DIN EN ISO 9001 norm. Because of that, all customers are ensured that their products fulfill the agreed quality standards by external validation. It is not a coincidence that the company slogan was “Every inch a quality product” for many years.

In 2000, Rudolf Biebl took over the management of the company. Since then, PAPUREX has not only grown in terms of turnover but in regards to team size as well. The reason for that was for example many product innovations, some of which were patented. For instance, several further developments of flamex®, that was introduced in 1999, the anti-static **A:S:S**® or the kink-proof **KSS** were introduced.

In 2021 already, PAPUREX celebrated the company's 40-year anniversary. However, the values that the founder Werner Büchner worked into the foundation of the firm in 1997 already, are still noticeable today. Hence, absolute peak quality, the focus on individual problem solutions for the customers combined with the connectedness with the region, and a sense of responsibility for all stakeholders are still the mixture today, that defines PAPUREX.

In 2024, Ivo and Dan, the sons of Rudolf Biebl, joined the management. While Ivo Biebl will be mainly responsible for the technical side of the company due to his background as an industrial master craftsman, Dan Biebl is planned to take over the commercial side of the business as a B.A. of business administration.

2.2 The Company

Figure 1: PAPUREX Mission Statement

PAPUREX is specialized in the manufacturing of high-quality polyurethane tubing. Despite the meanwhile very international customer base, these get exclusively produced in Germany. The share of exports was well over two-thirds in recent years and is distributed among more than 45 countries all over the globe.

More than 45 employees are responsible for the processing of around 450 tons of polyurethane per year. The production takes place on five lines in three shifts to meet the demand of international customers. PAPUREX educates trainees in-house since 2014 and thus, gives young people in the Odenwald region a perspective – without them having to leave their homes for surrounding big cities. At the same time, the education of professionals in-house secures the quality for the future.

Besides responsibility for colleagues and customers, regionality plays a big role in supplier selection as well. Hence, our IT service, the system house of our enterprise resource planning system, our tool mechanic, and many other partners are located within less than 20 kilometers distance. The raw material polyurethane comes to the largest part from Germany as well and thus, does not have to be transported around the globe before it can be processed in Mörlenbach.

Figure 2: Aerial view of the PAPUREX production hall

2.3 The Products

As described in the previous sections of this document, PAPUREX specializes in the extrusion of polyurethane tubing individually on customer demand. The extrusion of polyamide, which is still part of the company name (“PA” in PAPUREX), has since been discontinued. The reason for the specialization in polyurethane is the overwhelming material advantage during the production process in terms of flexibility and longevity.

In general, two sorts of polyurethanes get processed at PAPUREX: At first, polyester polyurethanes have to be mentioned. These excel especially through their mechanical robustness, flexibility, and pressure resistance. On the other hand, there are polyether-based polyurethanes, which have their advantages mostly in the field of chemical resistance. Due to the individual customization of our tubing to customer demands, more than 6.000 article variations were created over time.

These originate from different special areas, for example:

- Antistatic tubing
- Flame resistant tubing
- Anti-kink tubing
- Tubing for maximum flow rates
- Tubing for agriculture
- Special forms

The following illustration creates a visual overview of the product spectrum of PAPUREX:

Figure 3: Product Spectrum of PAPUREX

Further information is available online on papurex.de and as a download.

3. Environmental influences of PAPUREX

The following chapter depicts the influences of the work at PAPUREX on the environment. As mentioned at the beginning of this work, all calculations are based on actual values of the business years 2024, 2023, and 2022. However, this data does not claim to be absolutely accurate. The reason for that is several factors that cannot be calculated exactly. For instance, the commuting of employees differs: If the weather is nice, large parts of the staff walk to their workplace. In contrast, if the weather is bad, most of them come by car. Moreover, for some of our raw materials, there are no exact calculations of environmental influences available. Thus, in the case of some materials, estimations had to be used. Consequently, the classification of environmental influences must be understood as a scale rather than exact values. Nevertheless, it is our ambition to improve the accuracy in this area during the upcoming years to identify potential improvements even more precisely. Hence, the 2025 version of the environmental statement contains some values that could not be determined in the first publication of 2023. Hereby, further steps towards precision and transparency in the depiction of the environmental impact of PAPUREX have been made. During the following chapters, it is explicitly mentioned if data is mentioned for the first time in this version of the Environmental statement.

3.1 Greenhouse gases

3.1.1 Classification of greenhouse gases in so-called *scopes*

If capturing the GHG emissions of a company is the task, a classification in so-called scopes is usual.[1] The term describes in which area of the value chain GHG is emitted.

Scope 1: direct emissions

Includes all actions that can be directly linked to the value generation of a company. For example, energy sources that get consumed at the plant for fueling the production process or heating the company rooms count into this category. Moreover, company-owned vehicles used for the distribution at the plant site, are part of Scope 1 as well.

Scope 2: indirect emissions caused by purchased energy

Includes the purchasing of external energy. An example of this category is electricity from fossil energy sources. Defined more precisely, the energy has to be produced outside of the capturing system but consumed inside of the latter, to count as part of Scope 2.

Scope 3: indirect emissions inside of the value chain.

Includes all actions, that are part of the value chain but are out of the direct control of the capturing organization. For further delineating Scope 3 emissions from Scope 1 and 2, the United States Environmental Protection Agency (EPA) describes Scope 3 Emissions as *Not owned or under the control of the capturing organization but occurring with influence on the value chain.*[2]

The following figure depicts all three scopes for a better overview. The approximate percentages are taken from an investigation of 405 bigger companies (>250 EE), based in Europe.

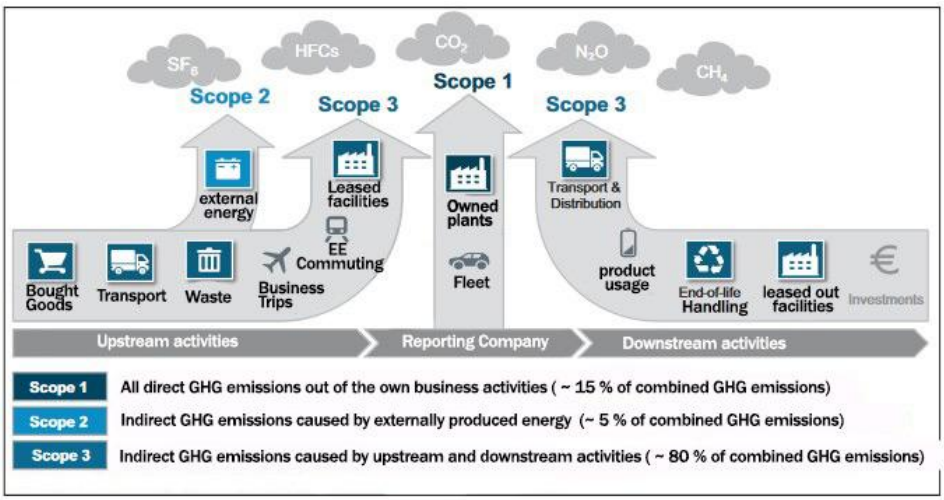

Figure 4: Overview of GHG Emissions along the value chain

3.1.2 Consideration of Scope 1 emissions of PAPUREX

Scope 1 emissions at PAPUREX arise exclusively from stationary combustion. This includes the fossil energy sources heating oil and propane gas since the first CO_2 balance sheet. Within Scope 1, the heating oil that is, as the name suggests, used to warm the business facilities of PAPUREX, makes up the largest part. In 2024, 7530 liters of heating oil were used. That is equivalent to

[1] Comp. (Klein & Kämmler-Burrak, 2021), p 154 ff.
[2] Comp. (United States Environmental Protection Agency, 2023)

20,22[3] tons of CO_2. As a comparison: In 2023 around 25 tons of CO2 emissions arose due to the combustion of heating oil. In 2022, it was 20,4 tons. As this data shows, the emissions remained fairly constant over the last years. However, for 2025 there is a significant reduction to be expected. Within the first quarter of 2025, a new heating system will be installed at the PAPUREX production facility that does not rely on fossil energy sources any longer. Details will be explained in chapters 4 and 5 of this document.

The only further Scope 1 emission that arises at PAPUREX is the combustion of propane gas. The latter is used to heat plastic residues on extruder parts and thus, make them easier to clean. The annual consumption of propane gas remained constant at around 30 kilograms over the last three years. This is equivalent to an emission of 0,13[4] tons of CO_2.

