# Strukton Group
# Chain analysis of sustainable overhead lines

Strukton

Version 2025

## Authorization

| Role | Company | Function | Name | Signature | Date |
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# Chain analysis of sustainable overhead lines
## Strukton Group

Reporting in the context of the CO2 Performance Ladder

**April 2025**
Created in collaboration with M.Vos of MVos Advies

# 1 Introduction

In order to gain more insight into the CO2 emissions associated with the production of overhead lines and as part of the CO2 performance ladder, Strukton Groep N.V. is conducting an analysis of a GHG (Green House Gas) generating chain. This document describes the chain analysis of the production, transport, use and disposal of the copper contact wire by Strukton Groep N.V. and its chain partners. This chain analysis was drawn up by MVos Advies on behalf of Strukton Groep N.V.

## 1.1 Reading guide

In this report, Strukton presents the chain analysis of sustainable overhead lines. The structure of the report is as follows:

| | |
|---|---|
| Chapter 1 | Describes what a chain analysis is, the activities and positioning of Strukton Group in the field of corporate social responsibility. |
| Chapter 2 | Justifies the choice of the chosen product category and also describes the scope |
| Chapter 3 | Describes the chain of the overhead line and provides background information about the various production locations |
| Chapter 4 | Appoints the chain partners |
| Chapter 5 | Quantifies CO2 emissions in the chain |
| Chapter 6 | Contains the objectives and measures for further reduction of CO2 emissions in the chain |
| Chapter 7 | Describes progress in 2024 |
| Chapter 8 | Displays the resources used |

## 1.2 Activities of Strukton Groep N.V.

Strukton is active in the design, construction and maintenance of a sustainable infrastructure, both above and below ground, using high-quality technology. Strukton's strength lies in the combination of civil engineering and rail fields. With more than 4,300 employees in Europe, Strukton achieved a turnover of 1.3 billion euros in 2022.

Strukton's activities are housed in various operating companies, namely:

| | |
|---|---|
| **Strukton Rail Netherlands** | Maintenance, management, renewal and construction of track, integration with other public transport systems |
| **Strukton Infra Specials** | Design, construction, management and maintenance of civil infrastructure (e.g. civil engineering structures: bridges, tunnels, locks and viaducts) |
| **Strukton Roads & Concrete** | Design, construction, management and maintenance of civil infrastructure (roads, civil engineering works, concrete construction |
| **Portfolio companies** | Various specializations |

In addition, Strukton has rail activities in Italy, Belgium, Sweden and Denmark.

## 1.3 What is a chain analysis

A chain analysis is created by considering the business process and the value chain, with the aim of mapping the CO2 emissions in the process. This concerns the CO2 emissions that are the result of, for example, the purchased materials or the costs of use of the product by the customer. In short, emissions that are not directly caused by their own company, but by suppliers or customers. The *entire chain* refers to the entire life cycle of the product: from extraction of the raw material to the end of its life.

## 1.4 Purpose of the chain analysis

The main objective for conducting this chain analysis is to identify CO2 reduction opportunities, define reduction targets and monitor progress.
Based on the insight into the scope 3 emissions and the chain analysis, a reduction target is formulated. Within the energy management system that has been introduced, there is an active focus on reducing scope 3 emissions.

Providing information to partners within the own chain and industry peers who are part of a similar chain of activities is an explicit part of this. Based on this chain analysis, Strukton will take steps to involve partners within its own chain in achieving the reduction targets.

## 1.5 Strukton's sustainability policy and its place in CO2

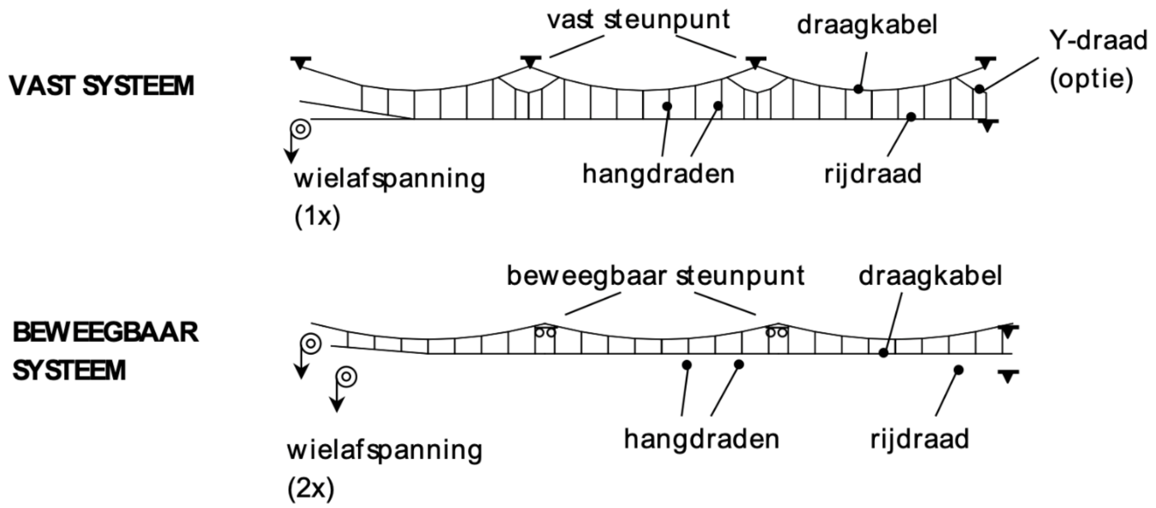
Strukton does business in a socially responsible way. Strukton is actively contributing to the reduction of CO2 emissions, for example by reducing the use of fossil fuels and generating its own energy on the projects.