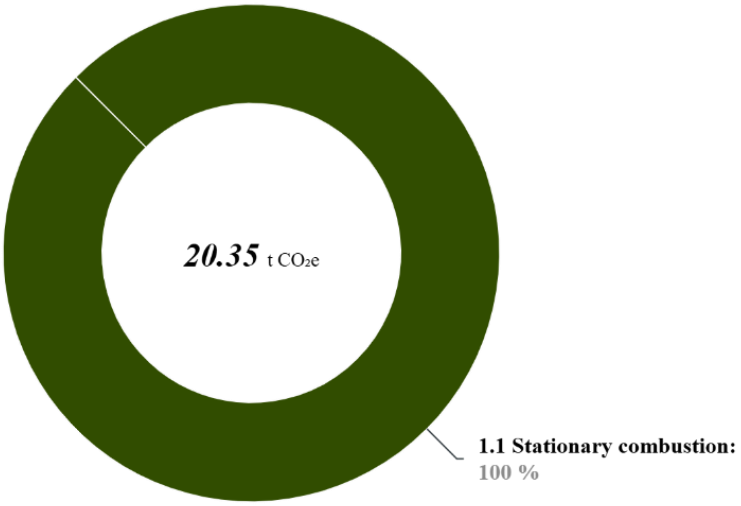

Figure 5: Scope 1 emissions by category

3.1.3 Consideration of Scope 2 emissions of PAPUREX

The consideration of Scope 2 is, in the case of PAPUREX, by far the simplest of the three emission dimensions. The only thing that falls in this category is the energy consumption of the production facilities in Klein-Breitenbach. In 2024, the energy consumption was 400.751 kWh, which is below the two previous years (433.808,38 kWh in 2023 and 477.303 kWh in 2022). However, it is important to mention that the company exclusively purchased green electricity since 2003. The according certificates can be found as figures 11 and 12 in the appendix of the Environmental Statement. According to the BAFA CO_2 factors, green electricity is calculated with a CO_2 equivalent of 0[5]. Hence, PAPUREX has been operating CO_2-neutral in Scope 2 for more than 20 years. Further elaborations on which efforts PAPUREX takes to minimize the environmental impacts of its energy consumption can be found in chapter 4.1.1 of this document.

3.1.4 Consideration of Scope 3 emissions of PAPUREX

Commuting of employees

The first part that has to be considered as part of Scope 3 emissions is the commuting of the PAPUREX team. To be able to grasp the impact that the daily commuting of the staff has on the

[3] Factor according to: (IINAS – Internationales Institut für Nachhaltigkeitsanalysen und -strategien, 2023)
[4] Comp. (Bundesamt für Wirtschaft und Ausfuhrkontrolle, 2024)
[5] Comp. (Bundesamt für Wirtschaft und Ausfuhrkontrolle, 2024)

environment, an annual survey is carried out that determines how each employee travels to work daily. This survey includes primary transportation as well as alternative possibilities to reach PAPUREX. For example, some team members change their way of commuting according to weather conditions. In total, the PAPUREX team commuted about 151.000 km to the production plant in Klein-Breitenbach. This is well over 9.000 km more than in 2023 and roughly 6.000 km more than in the first survey back in 2022. The reasons for this volatility in the overall commuting distance are relocations and fluctuations within the team. In the second version of the environmental statement which is based on the business year 2022, four categories of transportation have been divided:

1. EV (electric vehicles)
2. Petrol
3. Diesel
4. Walking/ bike

With the 2023 survey, another category had to be added, because some team members who joined PAPUREX this year come to work by public transport:

5. Public transport

In the annual comparison of the overall commuting distance clear tendencies towards low emission categories can be seen. One of the main reasons for that is the consequent conversion of the PAPUREX company fleet from combustion engines to EVs and the growing importance of public transport. In 2022, 72 % of the total commuted distance was traveled by cars with combustion engines – 64 % by petrol and 8 % by diesel cars. By 2024, this share decreased to 55 %. On the contrary, EVs gained importance significantly with 33 % proportion of the whole travel distance – in 2022 they made up only 22 %. Moreover, the usage of public transport does meanwhile contribute a portion of 9 % and was not even existent back in 2022. The following figure visualizes the development of shares of the described categories of the total commuting distance.

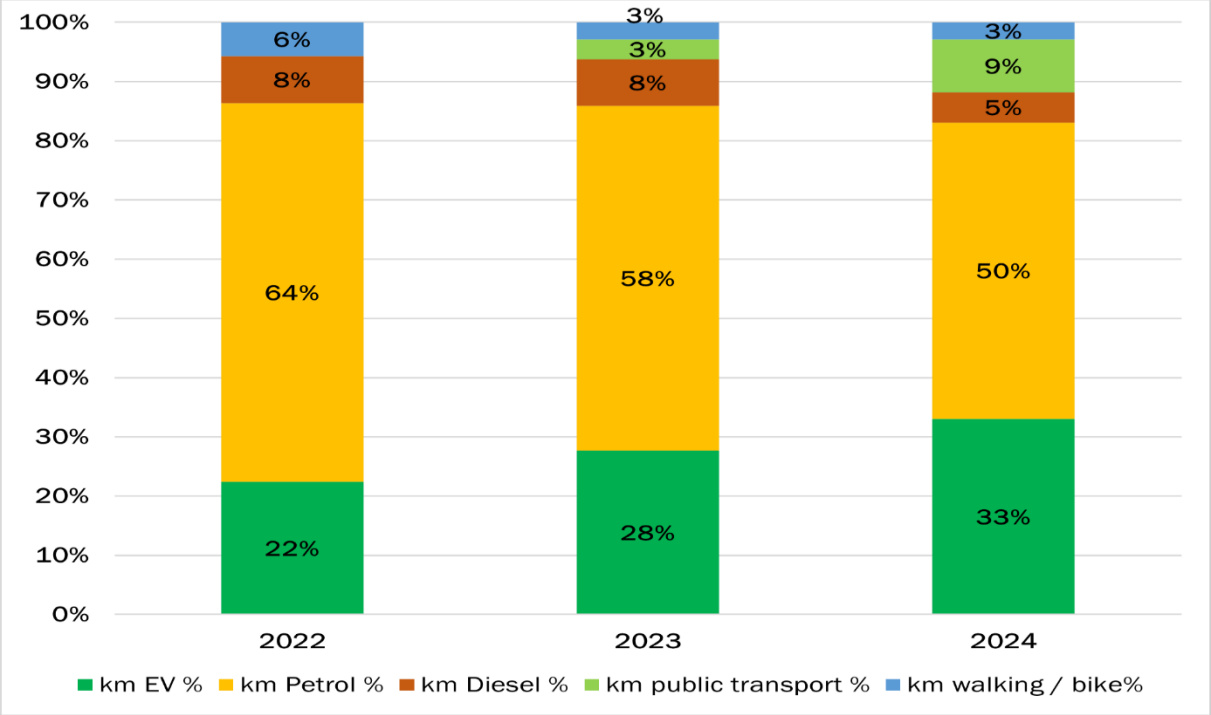

Figure 6: Shares of the transport categories of the total commuting distance

These changes within the transport categories directly affect emissions that arise from the commuting of PAPUREX employees. The calculation of emissions from vehicles with a combustion

engine is done with the individual model and the respective fuel consumption in mind. In total, during 2024 the drives to PAPUREX and back burned 4.560 liters of petrol and 825 liters of diesel. The calculation of the emissions that arise due to these amounts is done according to data from GEMIS 5.1[6]. For the company-owned EV, a zero value is assumed because they charge more energy generated by the solar panels at the PAPUREX production facility than they consume during the distance to work and back. The calculations for public transport, at least for bus rides, are done based on a publication of the German Umweltbundesamt[7]. The other part of public transport, the train rides, are calculated with data of Deutsche Bahn[8]. For kilometers done by bike or walking, there are no emissions assumed. Total CO_2 emissions caused by PAPUREX employees on their way to work and back amount to 15.410 kg based on the explained data. This is around 1.620 kg less than in the year before and 3.485 kg less than in the first calculation based on 2022. All in all, the overall emissions of the PAPUREX team on their way to work have decreased by a good 18 %. However, as explained at the beginning of this chapter, the overall distance covered has increased by around 9.000 km. With that in mind, the savings are even more significant. Calculated on each kilometer emissions reduced from 131 grams in 2022 to 102 grams in 2024 which is equivalent to 22 %. The following figure visualizes this decrease.