Strukton Group's sustainability policy is based on the Sustainable Development Goals, drawn up by the UN. Specifically, we focus on the SDGs in which we can make a difference, namely: 7, 8, 9, 12, 13, 15 and 17. The company's own operations must therefore meet strict sustainability requirements. We see this reflected in projects, innovations and collaborations with customers and suppliers in which we look for sustainable solutions. Since 2010, Strukton has been certified as a company on step 5 of the CO2 performance ladder, the highest possible level. Part of level 5 is actively managing CO2 reduction in scope 3 emissions by means of a chain analysis.

## 1.6 What is the overhead line

The overhead line in the rail infrastructure should facilitate the last part of the energy transport. All power used by the train is therefore supplied via the overhead wires.

An overhead line system looks like this:




*Visualization of an overhead line. In the Netherlands, there is both a fixed system and movable overhead wires. For the chain analysis, it is not important which system is used. It only concerns the contact wires that are the same in both systems.*

This shows that an overhead line system consists of five parts:

1. Contact wire
2. Carrier cable
3. Hanging wires
4. Y-wire (optional)
5. Clamps (not included in the drawing, these are the parts that clamp the contact wire to the hanging wires).

The purpose of the contact wire is to maintain good contact between the overhead line and the train in order to provide the traction feed. A pantograph is located on the trains that slides along the contact wires and draws the current. This current is then transported to the 'engine' in the train, where the electricity is converted into movement: the movement of the train.

There are two contact wires hanging above the tracks in the Netherlands with the regular 1500V system. These contact wires run parallel to each other. This increases the interface between the pantograph boat and the contact wire. The relatively low voltage of 1500 Volts provides a high current, so the more contact there is between the two, the less chance there is of sparking when driving in bad conditions. The Y-wire is a tool for the trains to move faster. It improves the dynamic behaviour of the contact wires when the train passes at a high speed, so that the pantograph remains in contact with the contact wires at all times.

The hanging wires ensure that the contact wire hangs horizontally. By pulling the contact wire up every seven meters, it does not hang far. Little sag is important to maintain contact between the contact wire and the pantograph.
The clamps ensure that the contact wire is kept apart. They are placed every 7 meters. The copper is incorporated in all five parts.

## 1.7 Professional support

This report was prepared with the support of Martin Vos of MVos Advies.
This professional external support meets requirement 4.A.3 of the CO2 Performance Ladder.

# 2 Scope 3 emissions & selection of chains for analysis

The business activities of the Strukton Group are part of a chain of activities. For example, materials that are purchased must first be produced (upstream) and the transport, use and processing of delivered "products" or "works" goes hand in hand with energy consumption and emissions (downstream).

## 2.1 Selection of chains for analysis

In accordance with the requirements of the CO2 Performance Ladder, Strukton must draw up two chain analyses from the emission categories with the highest CO2 emissions. Strukton has previously carried out a chain analysis on circular concrete erecting piles for the overhead line.

An important criterion for certification on step 5 is to provide insight into Strukton's Scope 3 emissions. In the document "Quantitative scope 3 analysis" the most material Scope 3 emission categories have already been mapped. In this analysis, the category electronics/cables comes in 5th place.

Strukton will actively collaborate with its chain partners and offer them a sustainable alternative, a contact wire made of fully recycled copper. In addition to the parties involved (Strukton Rail and La Farga), ProRail is the most important external chain partner.

## 2.2 Scope chain analysis

In order to determine the CO2 emissions in the contact wire value chain, it must first be determined which chain steps this value chain consists of and which of these steps are part of the analysis.

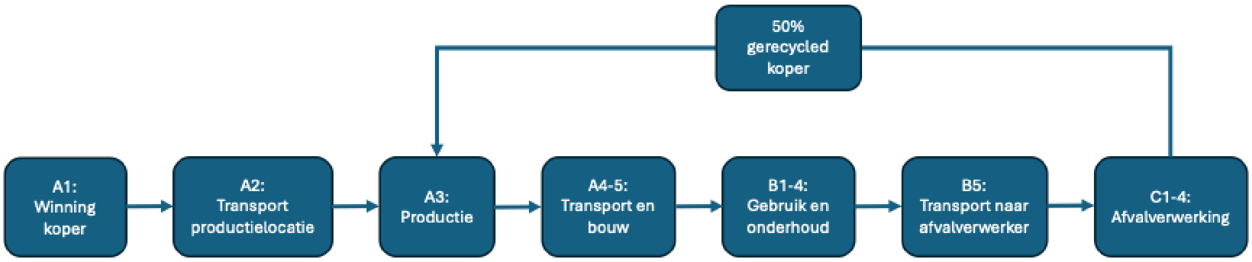
The scope of the chain analysis in this report covers the production phase, construction phase, use phase, demolition and processing phase and reuse and/or recovery of materials from the contact wire.

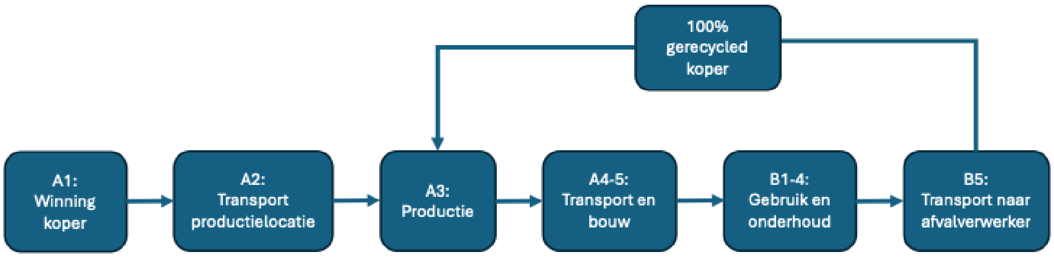
In this chain analysis, the CO2 emissions of traditional contact wire are mapped. These results are then compared with the CO2 emissions of the contact wire made of fully recycled copper.

# 3 Value chain

## 3.1 Description of the contact wire chain

The value chain of the copper contact wire is shown schematically below.




## 3.2 Extraction and production of contact wire A1-A3

**Extraction of raw materials**

The contact wire consists mainly of copper. Copper is mined in many parts of the world. In America (United States, Mexico, Chile), in Africa (Zambia, Zaire), in Asia (Kazakhstan, Indonesia) and in Europe (Poland and Sweden).
Minerals (copper ore) are mined first, of which chalcopyrite ($CuFeS_2$) is the most important, followed by chalcolite, covellite, azurite, malachite and bornite. In terms of weight ratio, these ores usually contain no more than one percent copper. Most copper ore is mined in open-pit mines.
The copper is dissolved from ore through chemical processes. Electrolytically pure copper is produced from this.
Copper can also be recycled. Copper is recycled by melting the copper scrap. If contaminated, the molten copper can be refined. For some applications, other elements are added to obtain the right alloy. In a contact wire, one part is recycled copper and one part is new copper. It is not clear how this composition compares. That is why 50% new copper and 50% recycling have now been chosen in the regular scenario.
New copper must also be applied when recycling old contact wires to ensure that the new contact wires meet ProRail's requirements. It is not clear how much new copper needs to be applied to the old contact wires, but it is certain that this will be less than in the regular process, because it already has the right composition of copper and only needs to reach the right thickness. In this case, 20% new copper and 80% recycling are used.

**Transport of the raw materials to the production site**

The copper is transported from the extraction or recycling site to the production site of the catenary parts. This is done by cargo ship or by truck, depending on the location. The location is not known at this time. What is known is that copper for the contact wires for one of the three contact wire producers (Isodraht) comes from Sweden and is processed into a new contact wire in Germany. Therefore, in this chain analysis, the transport distance from Sweden to Germany is used.

**Production of contact wire**

The production of contact wires is done by a contact wire manufacturer. These are not located in the Netherlands: contractors buy their contact wires from producers in Spain, Germany or Belgium. These producers are La Farga (Spain), Lamfill (Belgium), NKT (Germany) and Isodraht (Germany-Sweden).

## 3.3 Extraction and production of contact wire A1-A3

**Transport from production site to project site**

After production, the contact wires are transported to the project site by truck. Since these have to come from Spain, an average of 1,500 km is calculated.
It is possible that the contact wires are stored in a depot, but this does not always happen. This calculation is based on storage in an interim depot.

**Construction phase**

At the construction site, the contact wires are transferred from the trucks to the work train. Strukton uses a work train called the GEMMA. With this work train, the old contact wire can be removed immediately when the new contact wire is hung. This train can therefore hang and remove the contact wire in one go, which saves transport movements compared to the process in which both parts are carried out separately.
This chain analysis is based on the Gemma work train, but if such a train is not used and the two processes are carried out separately from each other (and therefore with multiple transport movements), CO2 emissions will be higher if the same assumptions for the other chain processes remain the same.

## 3.4 Maintenance B2-5

The contact wire also needs maintenance. If the contact wire does not hang flat, sparks can occur that cause wear on the contact wire. As a result, the power supply to the trains no longer works optimally. The overhead line, and especially the contact wire, is therefore regularly inspected. A number of measurement systems have been developed that allow inspections of the overhead lines to take place with a regular train, for example TNO's ATON system, so that there are no emissions associated with the inspections. In view of the total deployment of these systems, no additional emissions are attributed to the inspection of the contact wires.

## 3.5 Use

To allow the passenger and freight trains to run on the routes, they use the overhead wires. The overhead lines provide them with the power supply that the trains need to run. The power consumption of these trains is attributed to ProRail (consumption of traction energy), but the NS also reports on the electricity consumption of their trains, which is theoretically the same electricity consumption. In this chain analysis, the electricity consumption from ProRail's traction energy was used.

## 3.6 End of Life C1-4

If the contact wires no longer meet the required thickness (<7mm), the contact wire must be replaced. However, the replacement is often carried out before this limit is reached. This is done on the basis of maintenance guidelines from ProRail. On average, the contact wire is replaced once every 30 years. Given the fact that the contact wire consists of almost pure copper, it is often disposed of separately in containers. This is therefore not mixed with the "dirty" copper, such as cables, which are still surrounded by an insulation material. Separating these materials is therefore not necessary.
When replacing the contact wires, the new contact wire is also hung at the same time (see laying contact wire). This reel is loaded onto a low-loader/truck and transported to a waste processor with the 'Metal Recycling Federation quality mark (MRF)'. This waste processor melts down the copper and possibly sells it back to a copper dealer. It is not clear for what purpose the melted copper from the waste processor is used. The price quotation for the old copper for the waste processor has already been determined for each project in the contract with ProRail. For this price, the contractor will also sell the old contact wire to the waste processor. This is then independent of the copper price at the time of the sale of the old contact wire.
It is also possible to take the old contact wires directly to a contact wire manufacturer. This immediately melts the old contact wires with a small portion of extra clean copper into new contact wires with the required thickness that ProRail requires. For the contractor, there is currently no additional advantage of taking the old copper contact wires directly to the producer, they mainly choose the cheapest collector with an MRF quality mark. It does not matter whether this is also a producer or not.