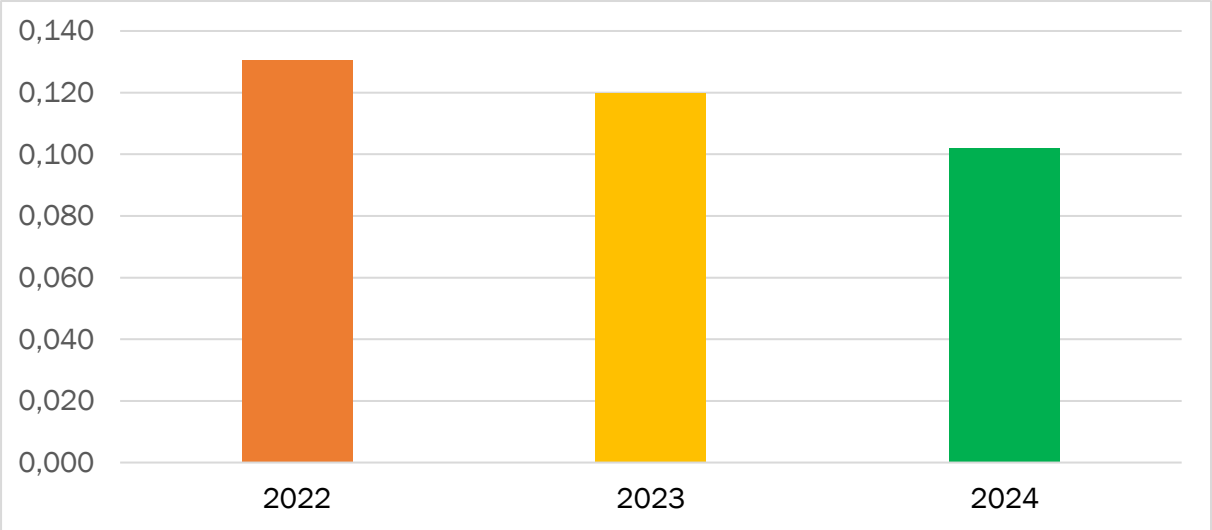

Figure 7: Average C02 emissions in [kg] per traveled kilometer

Procurement of raw materials

At the beginning of this section, it has to be mentioned that the consideration of Scope 3 emissions is by far more complex than the analysis of Scope 1 and 2. Not all suppliers of PAPUREX are able to provide data for the emissions of their products and hence, this part of the Environmental statement focuses on the materials that are most relevant for emissions. The degree of precision for all calculations in this chapter can be seen in the appendix. Due to NDA with raw material suppliers, the exact product name of the different polyurethanes had to be blackened.

The procurement of raw materials is by far the biggest factor for greenhouse gas emissions at PAPUREX. This is because all of the products are based on polyurethane. According to the suppliers, during the manufacturing of polyurethane between 3,6 and 4,9 kg CO_2 per produced kg of plastic arises. This data is "cradle to gate", which means from the point of raw material extraction to the

[6] Comp. (IINAS - Internationales Institut für Nachhaltigkeitsanalysen und -strategien, 2024)
[7] Comp. (Umwelt Bundesamt, 2024)
[8] Comp. (Deutsche Bahn AG, 2024)

point when the finished product leaves the gates of the production hall. The following processes, such as logistics, are described separately in this Environmental Statement.

In 2022, 430 tons of polyurethane were processed at PAPUREX. Broken down to the different polyurethane types and their amounts, a total emission of 1.691 kg can be determined. In 2023, the processed amount of polyurethane decreased by 16 % to 360,6 tons. Accordingly, the overall emissions due to material procurement declined as well, even if by a good 14 % not quite as much, to 1.458 tons. The reasons for the differences in margin are revised emission data by suppliers as well as differences in the shares of used materials. In 2024, 340,2 tons of polyurethane were processed, which is another 6 % less than in 2023. Broken down to the used material types, the emission savings were slightly over proportional this time with around 9 %. Overall, the procurement of polyurethane caused 1.333 tons of CO2 equivalents “cradle to gate” in 2024.

Raw material logistics

As mentioned before, emission data of the used raw materials are created on a "cradle to gate" basis. Hence, this section describes upstream raw material logistics separately. The smaller production amounts lead to decreased emissions in logistics from 2022 compared to 2023 as well. In 2022, the used 430 tons of polyurethane was transported over 52.216 km. This equals, divided into the absolute number of supplies, 184.040 tkm. In 2023, the 360 tons of polyurethane needed significantly fewer deliveries so the average weight per delivery was higher. Divided into the number of supplies, 154.336 tkm can be determined. The emissions for raw material logistics decreased accordingly from 9,25 tons in 2022 to 7,24 tons in the following year. In 2024, as mentioned above, less polyurethane was processed again. Split up to the number of supplies, 145.603 tkm were traveled to PAPUREX by its suppliers. This equals around 6,83 tons of CO_2 emissions. [9]

Procurement of other goods

Besides the purchase of polyurethane described beforehand, there are two more large positions that are relevant to the business at PAPUREX and must be mentioned here. Firstly, there are plastic plug-in connectors that are needed to connect the kink-proof KSS tubes.[10] In 2023 (first recording) around 1.220 kg of these were purchased. This equals emissions of roughly 4,5 tons of CO_2. In 2024 with 905 kg around 26 % less were needed. Consequently, the emissions lessened proportionally to 3,35 tons.

Secondly, cardboard boxes for shipping are a significant position that must be mentioned in this section. These were considered in 2023 from the emissions point of view for the first time as well. Overall, in 2023 just shy of 10 tons of cardboard boxes were used for shipping. This equals 6,18 tons of CO_2 emissions. In 2024 the used amount of cardboard boxes was considerably smaller with just under 6 tons. The emissions in this section decreased consequently to 3,68 tons.

Waste

With the accounting year 2023, the consideration of waste from an emissions point of view added even more precision to the Scope 3 emissions analysis of PAPUREX and thus, to the CCF. Wastewater is the first point to mention in this new category. In 2023, around 792 m^3 of water was used at PAPUREX. This means approximately 0,16 tons of CO_2 equivalents. The following year water consumption increased slightly to 842 m^3. However, due to changes in the calculation bases for German wastewater from 2023 to 2024, calculated total emissions remain at 0,16 tons.

Paper waste is the second point to mention in this section. In 2023, a good 3,7 tons of the latter had to be departed. This corresponds to 1,95 tons of CO_2 equivalents. The amount of emptied trash

[9] Comp. (IINAS - Internationales Institut für Nachhaltigkeitsanalysen und -strategien, 2024)
[10] See Chapter 2.3

containers that are used to calculate the weight of the waste remained constant for 2024. Consequently, the calculated emissions are the same as well. This is similar to the last waste category that must be mentioned in this section: Residual waste. Both in 2023 and 2024 containers with a calculated mass of 3,36 tons had to be worn out, which equals 1,95 tons of CO_2 equivalents.

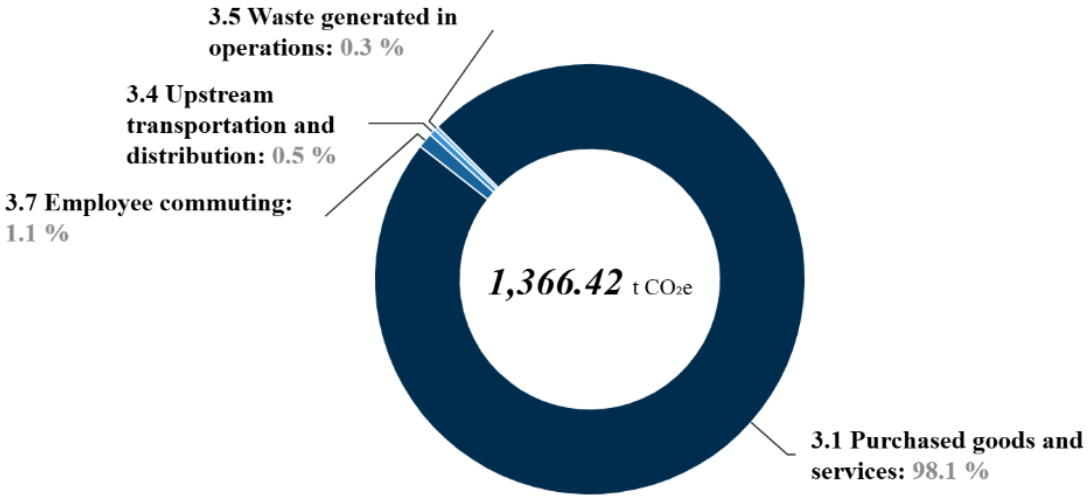

Figure 8: Scope 3 emissions by category

3.1.5 Classification of greenhouse gas emissions from PAPUREX

With the development of all three Scopes from 2022 to 2024 considered it becomes clear that the influence of the first two Scopes on total emissions is marginal. The by far largest part comes from Scope 3. Within the latter, raw material procurement is responsible for the main share with more than 95 % in all three years. This insight which was brought to light with the first Environmental Statement in 2022, is essential for the management decisions of PAPUREX. After bringing Scope 1 emissions even further towards zero by installing the new heating system at the production facility in Klein-Breitenbach, the focus has to be put on alternatives in raw material procurement. Which efforts PAPUREX already makes to reduce the CCF, are described more closely in chapter 4.1.

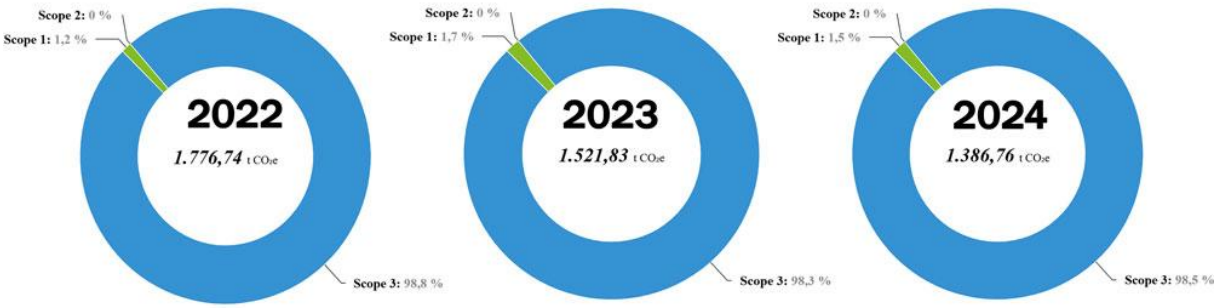

Figure 9: Overview - Scope 1 to 3 2022 to 2024

3.2 Water

The wastewater of PAPUREX was already considered from an emissions point of view in chapter 3.1.4. In the following section, the focus is put on the other environmental impacts of wastewater.

Extreme weather Events, which include long-lasting droughts, occur more frequently because of climate change, even in regions classified as humid the whole year, as many parts of Germany are.[11] Hence, avoiding unnecessary or unproportional freshwater consumption is already part of the discussions about laws for due diligence in supply chains.[12]

For the extrusion of polyurethane tubing, as it is done at PAPUREX, it is necessary to heat the raw material significantly. However, when the tubing receives its desired form, it has to get cooled down as soon as possible so that the material can harden and the tubing stays in its form. For this process, water cooling is required. This is why up to 95 % of the annual water consumption of PAPUREX arises in production. The other 5 % can be assigned to everyday usage like sanitary facilities. In 2022, the whole company consumed around 707 cubic meters of water this way. According to data from the BDEW, this equals the water consumption of 3,8 four-person households in Germany.[13] For Comparison: PAPUREX employs 45 people, and the production runs all day long. In 2023, water consumption was slightly higher than in 2022 with a total of 792 m^3. This trend continues in 2024: 842 m^3 means another increase in water consumption. The reason for that is optimizations within the production process that led to a temporary higher need for cooling water.

The needed effort to keep water consumption at this relatively low level is described in chapter 4.2 of this document.

3.3 Waste

Waste was considered in terms of its impact on the CCF of PAPUREX in chapter 3.1.4 as well. The description of the rest of the environmentally relevant themes follows hereafter.

As a plastic processing company, the main part of waste at PAPUREX consists of the used raw material: Polyurethane. This is not because of a lack of diligence of our staff, but rather due to unavoidable waste that arises during the extrusion. For instance, when a production line is started up, it takes some time until all parameters of the tubing are within the desired range. The material extruded up to this point does not fulfill the requirements of the customer and hence, can not be sold. Chapter 4.3 explains what PAPUREX does to minimize these amounts and to use the arising waste as well as possible. In 2022, 17,024 tons of plastic waste arose during the production process. This waste gets collected and handed to a recycling company annually. In 2023, the amount of unused plastic waste could be reduced to 13,64 tons or by 20 %. In the following year, 2024, another decrease of one ton could be realized. This equals just shy of 7 %.

Besides the special plastic waste, there is standard waste that arises throughout the daily business as well. This waste gets, as obligatory in the state of Hessen, divided into residual waste, paper waste, biological waste, and plastic waste. This measure is to prepare the waste optimally for recycling. For the amounts of biological and plastic waste, there is currently no reliable data at PAPUREX because the waste disposal company responsible does not state them separately in their billing. The amount of residual waste remained constant from 2022 to 2024 at 18 m^3. The same is true for the paper waste that was determined with 18,72 m^3 from 2022 to 2024.

The last point to mention in this chapter is hazardous substances, that have to be disposed of separately. At PAPUREX this is only true for solvents that get used during the marking of tubes. In the years up to and including 2022, around 70 liters had to be handed to a specialist for disposal annually. However, since the introduction of a solvent recycling system in 2022, this amount could

[11] See (Bundesministerium für Bildung und Forschung, 2023)
[12] See (Würz & Birker, 2022, S. 54)
[13] See (Bundesverband für Energie- und Wasserwirtschaft, 2023)

be reduced dramatically. In 2023 and 2024 only five liters of solvents had to be disposed of. A more precise description of solvent recycling follows in chapter 4.3.

4. Measures to reduce environmental impact

4.1 Reduction of greenhouse gases

4.1.1 Energy consumption

Since 2003, PAPUREX exclusively purchased green electricity. Per definition, green electricity is generated exclusively from renewable energy sources. Proof for the PAPUREX green electricity purchasing is in the appendix.[14] Electricity won by renewable energies is, however, not 100 % CO_2-neutral due to the current power mix in Germany because for the creation of their infrastructure energy generated by fossil energy sources is used. Nevertheless, power generated by wind, solar, or water energy happens completely without GHG emissions. Hence, their calculation in the CO_2 balance sheet by the Eco Cockpit of the efficiency agency NRW with net zero is allowed.[15] For the current power mix in Germany, 428g of CO_2 was emitted for one kilowatt-hour, according to the Federal Environmental Agency of Germany.[16] If you put this in relation to the energy consumption of PAPUREX in 2022 which was 477.303 kilowatt-hours, around 204 tons of CO_2 were saved because of the exclusive usage of green electricity (Scope 2)[17].

In 2023, the emission per kWh in the German power mix was reduced to 380 g.[18] Calculated the energy consumption of PAPUEREX which was 433.808 kWh in the respective year, this is still a saving of around 165 tons of CO_2. Both the total energy consumption of PAPUREX and the emitted greenhouse gases per kWh in Germany continued to decrease in 2024. 400.751 kWh were needed to produce polyurethane tubing in Klein-Breitenbach, while a record year in regards to green power in Germany led to another low in emissions per kWh for energy in Germany. However, another 152 tons of C02 emissions could be saved at the PAPUREX production facilities in comparison to the general energy mix in Germany by exclusively purchasing green electricity. These savings will continue to decrease with the progress of the energy transition in Germany, which is a trend that PAPUREX embraces very much as a company that was one of the first movers away from conventional energy towards green sources. Over the last 20 years, around 3.936 tons of C02 could be saved by consequently producing with green power. Figure 10 illustrates these numbers by comparing the savings of C02 emissions by the usage of green electricity against the regular energy mix in Germany since 2005.

Moreover, PAPUREX produces electricity out of solar power via photovoltaic systems. 32 panels on the roof of the bureau building were supplemented by 186 on top of the production building in 2022. In February 2023 another 26 panels on another company-owned building were added. Resultingly, PAPUREX not only contributes to the reduction of GHG emissions by purchasing green electricity but also improves the power mix in Germany by generating solar energy.

[14] See appendix
[15] Comp. (Effizienz-Agentur NRW, 2023)
[16] Comp. (Umwelt Bundesamt, 2023)
[17] Comp. See chapter 3.1.1
[18] Comp. (Umwelt Bundesamt, 2024)

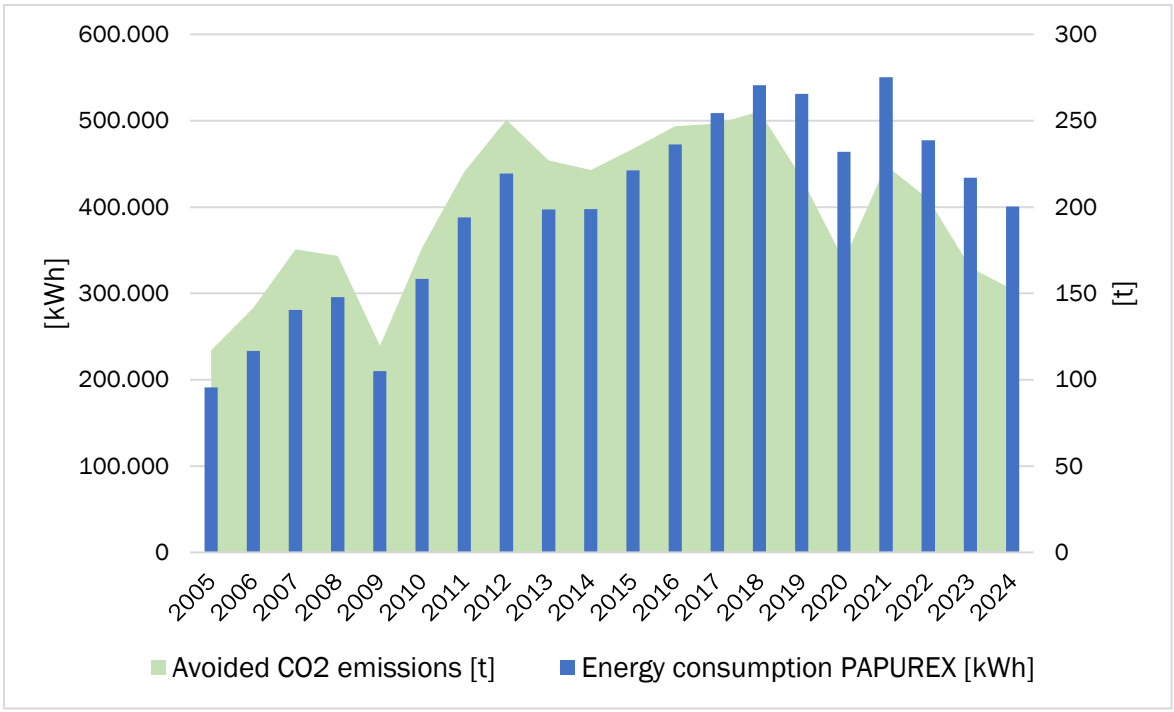

Figure 10: Avoided CO_2 emissions through green power

4.1.2 Energy management

Despite the procurement of green electricity, which leads to less greenhouse gas emissions compared to regular electricity anyway, PAPUREX tries to keep its energy consumption as low as possible. For the first part, this is important because green power is, as described before, not 100 % emission neutral yet, secondly, it is only available in limited amounts. Because of these reasons, in 2024 an energy management system was installed at the production facility in Klein-Breitenbach. This enables the management to observe different metrics and thus design energy consumption more efficiently. This system is compliant with ISO 50001 and is able to identify single energy consumers within the company precisely. This way, hidden consumptions can be uncovered and as a result, total energy consumption can be minimized. Moreover, the system makes the avoidance of peak loads possible which smoothens the impact of PAPUREX on the local electricity infrastructure. During the first quarter of 2025, the system can develop its full influence and can be used for efficient energy management at PAPUREX.