# 4 Chain partners

Identifying the chain partners is part of the chain analysis. This makes it clear what the role of the chain partners is and from whom what information must be requested for the purpose of determining CO2 emissions in the chain.
In addition, insight into the influence of the various chain partners is important. In order to answer the question: 'With whom can Strukton best work to achieve CO2 reduction?' the following questions must be answered:
- Who are the chain partners?
- Where are the largest emissions within the chain?
- Which chain partners are involved in the chain steps with the largest emissions?

In order to determine where Strukton has the most influence on emissions, it is important to define which chain partners are involved in the project and in what way. This is discussed in this chapter. The largest emissions are dealt with in Chapter 5. In chapter 6, the chain partners are related to the emissions per chain step.
The definition of the term chain partner is first described below. The chain partners in the project are named and explained below.

## 4.1 Definition of chain partners

Chain partners are parties both upstream and downstream in the chain(s) of the company with which the company cooperates. These can be, for example, customers, distributors, suppliers or clients.
When identifying chain partners, a distinction must be made between direct chain partners and indirect chain partners. Direct chain partners are parties in the chain with whom Strukton has a contractual relationship, such as suppliers, customers, subcontractors and clients. Indirect chain partners are parties with which Strukton does not have a direct (contractual) relationship, such as suppliers of the subcontractors. Information about the CO2 data of indirect chain partners is more difficult for Strukton and generally more difficult to obtain because of the indirect relationship.
According to claim 5.A.3. in the CO2 performance ladder, the party to be certified (Strukton) of the direct (and potential) chain partners that are relevant to the implementation of the scope 3 strategy must have specific emission data from direct chain partners. Where possible, Strukton should also try to obtain emission data from relevant indirect chain partners.

## 4.2 Chain partners

| Chain activity | Chain partner | Explanation |
|---|---|---|
| Extraction of raw material and production of contact wire | ProRail | Determines contact wire composition |
| | La Farga, Lamfill, NKT, Isodraht, elcowire | Contact wire manufacturer |
| Transport contact wire | La Farga, Lamfill, NKT, Isodraht, elcowire | Choice of means of transport |
| | Strukton (or other) | Choice of means of transport |
| Construction of contact wire | Strukton (or other) | Way of hanging<br>(GEMMA train) |
| | ProRail | Decides on decommissioning |
| Use track | ProRail, NS, Arriva and others | Deciding how many times a train can run on the track |
| Contact wire inspections | Strukton (or other) | Performs inspections |
| | ProRail | Sets requirements for the minimum thickness of the contact wire |

| | | |
|---|---|---|
| Replacement contact wires | ProRail | Proposes procedures |
| | Strukton (or other) | Replaces contact wire. Buyer relinquishes to contractor |
| Waste management | Various waste processors, La Farga | Melting down / recycling copper |

The chain partners are explained per step below.

**Production and construction: ProRail**
ProRail sets out the requirements that the contact wire must meet. These include the strength of the contact wires, the choice of copper and the composition of the copper.
The production is done by La Farge (Spain), Isodraht (Germany), elcowire (Germany), NKT (Germany) or Lamfill (Belgium). The contact wires are always delivered by truck. This is often arranged by the producer.
The construction is being carried out by various contractors such as Strukton. They use a GEMMA train (or a KROL for the other contractors) that carries out the hanging of the new contact wire and removal of the old contact wire at the same time.

**Use: ProRail and NS**
ProRail and NS jointly determine how often a train can run on the track. How often a train passes the contact wires partly determines the degree of wear of the contact wires.

**Maintenance: Contractor & ProRail**
ProRail has also laid down procedures for maintenance, indicating when the contact wire must be inspected. The contractor, for example Strukton, decides for itself how to carry out the inspection within these requirements.

**End of life: ProRail and contractor**
ProRail has also laid down procedures for replacement at the end of the contact wire's life, indicating when the contact wire must be replaced. The contractor decides for himself how to carry out the replacement within these requirements. The copper of the old contact wires also reverts to the contractor. He sells this on to a waste worker with an MRF quality mark via a fixed price in the contract with ProRail.

**End of life: Waste processor with MRF quality mark**
The copper is then transported to the waste processor with the MRF quality mark. The mode of transport is determined by the waste processor. The waste processor melts down the copper and sells it on for new purposes. It is not clear to whom he sells this, so the melted copper from the contact wires is not exclusively intended for new contact wires in the current situation.
In the new situation, it is also possible to have the old contact wire processed by La Farga.

## 4.3 Conclusion on the involvement of chain partners

The information shows that ProRail can lay down a lot in its procedures in the requirements that the contact wires must meet and how the process of laying the contact wires proceeds. However, it has not set any requirements for the (waste) processing of the contact wires to be replaced. This is an important step for ProRail.
For example, they can include a contract requirement or MEAT criteria in which the contractor gets an advantage if it sells the contact wire directly to the producer.
Furthermore, the contractors have indicated that they cannot choose between different types of materials that can be used in the contact wires. The type and composition of copper is fixed.
The contractors can express their wishes about the way in which the new contact wires are supplied and the old contact wires are disposed of. However, the producer and the waste processor ultimately have the final say on the way in which the transport is carried out.