The first measure that as a result of this new energy management is the installation of a new compressor system. The entire working halls on the PAPUREX production site are equipped with pneumatics that are used for various purposes, such as the drying of tubes or the supply of compressed air.

4.1.3 Utilization of production waste

A further measure that contributes to the avoidance of greenhouse gas emissions is the utilization of production waste. These are, as described in chapter 3.2, a result of the starting process or material changes during production. To avoid wasting the effort that is necessary to produce the polyurethane that is not usable for PAPUREX end products, a company-own method for making this material reusable has been developed. This method made the recycling of 24 tons of polyurethane possible in 2022. Purchasing new material instead of this recycled amount, a further 94,8 tons of CO_2 would have been emitted but could be avoided this way (Scope 3).[19] In 2023, another 20,8 tons of production waste could be prepared and reprocessed. This led to another saving of around 85 tons of CO_2. The reason for the decrease in reprocessed production waste is simple: The total

[19] See section 3.1.1

amount of processed material was significantly lower in 2023 than in 2022 (-16 %). Relatively seen, the reprocessed share even increased slightly from 5,6 % to 5,8 %. The same is true for the comparison between 2023 and 2024. In absolute numbers, the amount of reused material decreased again to 20,2 tons. However, the total amount of processed material was 6 % lower in 2024, so the share of reprocessed polyurethane reached a new peak again with 5,94 %. With the "cradle to gate" emission data of the different material types in mind, this equals another saving of 82 tons of CO_2 emissions in 2024.

4.1.3 Sensitization of employees

One of the most important contributions of a company to environmental protection is the sensibilization of its staff to the topic. Only with a positive attitude of the whole team, impactful measures to avoid impacts on the environment in work life and ideally in private as well, can be implemented long-term.[20] Hence, there are regular pieces of training on the topic of saving energy and reducing impacts on the environment at PAPUREX. Moreover, there is a permanent option for all employees to make suggestions for improvement that lead to energy savings or avoidance of waste. These suggestions get rated individually and awarded in case of implementation. Moreover, the whole company fleet will be electrified. This includes all lift trucks that reduce emissions in Scope 1[21] on the one hand, and the other hand, cars that get used by our staff for commuting and thus, are part of Scope 3.[22] In 2024, there are five EVs in the company fleet. During the course of 2025, another two plug-in hybrids will be replaced by EVs. Besides, it is an important part of staff sensitization to keep them up to date. Hence, there are regular pieces of training on how everyone can contribute to energy saving and waste reduction with their habits and thus, reduce GHG emissions. Starting with turning off screens when they are not in use, avoiding unnecessary lighting in unused work facilities to correcting heating and ventilation, everyday life can be created more efficiently and environmentally friendly.

4.2 Water saving

As explained in chapter 3.2, the water consumption of the whole company in 2022 was around 707 cubic meters. The vast majority of that can be assigned to the cooling of produced tubing. The comparison with 2002 shows that this number means a significant reduction in water consumption for PAPUREX. Back then, 596 cubic meters of water were consumed. However, in 2002 the production ran only 11.410 machine hours. In comparison, in 2022 PAPUREX produced tubing with 21.814 machine hours and thus significantly more than 20 years earlier. These values put into relation show, that the consumption of water per machine hour has reduced from 52,5 to 32,4. This is a reduction of 38 % in water consumption.

This efficiency increase can be traced back to improvements in the water circulation of PAPUREX. On the one hand, the production meanwhile gets cooled with a closed cooling circle. This almost exclusively gets fed with service water, which leads to significant savings in fresh water. On the other hand, the usage of the company-owned cistern gets maximized. A cistern collects rainwater that can be used for applications that do not require drinking water quality.

4.3 Waste avoidance

As described in chapter 4.2, some waste amounts are simply unavoidable during the production process. The enable optimal recycling of these, all waste types get strictly separated from each other and disposed of compliant with the valid norms.

[20] Comp. (Klein & Kämmler-Burrak, 2021, S. 116)
[21] See chapter 3.1.1
[22] See chapter 3.1.1

The most important item at PAPUREX is plastic waste due to production. This is not only true because of the amount that has to be disposed of, but especially because of the GHG emissions that arise during the production process of the raw material (see chapter 4.1). This is the reason why the in-house recycling of production waste is of the highest priority at PAPUREX. In 2024, around 20,2 tons of polyurethane was reused in this way. This equals 62 % of the total waste volume. This share has increased by a good 3 % since the first Environmental Statement in 2022, when it was 59 %. In contrast, 12 tons were handed to a recycling company to make the best out of the plastic waste that could not be reused in-house. The externally recycled amount equals 38 % of the total plastic waste volume at PAPUREX. The goal in this area is set: The waste ratio, which decreased anyway over the last few years (from 10,78 % in 2010 to 3,72 % of the total processed raw material in 2024) is to be reduced further. Additionally, PAPUREX increases the share of the in-house recycled materials from year to year, so that even less polyurethane must be externally recycled in the future.

The sales of our polyurethane tubing hold the additional potential to reduce waste. For instance, PAPUREX has wrapped products that have been selling in great lengths on reusable wooden reels for many years. To give our customers enough incentives to send the reels back and instead of scrapping them, we introduced a deposit system. This way, hundreds of reels can be reused, and all participants profit monetarily from that. However, most importantly the impact on the environment can be reduced by the deposit system.

In 2022, PAPUREX introduced a further measure to reduce waste: The reprocessing of used solvents. These are for example necessary, to run the printers which sign our tubing. In the past, used solvents were handed to a professional hazardous materials recycler. Meanwhile, we are able to reprocess them and thus, use them several times before their deposit. This way, the amount of used solvents that must be disposed have decreased drastically from 70 liters to 5 liters annually, which is more than 90 %.

Besides the reduction of waste due to production, the behavior of each colleague at PAPUREX plays a role. Through consistent training, we ensure that all of our employees support the clear course to avoid waste. Because small things like using the in-house water dispenser instead of PET bottles, the usage of reusable containers for food storage, or labeling food and beverages in the fridge, avoid waste. In the sum of 45 coworkers, these savings are even more important.

5. Outlook

We already set the goal to produce CO_2 neutral until 2025 in our environmental statement of 2021.[23] With this third, revised edition of the environmental statement, this goal can be further concretized: PAPUREX strives to bring all GHG emissions that can be influenced by internally made decisions to zero. This includes all CO_2 emissions and all CO_2 equivalents of other GHGes, which fall under Scope 1 and Scope 2. The measures to realize this are already in planning: The main emitter of Scope 1 emissions is the heating system of the production plant in Mörlenbach. The replacement of the system began in December of 2024. In February 2025, the first part of the new CO2-neutral heating system with a powerful heat pump was put into operation. The second part of the new system will follow in the first half of 2025[24] so that the goal of achieving CO2 neutrality in Scope 1 and 2 comes within reach.

Scope 3 emissions are to be reduced, if influenceable, as well. The electrification of the company fleet, regarding the commuting of our employees to work, falls into this category and is already in

[23] Comp. (PAPUREX W. Büchner GmbH, 2021, S. 10)
[24] Status: February 24th 2025

full swing. The exchange of several vehicles with combustion engines by electrified equivalents is already sealed. By 2026, the entire company fleet will be powered electrically. Furthermore, already existing incentives as the possibility to lease bikes and e-bikes via the provider Job Rad[25] for the usage of GHG-neutral ways for commuting, are to be intensified. The goal is to expand the share of GHG-neutral commuting of currently 36 % (it already increased from 28 % in 2022) significantly. The biggest and at the same time most difficult task is the reduction of the indirect GHG emission due to purchasing polyurethane. Here, PAPUREX depends on the development of production techniques of the suppliers. The task is to influence this development by conscious decision-making and consequent representation of interests.

One of the most effective leverages to avoid GHG emissions is one of the most important points in reducing waste at the same time: The reduction of plastic waste due to production and simultaneous increase in recycling of unsellable materials. Both performance indicators are monitored closely at PAPUREX, and specially created competence teams work on their steady improvement. Consequent training and education of the staff is the key to further reducing the remaining impacts on the environment by reducing waste and water consumption and keeping their impact as small as possible. Hence, we will work persistently on improving in this area so that significant improvements can be reported in the next edition of the PAPUREX environmental declaration.

[25] See (JobRad GmbH, 2023)

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Appendix

Klimaschutzzertifikat

Unser Beitrag zum Umweltschutz:
100% Ökostrom

Papurex W. Büchner GmbH

Seit dem 01. Januar 2003 wird dieser Betrieb von LichtBlick mit Ökostrom versorgt. Die durch LichtBlick in das Stromnetz eingespeiste elektrische Energie:

- **stammt weder aus Atom-**, noch aus **Kohle- oder Ölkraftwerken**
- wird vollständig aus **ökologischen Energiequellen** gewonnen.

Durch den Bezug von LichtBlick-Strom vermeidet dieser Betrieb jährlich

235,33 Tonnen

zurechenbare CO_2-Emissionen.

Geschäftsführung LichtBlick SE

TÜV NORD
TÜV NORD CERT GmbH
Geprüfter Ökostrom

LichtBlick SE
Zirkusweg 6 • 20359 Hamburg • www.lichtblick.de

LichtBlick
Generation reine Energie

Figure 11: Green power certificate (before 2024)

ZERTIFIKAT*

CO2-VERMEIDUNG DURCH ÖKOSTROM

Papurex W. Büchner GmbH

Klein-Breitenbach 4, 69509 Mörlenbach

hat sich für Ökostrom der ENTEGA Plus GmbH entschieden.

Die dem Stromverbrauch entsprechende zu erwartende Jahresmenge von voraussichtlich 432.663 kWh wird in skandinavischen Wasserkraftwerken erzeugt und in das Stromversorgungsnetz der allgemeinen Versorgung eingespeist.

Der TÜV Rheinland bestätigt in einem jährlichen Konformitätsnachweis des Tarifs ENTEGA NATURpur Ökostrom - Basis, dass die bezogene Energie aus den benannten regenerativen Quellen stammen und Ihr Stromverbrauch im Herkunftsnachweisregister des Umweltbundesamtes dem Tarif zugeordnet wurde.

Durch den Bezug von ENTEGA Ökostrom vermeidet Papurex W. Büchner GmbH jährlich die Entstehung von voraussichtlich 163 Tonnen des klimaschädlichen Gases Kohlenstoffdioxid (CO2) und leistet damit einen wertvollen Beitrag zum Klimaschutz. Die Berechnung erfolgte auf Basis der Stromkennzeichnung Stand November 2022.

Die Vertragslaufzeit für den Ökostrombezug ist vom 01.01.2024 bis 31.12.2024.

Darmstadt, der 23.01.2024

Frank Gey

Vorsitzender der Geschäftsführung
ENTEGA Plus GmbH

Antje Winter

Geschäftsführerin
ENTEGA Plus GmbH

Zertifiziert und regelmäßig überprüft durch:

TÜVRheinland ZERTIFIZIERT
100% Erneuerbare Energie
Regelmäßige Überwachung
www.tuv.com
ID 0000033919

entega

EINFACH KLIMAFREUNDLICH FÜR ALLE.

Figure 12: Green power certificate (from 2024)

Corporate Carbon Footprint

PAPUREX W. Büchner GmbH

2024

Compliance-relevante Informationen vollständig

Alle Informationen für GHG Protocol und ISO 14064-1 Konformität ausgefüllt

ISO 14064-1 & Greenhouse Gas Protocol
Corporate Accounting and Reporting Standard

Konformität des „ENIT carbon"
Version 1.0.0
mit Stand vom 05.07.2024

GUTcert
AFNOR Group

Berichterstellung: 20.03.2025

Erstellt mit Enit carbon

Systemgrenzen

Dieser CO_2-Bericht richtet sich nach den Vorgaben des „Greenhouse Gas Protocol“ und bilanziert alle im Kyotoprotokoll festgelegten klimaschädlichen Emissionen. Betrachtet werden die Klimaauswirkungen der Treibhausgase über einen Zeitraum von 100 Jahren (GWP100), angegeben in CO2-Äquivalenten (CO2e). Berücksichtigt werden die Treibhausgaspotentiale, sofern möglich, gemäß fünftem IPCC Sachstandsbericht (AR5).

Zeitliche Systemgrenze

Bilanzierungsjahr
2024

Basisjahr
2022

Organisatorische Systemgrenze

PAPUREX W. Büchner GmbH
1 Entität

PAPUREX W. Büchner GmbH

Bilanzierungsansatz
Operativer Kontrollansatz

Operative Systemgrenze

Alle Emissionen eines Unternehmens werden gemäß GHG Protocol in drei Geltungsbereiche, die sogenannten "Scopes", unterteilt. Scope 1 umfasst alle Treibhausgas-Emissionen, die direkt im Unternehmen entstehen, beispielsweise durch die Verbrennung von fossilen Brennstoffen. Unter Scope 2 versteht man diejenigen Emissionen, die durch den Bezug von leitungsgebundenen Energien, wie z.B. Strom, freigesetzt werden. Hierbei fallen nur indirekte Emissionen an, da diese bereits bei der Produktion beim Energielieferanten verursacht werden. Scope 3-Emissionen sind ebenfalls indirekte Emissionen, die in den vorgelagerten oder nachgelagerten Wertschöpfungsstufen eines Unternehmens entstehen. Die Bilanzierung der Scope 1- und Scope 2-Emissionen deckt nach GHG Protocol die Mindestanforderung an einen vollständigen Bericht ab, wohingegen die Bilanzierung der Scope 3-Emissionen nicht verpflichtend ist. In der vorliegenden Bilanz wurden alle relevanten Scope 1- und Scope 2- Emissionen vollständig betrachtet. Zur Identifikation der relevanten Scope 3-Kategorien wurden die folgenden Kriterien bewertet: Relevanz, Kontrolle und Beeinflussbarkeit, Vermeidungspotenzial sowie Datenerhebungs- und Transaktionskosten.

Insgesamt wurden vier Scope-3-Kategorien bei der Bewertung dieser Kriterien als relevant eingestuft

- 3.1 Eingekaufte Waren und Dienstleistungen
- 3.4 Logistik (vorgelagert)
- 3.5 Abfall
- 3.7 Anfahrt Mitarbeitende

Die folgenden Scope-3-Kategorien wurden für diesen Bericht als nicht relevant erachtet:

- 3.2 Kapitalgüter
- 3.3 Vorkette Brennstoffe
- 3.6 Geschäftsreisen
- 3.8 Angemietete Sachanlagen
- 3.9 Logistik (nachgelagert)
- 3.10 Verarbeitung verkaufter Produkte
- 3.11 Nutzung verkaufter Produkte
- 3.12 Entsorgung verkaufter Produkte
- 3.13 Vermietete Sachanlagen
- 3.14 Franchise
- 3.15 Investitionen

Beschreibung der operativen Systemgrenze

Für die Bilanzierung wurden die wichtigsten Treibhausgasemittenten der PAPUREX W. Büchner GmbH ausgewählt. In Scope 1 und Scope 2 sin diese sehr übersichtlich. In Scope 3 beschränkt sich die Analyse hauptsächlich auf das von uns verarbeitete Rohmaterial, also Polyurethan. Zudem wurden die Anfahrten unserer Mitarbeiter mit Strecke und genauem Fahrzeugtyp analysiert. Bei der Verwendung anderer Produkte wurden diese herangezogen, die den größten Einfluss auf die Emissionen haben. Die Emissionen der nicht berücksichtigten Produkte liegen innerhalb des angegebenen Genauigkeitsintervalls.

Executive Summary

Gesamtemissionen
1.386,76 t CO_2e

zzgl. biogener Emissionen
0 t CO_2e

Datenqualität
Sehr Hoch

GHG-Protocol Unsicherheit
+/- **4** %

Sehr Hoch = ± 5%, Hoch = ± 15%, Mittel = ± 30%, Niedrig = mehr als ± 30%

Einteilung in Scopes

Scope 1
20,35 t CO_2e

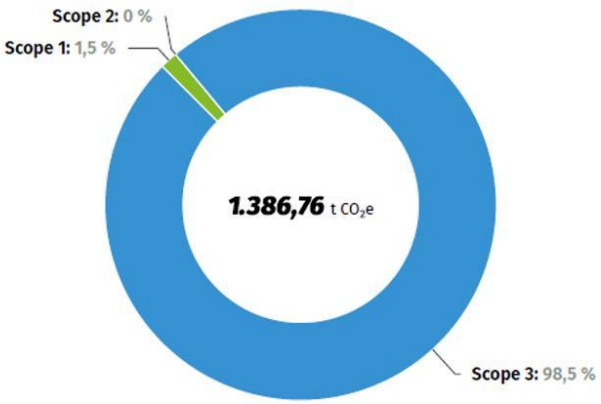
Scope 1 umfasst die direkte Freisetzung klimaschädlicher Gase in Ihrer Organisation.