# 5 Quantifying emissions

This chapter describes the following components:
- data collection;
- the functional unit of the analysis;
- the exclusions and influencing factors on $CO_2$ emissions;
- the calculated $CO_2$ emissions of the traditional and circular contact wire.

## 5.1 Data collection

This chain analysis uses both primary data provided by Strukton, elcowire, La Farga and ProRail, as well as secondary data from scientific research. The primary data consists mainly of data on the different types of copper wire, including reports and LCA calculations.
The secondary data mainly consist of the calculations for the various chain steps and the estimation of the transport distances.
No use is made of data allocation.

## 5.2 Functional unit

In order to calculate the $CO_2$ emissions in scope 3 of the contact wire, the functional unit and corresponding system boundary must be determined for the analysis. The functional unit (FE) is a description of the core function; It defines the service of the product. For the contact wire, the FE is a combination of services, quality requirements and the period over which the contact wire is in service.
The functional unit is:

*Contact wires in the catenary B1 system – for conducting electrical currents for the transport of trains over a period of thirty years over the entire length of contact wires in the Dutch rail network. This is based on an average type of application (route, line speed, etc.).*

All other parts of the overhead line such as suspension wires, reinforcement cables and terminals fall outside the system boundary of this chain analysis.
The chain analysis will calculate with a lifespan of thirty years, the average lifespan of a contact wire. This can be extrapolated to several years and/or multiple contact wires, so that this chain analysis can be used for multiple purposes.

## 5.3 Exclusions and influences

The following exclusions have been determined for this chain analysis:
• Movable tensions are not included
• The materials that are also used in a contact wire, such as silver and bronze, are not included, because the chain analysis focuses on the circularity of the copper and the copper is the main material used in the cables.
• The other parts of the catenary system, the reinforcement line, the hanging wire and the clamps, because they are hardly replaced (last 80 years compared to 30 years for a contact wire) or have a different material composition.

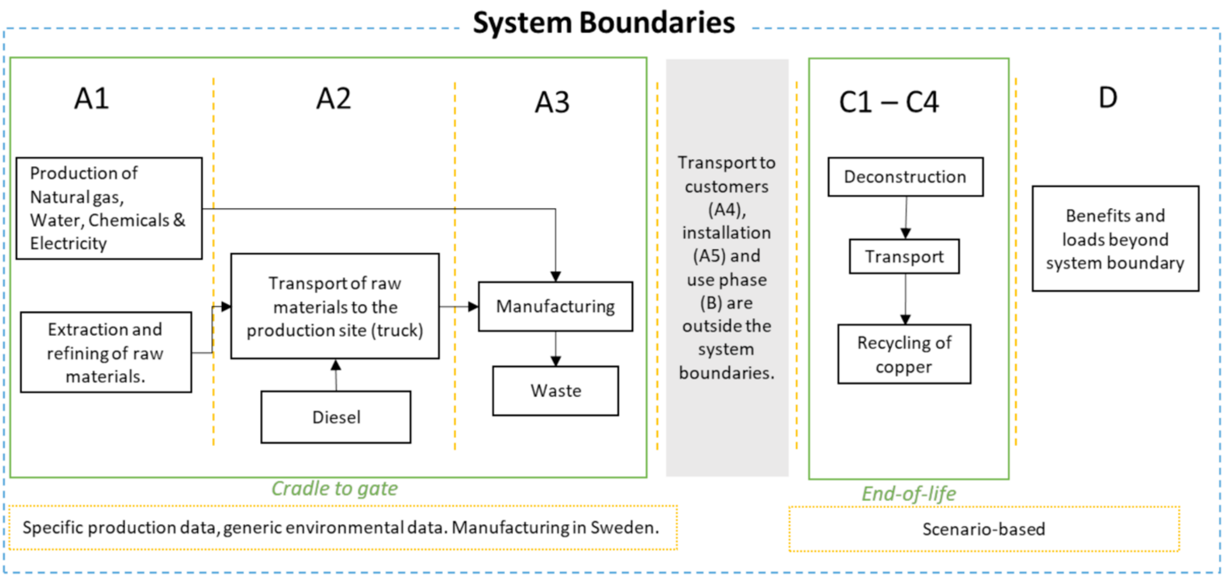
The $CO_2$ emissions per functional unit are also influenced by other factors, apart from the maintenance of the contact wire. These factors are explained below.
• The more intensively the section of track is used, the more often the contact wires have to be replaced. More maintenance will increase the $CO_2$ emissions released during this phase of life.
• The faster movement of the train causes the contact wire to wear out mainly because there is less good contact between contact wire and pantograph.

## 5.4 Traditional contact wire

This section quantifies the chain of the traditional contact wire.

### 5.4.1 Copper Wire Production

The traditional contact wire is currently purchased via elcowire. At the moment, the EPD of the copper wire that is used is available. The figure below shows which parts of the system are included in the calculation of the EPD. The table below shows the data and the final outcome per phase (A1 to D).




### Potential environmental impact – additional mandatory and voluntary indicators

| Results per kg copper wire rod | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Indicator** | **Unit** | **A1** | **A2** | **A3** | **Tot.A1-A3** | **C1** | **C2** | **C3** | **C4** | **D** |
| GWP-GHG[1] | kg $CO_2$ eq. | 4.14E+00 | 3.21E-02 | 1.64E-01 | 4.34E+00 | 0.00E+00 | 1.74E-02 | 1.01E-04 | 0.00E+00 | -6.81E+00 |

### 5.4.2 Transport to the Netherlands

The traditional contact wire is (among others) made in Germany (elcowire in Hettstedt). The transport to the Netherlands takes place by road. In the Netherlands, there are various Strukton subcontractors who can supply the contact wire. The average transport distance from Hettstedt to the Netherlands is 579km.