Scope 2
0 t CO_2e

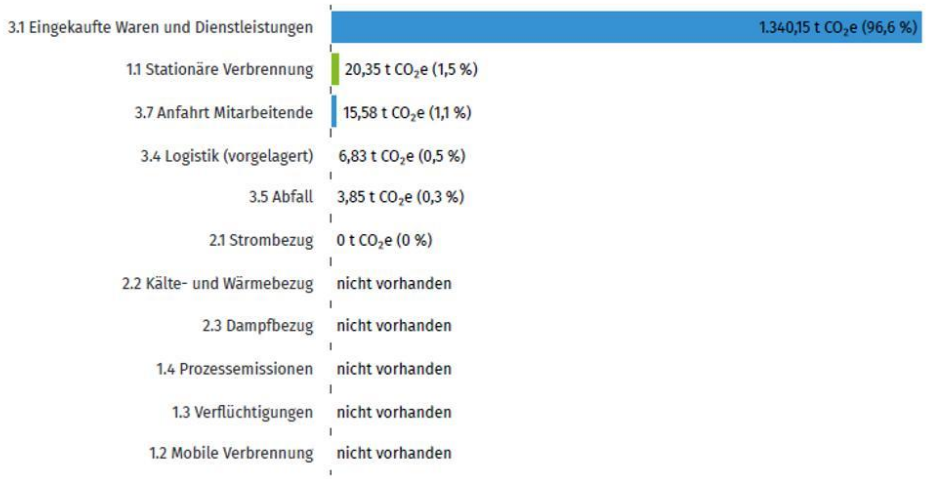
Scope 2 umfasst die indirekte Freisetzung klimaschädlicher Gase durch Energielieferanten.

Scope 3
1.366,42 t CO_2e

Scope 3 umfasst die indirekte Freisetzung klimaschädlicher Gase in der vor- und nachgelagerten Lieferkette oder weiteren, externen Aktivitäten.

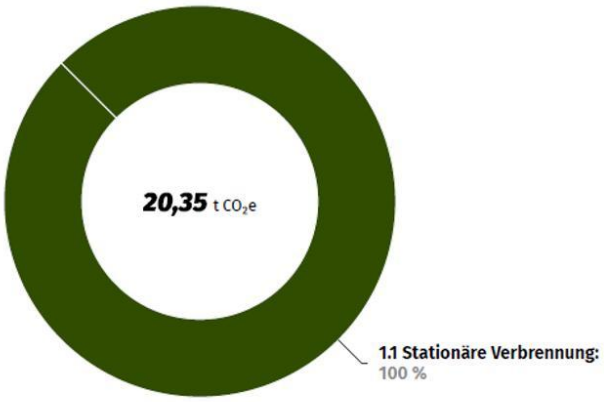


Einteilung in Kategorien



Scope Emissionen

Scope 1 Emissionen



Emissionsquellen

1.1 Stationäre Verbrennung

Bezeichnung	Aktivitätsdaten		Emissionsfaktor		Emissionen	
	Menge	Datenquelle	Faktor	Datenquelle	Gesamt	Datenquelle
Heizöl	7.530 l	Inventur	2,6851 kg CO_2e / l	GEMIS 5.1	20,22 t CO_2e ⓘ	
Propangas	33 kg	Inventur PAPUREX	3,8571 kg CO_2e / kg	BAFA CO2-Faktoren (2023)	0,13 t CO_2e ⓘ	

1.2 Mobile Verbrennung nicht vorhanden

Keine Emissionsquellen

1.3 Verflüchtigungen nicht vorhanden

Keine Emissionsquellen

1.4 Prozessemissionen nicht vorhanden

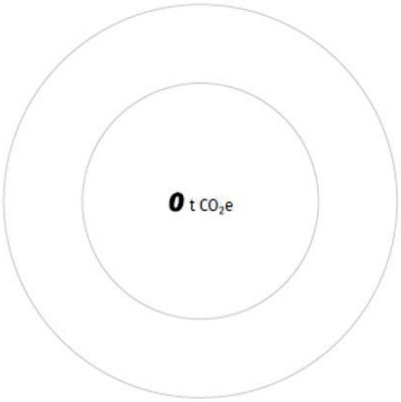
Keine Emissionsquellen

Emissionen pro Treibhausgas (absolute Menge) ohne biogene Emissionen

CO_2	CH_4	N_2O	HFKW	FKW	SF_6	NF_3	VOC
20,18	0	0	0	0	0	0	0

Angaben in t

Scope 2 Emissionen



Emissionsquellen

2.1 Strombezug

Bezeichnung	Aktivitätsdaten		Emissionsfaktor		Emissionen	
	Menge	Datenquelle	Faktor	Datenquelle	Gesamt	Datenquelle
Stromverbrauch	400.751 kWh	Abrechnung Stromversorger	0 kg CO_2e / kWh	BAFA CO2-Faktoren (2024)	0 t CO_2e ⓘ	

2.2 Kälte- und Wärmebezug nicht vorhanden

Keine Emissionsquellen

2.3 Dampfbezug nicht vorhanden

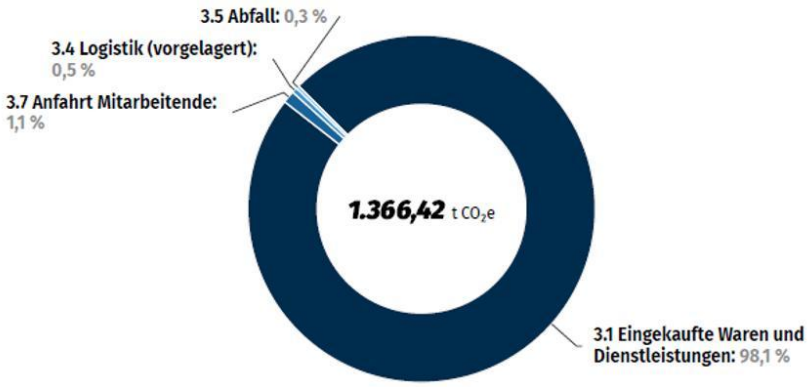
Keine Emissionsquellen

Emissionen pro Treibhausgas (absolute Menge) ohne biogene Emissionen

CO_2	CH_4	N_2O	HFKW	FKW	SF_6	NF_3	VOC
0	0	0	0	0	0	0	0

Angaben in t

Scope 3 Emissionen



3.1 Eingekaufte Waren und Dienstleistungen

Bezeichnung	Aktivitätsdaten		Emissionsfaktor		Emissionen	
	Menge	Datenquelle	Faktor	Datenquelle	Gesamt	Datenquelle
[redacted]	154.291 kg	Warenwirtschaftssystem	3,6 kg CO_2e / kg	Lieferant	555,45 t CO_2e	
[redacted]	67.437 kg	Warenwirtschaftssystem	4,2 kg CO_2e / kg	Lieferant	283,24 t CO_2e	
[redacted]	29.113,75 kg	Warenwirtschaftssystem	4,5 kg CO_2e / kg	Lieferant	131,01 t CO_2e	
[redacted]	24.667 kg	Warenwirtschaftssystem	4,4 kg CO_2e / kg	Lieferant	108,53 t CO_2e	
[redacted]	20.367 kg	Warenwirtschaftssystem	3,7 kg CO_2e / kg	Lieferant	75,36 t CO_2e	
[redacted]	9.138,57 kg	Warenwirtschaftssystem	4,15 kg CO_2e / kg	Lieferant	37,93 t CO_2e	
[redacted]	6.432,8 kg	Warenwirtschaftssystem	4,8 kg CO_2e / kg	Lieferant	30,88 t CO_2e	
[redacted]	6.772 kg	Warenwirtschaftssystem	4 kg CO_2e / kg	Lieferant	27,09 t CO_2e	
[redacted]	5.488 kg	Warenwirtschaftssystem	4,9 kg CO_2e / kg	Lieferant	26,89 t CO_2e	
[redacted]	3.662 kg	Warenwirtschaftssystem	4,5 kg CO_2e / kg	Lieferant	16,48 t CO_2e	
[redacted]	4.504 kg	Warenwirtschaftssystem	3,6 kg CO_2e / kg	Lieferant	16,21 t CO_2e	
[redacted]	2.264,01 kg	Warenwirtschaftssystem	4 kg CO_2e / kg	Lieferant	9,06 t CO_2e	
[redacted]	1.520,95 kg	Warenwirtschaftssystem	3,9 kg CO_2e / kg	Lieferant	5,93 t CO_2e	
[redacted]	1.222 kg	Warenwirtschaftssystem	4,6 kg CO_2e / kg	Lieferant	5,62 t CO_2e	
Versandkartons	5.942 kg	Warenwirtschaftssystem	0,62 kg CO_2e / kg	BAFA CO2-Faktoren (2024)	3,68 t CO_2e	
Kunststoffstecker	905 kg	Warenwirtschaftssystem	3,7 kg CO_2e / kg	BAFA CO2-Faktoren (2024)	3,35 t CO_2e	

Bezeichnung	Aktivitätsdaten		Emissionsfaktor		Emissionen	
	Menge	Datenquelle	Faktor	Datenquelle	Gesamt	Datenquelle
[redacted]	355,8 kg	Warenwirtschaftssystem	4 kg CO_2e / kg	Lieferant	1,42 t CO_2e	
[redacted]	306 kg	Warenwirtschaftssystem	4,15 kg CO_2e / kg	Lieferant	1,27 t CO_2e	
[redacted]	182,5 kg	Warenwirtschaftssystem	4,15 kg CO_2e / kg	Lieferant	0,76 t CO_2e	

3.4 Logistik (vorgelagert)

Bezeichnung	Aktivitätsdaten		Emissionsfaktor		Emissionen	
	Menge	Datenquelle	Faktor	Datenquelle	Gesamt	Datenquelle
Transport Polyurethan	145.604 tkm	Interne Berechnung	0,0469 kg CO_2e / tkm	GEMIS 5.1	6,83 t CO_2e	

3.5 Abfall

Bezeichnung	Aktivitätsdaten		Emissionsfaktor		Emissionen	
	Menge	Datenquelle	Faktor	Datenquelle	Gesamt	Datenquelle
Papiermüll	3.744 kg	Abrechnung Entsorgungsunternehmen	0,5203 kg CO_2e / kg	Defra (2024)	1,95 t CO_2e	
Restmüll	3.360 kg	Abrechnung Entsorgungsunternehmen	0,5203 kg CO_2e / kg	Defra (2024)	1,75 t CO_2e	
Abwasser	842 m^3	Abgabenbescheid Gemeinde	0,1857 kg CO_2e / m^3	Defra (2024)	0,16 t CO_2e	

3.7 Anfahrt Mitarbeitende

Bezeichnung	Aktivitätsdaten		Emissionsfaktor		Emissionen	
	Menge	Datenquelle	Faktor	Datenquelle	Gesamt	Datenquelle
Benzin	4.561 l	Interne Erhebung	2,6864 kg CO_2e / l	United States Environmental Protection Agency	12,25 t CO_2e	
Diesel	825 l	Interne Erhebung	2,8142 kg CO_2e / l	United States Environmental Protection Agency	2,32 t CO_2e	
Anreise mit dem Bus	10.758 Pkm	interne Erhebung	0,093 kg CO_2e / Pkm	Deutsches Umweltbundesamt	1 t CO_2e	
Anreise mit dem Zug	2.441 Pkm	Interne Erhebung	0,001 kg CO_2e / Pkm	Deutsche Bahn	< 0,01 t CO_2e	

Enit Emissionsfaktordatenbank Quellenverzeichnis

Kurzverweis	VerfasserIn(nen)	Jahr	Titel	Quelle
Allekotte et al. (2020)	Allekotte et al. in Umweltbundesamt (Hrsg.)	2020	Ökologische Bewertung von Verkehrsarten	https://www.bmuv.de/fileadmin/Daten_BMU/Pools/Forschungsdatenbank/fkz_3717_58_1060_oekologischer_verkehrsartenvergleich_bf.pdf
Association of Issuing Bodies (2023)	Association of Issuing Bodies	2023	European Residual Mixes 2022	https://www.aib-net.org/sites/default/files/assets/facts/residualmix/2022/AIB_2022_Residual_Mix_Results_inclAnnex.pdf
badenova Energie GmbH (2023)	badenova Energie GmbH	2023	Stromkennzeichnung 2022 (gemäß § 42 Energiewirtschaftsgesetz)	https://www.badenova.de/downloads/geschaeftskunden/energie/strom-und-oekostrom/strom-und-oekostrom/stromkennzeichnung-2022-badenova.pdf
BAFA CO2-Faktoren (2023)	Bundesamt für Wirtschaft und Ausfuhrkontrolle	2023	Informationsblatt CO2-Faktoren v2.9	https://www.bafa.de/SharedDocs/Downloads/DE/Energie/eew_infoblatt_co2_faktoren_2023.html
BAFA CO2-Faktoren (2024)	Bundesamt für Wirtschaft und Ausfuhrkontrolle	2024	Informationsblatt CO2-Faktoren v3.0	https://www.bafa.de/SharedDocs/Downloads/DE/Energie/eew_infoblatt_co2_faktoren_2024.html
Defra (2023)	Department for Environment, Food and Rural Affairs	2023	GHG Conversion Factors for Company Reporting	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023
Defra (2024)	Department for Environment, Food and Rural Affairs	2024	GHG Conversion Factors for Company Reporting	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
Defra (2024) spend-based	Department for Environment, Food and Rural Affairs	2024	Conversion factors KgCO2 per £ spent	https://www.gov.uk/government/statistics/uks-carbon-footprint
Deutscher Verband Flüssiggas e.V. (2012)	Deutscher Verband Flüssiggas e.V.	2012	Well-to-Wheel- (WTW-) Analysen von Gasfahrzeugen	https://www.dvfg.de/fileadmin/user_upload/downloads/studien-gutachten/wtw-studie-gasantriebe-2012-prof.heinzehtw.pdf
ecoinvent	Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B.	2023	The ecoinvent database version 3.10	http://link.springer.com/10.1007/s11367-016-1087-8
EnBW Energie Baden-Württemberg AG (2023)	EnBW Energie Baden-Württemberg AG	2023	Energieträgermix 2022, Stromkennzeichen gemäß § 42 Energiewirtschaftsgesetz	https://www.enbw.com/media/vertrieb/docs/stromkennzeichnung.pdf
EPA (2020)	United States Environmental Protection Agency	2020	Supply Chain Greenhouse Gas Emission Factors for US Industries and Commodities	https://catalog.data.gov/dataset/supplychain-greenhouse-gas-emissionfactors-for-usindustries-andcommodities
Europäische Kommission (2023)	European Commission	2023	Default values for the transitional period of the CBAM between 1 October 2023 and 31 December 2025	https://taxation-customs.ec.europa.eu/system/files/2023-12/Default%20values%20transitional%20period.pdf
EXIOBASE	Stadler, K.; Wood,R; Bulavskaya, T.; Södersten, C.	2019	EXIOBASE3	https://doi.org/10.5281/zenodo.5589597
Furberg et al. (2019)	Furberg et al.	2019	Environmental life cycle assessment of cemented carbide (WC-Co) production	https://www.sciencedirect.com/science/article/pii/S0959652618332992?ref=pdf_download&fr=RR-2&rr=891fb05458329000
GEMIS 5.0	IINAS, Software	2019	GEMIS 5 Globales Emissions-Modell integrierter Systeme	Verfügbar unter GEMIS - IINAS

Kurzverweis	VerfasserIn(nen)	Jahr	Titel	Quelle
GEMIS 5.1	IINAS, Software	2022	GEMIS 5 Globales Emissions-Modell integrierter Systeme	Verfügbar unter GEMIS - IINAS
ProBas	Umweltbundesamt	2015	Prozessorientierte Basisdaten für Umweltmanagementsysteme	https://www.probas.umweltbundesamt.de/php/index.php
Sustamize	sustamizer®	2023	CO2e Reference Database v.2.3.1	https://www.sustamize.com/data
Umweltbundesamt Strommix (2023)	Umweltbundesamt	2023	Entwicklung der spezifischen Treibhausgasemissionen des deutschen Strommix in den Jahren 1990 - 2022	https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2023_05_23_climate_change_20-2023_strommix_bf.pdf
Umweltbundesamt Strommix (2024)	Umweltbundesamt	2024	Entwicklung der spezifischen Treibhausgasemissionen des deutschen Strommix in den Jahren 1990 - 2023	https://www.umweltbundesamt.de/publikationen/entwicklung-der-spezifischen-treibhausgas-10
Umweltbundesamt Verkehrsmittel (2022)	Umweltbundesamt	2022	Vergleich der durchschnittlichen Emissionen einzelner Verkehrsmittel im Personenverkehr in Deuschland 2022	https://www.umweltbundesamt.de/themen/verkehr/emissionsdaten#tremod
Umweltbundesamt: Verbindungen und Gemische (2024)	Umweltbundesamt	2024	Treibhauspotentiale (Global Warming Potential, GWP) ausgewählter Verbindungen und deren Gemische gemäß Viertem (AR4) und Fünftem (AR5) Sachstandsbericht des IPCC bezogen auf einen Zeitraum von 100 Jahren	https://www.umweltbundesamt.de/sites/default/files/medien/10594/dokumente/2024-03_treibhauspotentiale_gwp_ar4_ar5_vo2024-573_homepage_deutsch.pdf

Figure 13: PAPUREX GHG Report