The CO2 emissions as a result of transport then become 579 km x 0.088 gCO2/tonnekm = 0.051 kg $CO_2$/kg copper.

### 5.4.3 Fix

The contact wire is installed in the same way in both cases. The application can be done with the help of the Gemma work train or with the help of a roller and associated equipment. The calculation of the placement of the contact wire is then as follows:

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | Krol | 10 | ltr/hour | 10 | |
| | 2 | HWOL | 10 | ltr/hour | 20 | |
| | | | | | 30 | ltr/hour |
| Production 100mm2 | | 2 | 300 | m/hr | 600 | m/hr |
| | | | | | 0,05 | ltr/mtr |
| CO2 emissions | | | 3,3054 | kg CO2/ltr | 0,165 | kg CO2/mtr |
| | | | 698,22 | kg/km | 0,237 | kg CO2/kg |

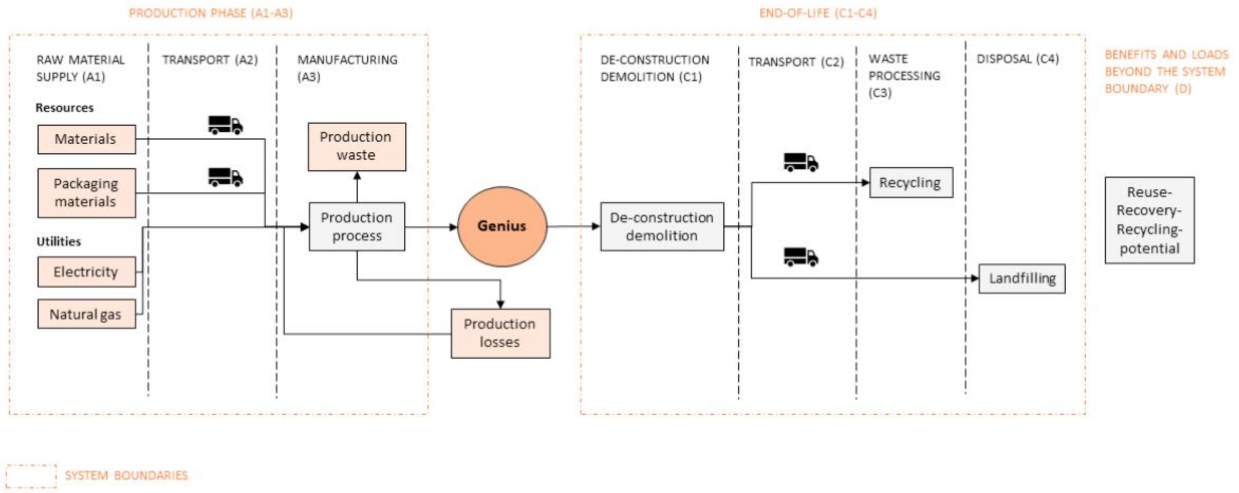
| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | GEMMA | 25 | ltr/hour | 25 | |
| | 2 | HBW | 7 | ltr/hour | 14 | |
| | 1 | Wrapper | | ltr/hour | 0 | |
| | | | | | 39 | ltr/hour |
| Production 100mm2 | | 2 | 500 | m/hr | 1000 | m/hr |
| | | | | | 0,039 | ltr/mtr |
| CO2 emissions | | | 3,3054 | kg CO2/ltr | 0,129 | kg CO2/mtr |
| | | | 698,22 | kg/km | 0,185 | kg CO2/kg |

## 5.5 Circular contact wire

In this section, the chain of the circular contact wire is quantified.

### 5.5.1 Copper Wire Production

The circular contact wire is currently being purchased through La Farga. At the moment, the EPD of the copper wire that is used is available. The figure below shows which parts of the system are included in the calculation of the EPD. The table below shows the data and the final outcome per phase (A1 to D).




**Additional mandatory and voluntary impact category indicators**

| Results per declared unit | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Indicator** | **Unit** | **A1-A3** | **C1** | **C2** | **C3** | **C4** | **D** |
| GWP-GHG*(3) | kg CO2 eq. | 3,00E-01 | 0,00E+00 | 2,46E-02 | 0,00E+00 | 7,61E-04 | 0,00E+00 |

### 5.5.2 Transport to the Netherlands

The circular contact wire is made in Spain (La Farga in Les Masies de Voltregà). The transport to the Netherlands takes place by road. In the Netherlands, there are various Strukton subcontractors who can supply the contact wire. The average transport distance from Spain to the Netherlands is 1501km.

The CO2 emissions as a result of transport then become 1501 km x 0.088 gCO2/tonnekm = 0.132 kg $CO_2$/kg copper.

### 5.5.3 Fix

The contact wire is installed in the same way in both cases. The application can be done with the help of the GEMMA work train or with the help of a roller and associated equipment. The calculation of the placement of the contact wire is then as follows:

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | Krol | 10 | ltr/hour | 10 | |
| | 2 | HWOL | 10 | ltr/hour | 20 | |
| | | | | | 30 | ltr/hour |
| Production 100mm2 | 2 | | 300 | m/hr | 600 | m/hr |
| | | | | | 0,05 | ltr/mtr |
| CO2 emissions | | | 1,49 | kg CO2/ltr | 0,074 | kg CO2/mtr |
| | | | 698,22 | kg/km | 0,107 | kg CO2/kg |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | GEMMA | 25 | ltr/hour | 25 | |

| | | | | | |
|---|---|---|---|---|---|
| | 2 HBW | 7 | ltr/hour | 14 | |
| | 1 Wrapper | | ltr/hour | 0 | |
| | | | | 39 | ltr/hour |
| Production 100mm2 | 2 | 500 | m/hr | 1000 | m/hr |
| | | | | 0,039 | ltr/mtr |
| CO2 emissions | | 1,49 | kg CO2/ltr | 0,058 | kg CO2/mtr |
| | | 698,22 | kg/km | 0,083 | kg CO2/kg |

## 5.6 Comparison of CO2 emissions

This section compares the CO2 emissions of the traditional and circular contact wires.

### 5.6.1 Production

The comparison of the production of the raw material, the copper wire, yields a difference in total CO2 emissions. The circular copper wire has 93% less CO2 emissions than traditional copper wire.

| Genius Copper Wire Rod - La Farga | | | | | | | |
|---|---|---|---|---|---|---|---|
| | A1-A3 | C1 | C2 | C3 | C4 | Totaal | |
| GWP-GHG | 3,00E-01 | 0 | 2,46E-02 | 0 | 7,61E-04 | 0,33 | kg CO2 / kg copper |
| | | | | | | | |
| Copper Wire Rod - elcowire | | | | | | | |
| | A1-A3 | C1 | C2 | C3 | C4 | Totaal | |
| GWP-GHG | 4,34E+00 | 0 | 1,74E-02 | 1,01E-04 | 0,00E+00 | 4,35 | kg CO2 / kg copper |
| | | | | | | 93% | reductie |

### 5.6.2 Transport to the Netherlands

The comparison of transport yields a difference in total CO2 emissions. The circular copper wire has about 2.5 times more CO2 emissions than the traditional copper wire. This is of course motivated by the fact that the production location of the circular contact wire is in Spain and the production location of the current supplier is in Germany.

| | | Traditional | Circular |
|---|---|---|---|
| Transport to NL | | | |
| | *Road* | 0.051 kg CO2/kg | 0.132 kg CO2/kg |

### 5.6.3 Summary of comparison

The biggest differences in the traditional and circular contact wires are the production and transport to the Netherlands. Application and transport within the Netherlands are comparable. The difference between the traditional and circular contact wire ultimately comes to about 82%. There is a slight difference between the two methods of application. Whereby the application with the GEMMA work train is more sustainable.

| | **Traditional** | **Circular** |
|---|---|---|
| Production | 4,35 | 0,33 |
| Transport to NL | | |
| *Road* | 0,051 | 0,132 |
| Transport in NL | 0,002 | 0,002 |
| Fix | | |
| *Krol* | 0,107 | 0,107 |
| *GEMMA* | 0,083 | 0,083 |
| Transport of waste | 0,051 | 0,132 |
| | | |
| Total (Krol) | 4,56 | 0,70 |
| Total (GEMMA) | 4,54 | 0,67 |
| | | |
| **Reduction** | | |
| Trad vs Cir (Krol) | 85% | |
| Trad vs Cir (GEMMA) | 85% | |

*All values in the table are in kg CO2/kg.*

## 5.7 Improving data quality

For the mutual comparison, the data (EPDs) of the production of the copper wire are currently used. This does not yet concern the production of a contact wire or the driving system. Strukton expects to be able to take the following actions to improve data quality:

- La Farga is currently working on an LCA that takes more steps into the chain. The LCA is expected to be ready in the first half of 2025
- At Railtech, a similar request is made for the traditional contact wire. It is expected that elcowire will also be able to provide better data in 2025
- The fuel consumption of the various pieces of equipment is not yet 100% certain. Of course, this also depends on the load during implementation. In 2025, it will probably be possible to determine an accurate consumption.
- The exact transport modality and distance for sustainable transport from Spain is currently being determined. This is expected to become available in the first half of 2025.

As soon as the above data is available (and comparable), the chain analysis can be improved.

# 6 Strukton's objectives

## 6.1 Reduction targets for 2025-2035

Strukton wants to commit to the application of the circular copper contact wire. That is why an agreement has been concluded with ProRail about the application of the sustainable contact wire. We want to achieve the following objective:

*Target* $CO_2$ *emissions:*
Within the value chain regarding the production and commissioning of copper contact wire, we will reduce $CO_2$ emissions by at least 55% by 2035 compared to 2025.

## 6.2 Reduction measures 2025 - 2035

In order to reduce $CO_2$ emissions in the chain, Strukton will implement $CO_2$ reduction measures in the various phases within the chain in the years up to and including 2035. Below are the measures listed with the intended reduction potential. Table 3 shows the planning of the reduction measures and their effect.

**Production**

**Current emissions: 4.35 kg $CO_2$/kg**

- Replacement with 100% circular copper contact wire. Intended effect 85% in the chain.
- La Farga currently has no detailed plans to make its own production location even greener.

**Transport to NL**

**Current emissions: 0.132 kg $CO_2$/kg**

- Transport by rail (electric). Intended effect 1.7% reduction in the chain.
- Transport by axle electric. Intended effect: 0.5% reduction in the chain.

**Fix**

**Current emissions: 0.107 kg $CO_2$/kg vs 0.083 kg $CO_2$/kg**

Current machines required for applying the contact wire run on HVO50 as standard. Strukton's policy is aimed at electrifying the rolling stock. In the coming year, it will be investigated whether the application of HVO100 in the projects with the circular contact wire is possible and desirable.

- Electrical (green) equipment. Intended effect: 3% reduction in the chain compared to reduction as a result of the use of HVO50.

**Remove**

**Current emissions: 0.107 kg $CO_2$/kg vs 0.083 kg $CO_2$/kg**

Current machines required for the removal of the contact wire run on HVO50 as standard. Strukton's policy is aimed at electrifying the rolling stock. In the coming year, it will be investigated whether the application of HVO100 in the projects with the circular contact wire is possible and desirable.

- Electrical (green) equipment. Intended effect: 3% reduction in the chain compared to reduction as a result of the use of HVO50.

**Transport of waste**

**Current emissions: 0.132 kg $CO_2$/kg**

- Transport by rail (electric). Intended effect 1.7% reduction in the chain
- Transport by axle electric. Intended effect: 0.5% reduction in the chain.

*No reduction measures have been identified for phases C3, C4 and D.*

| **Summary** | Traditional | Circular | Circular+ |
| --- | --- | --- | --- |
| Production | 4,35 | 0,33 | 0,33 |
| Transport to NL | | | |
| *Road* | 0,051 | 0,132 | |
| *Rail + Road* | | | 0,048 |
| Transport in NL | 0,002 | 0,002 | 0,002 |
| Fix | | | |
| *Krol* | 0,107 | 0,107 | 0,071 |
| *GEMMA* | 0,083 | 0,083 | 0,083 |
| Transport rest | 0,051 | 0,132 | 0,048 |
| Total (Krol) | 4,56 | 0,70 | 0,49 |
| Total (GEMMA) | 4,54 | 0,67 | 0,51 |
| | | | |
| Reduction | | | |
| Trad vs Cir (Krol) | 85% | | |
| Trad vs Cir (GEMMA) | 85% | | |
| Trad vs Cir+ (Krol) | 89% | | |
| Trad vs Cir+ (GEMMA) | 89% | | |

## 6.3 Planning reduction measures

Table 3 below shows a breakdown of all reduction measures per phase and their intended reduction. The planning of the reduction measures in the circular contact wire chain will be carried out in the years up to and including 2035. Table 3 gives an indication of the years in which (parts of) the measures will be implemented and the calculated reduction.

**Table 3** – Planning of CO2 reduction measures and their effect up to and including the year 2035

| Phase | Measure | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | *2034* | *2035* | *Sub* | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Production** | Circular contact wire | 0,5 % | 1,0 % | 1,0% | 2,0% | 2,0% | 5,0% | 5,0% | 7,5% | 7,5% | *7,5%* | *10%* | *49%* | **49%** |
| **Transport** | Transport by rail | | | | 0,5% | 0,6% | 0,6% | | | | | | *1,7%* | **2,2%** |
| | Transport elec. per axle | | | | 0,1% | 0,2% | 0,2% | | | | | | *0,5%* | |
| **Fix** | Electrical equipment | | 0,6% | 0,3% | 0,3% | 0,4% | | | | | | | *1,6%* | **1,6%** |
| **Remove** | Electrical equipment | | 0,6% | 0,3% | 0,3% | 0,4% | | | | | | | *1,6%* | **1,6%** |
| **Transport** | Transport by rail | | | | 0,5% | 0,6% | 0,6% | | | | | | *1,7%* | **2,2%** |
| | Transport elec. per axle | | | | 0,1% | 0,1% | 0,2% | | | | | | *0,4%* | |
| **Total** | | **0,5%** | **2,2%** | **1,6%** | **3,8%** | **4,2%** | **6,6%** | **5,0%** | **7,5%** | **7,5%** | **7,5%** | **10%** | | **56,4%** |

# 7 Progress 2025

*After the first half of 2025, the progress of the chain analysis will be described here.*

## 7.1 Alterations

…

## 7.2 Reductions achieved

…

Below we describe the progress achieved per phase:
..

## 7.3 Summary

…

# 8 Sources


1) Roadmap Transition Path Rail (2023)
2) Chain analysis Contact wire renewal – copper cycle - Arcadis
3) Environmental Product Declaration Copper Wire Rod – elcowire AB
4) Environmental Product Declaration Genius Copper Wire Rod – La Farga SA
5) www.co2emissiefactoren.nl, consulted Mar 2025


The structure of this document is based on the Corporate Value Chain (Scope 3) Standard. In addition, the methodology of the Product Accounting & Reporting Standard has been used where necessary (see Table 4).

**Table 4** – Overview of the application of standards in chain analysis

| Corporate Value Chain (Scope 3) Standard | Product Accounting & Reporting Standard | Chain analysis |
|---|---|---|
| H3. Business goals & Inventory design | H3. Business Goals | Chapter 1 |
| H4. Overview of Scope 3 emissions | *N/a.* | Chapter 2 |
| H5. Setting the Boundary | H7. Boundary Setting | Chapter 3 |
| H6. Collecting Data | H9. Collecting Data & Assessing Data Quality | Chapter 4 |
| H7. Allocating Emissions | H8. Allocation | Chapter 2 |
| H8. Accounting for Supplier Emissions | *N/a.* | Part of the implementation of the CO2 Performance Ladder level 5 |
| H9. Setting a reduction target | *N/a.* | Chapter 5 |

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