Comparative Carbon Footprint Study tesa® 4965 Original and tesa® 4965 Original Next Gen

Technical summary

The report explains the difference of the carbon footprint between tesa® 4965 Original and Original Next Gen. The results reveal a 40% reduction in CO_2 eq. compared to the original version tesa® 4965 Original[1]. Specifically, the substitution of conventional materials by lower carbon footprint materials, such as biomass balanced adhesives and recycled content in the backing results in greenhouse gas reductions while maintaining high-quality products. The study is focused on the hand roll format as a typical dimension for most end-users, but also includes an additional calculation for the typical log roll format for our converting partners. The results for the individual product variants PV0, PV1, PV2 and PV4 are provided, and the cradle-to-gate (with and without End-of-Life) values (refer to **Table 2**) can be used for our customers' own carbon footprint studies.

This technical summary has been prepared by tesa based on the full ISO-compliant report provided by Quantis as a reference document for an ISO-compliant Carbon Footprint study completed in October 2023 and determined to be in conformance with applicable ISO standards by a third-party critical review. It contains the necessary information and numbers to back up comparative environmental claims; both compared product options are produced by tesa. The full responsibility for clarity, robustness and transparency in the creation and communication of the environmental claims (on and off the packaging) based on this study is the sole responsibility of tesa.

October 2023

[1] Product Carbon Footprint (PCF) reduction for the new tesa® 4965 Original Next Gen (50m x 50mm handroll, PV0: red MOPP liner) compared to the current tesa® 4965 Original (50m x 50mm handroll, PV0: red MOPP liner) calculated in 2023 with Cradle-to-Gate values including biogenic carbon uptake.

Table of contents

Introduction

For more than 125 years, tesa has developed industry-leading adhesive solutions for a wide variety of applications. We are known around the world for the quality and value of our products, which is why we are ready to take the next step in an increasingly vital process of securing a more sustainable future for customers.

At tesa, we take sustainability seriously, therefore, we re-evaluate and overhaul products in our assortment and have succeeded in developing a next generation of our tesa® 4965 Original multi-talent product.

By offering a next generation, we are pro-actively driving positive change in the industry by combining biomass balanced (BMB) adhesive components and a 90% post-consumer recycled PET backing as a double-sided tape solution, thereby reducing fossil fuel components in tesa® 4965. Importantly, we wanted to offer an innovative adhesive solution that cuts CO_2 equivalent (eq.) emissions but retains performance. We are excited to offer a product that not only meets our high standards for quality and performance, but also helps to reduce greenhouse gas emissions.

To evaluate this impact, an ISO 14067 conformant carbon footprint (CFP) study was conducted by Quantis.[2] The objective of the carbon footprint study was the in-depth elucidation of the CO_2 eq. emission of our tape manufacturing steps and the impact of the substitution of individual tape components. Furthermore, we wanted to enable carbon footprint calculations of our customers with externally validated and ISO-conform carbon footprints.

Importantly, our tesa® 4965 Original Next Generation (Next Gen) offers the same reliable performance as the previous tape version and 40%[1] less CO_2 eq. emissions. The carbon footprint reduction is equal to 0.48 kg CO_2 eq./m^2, stemming primarily from the incorporation of biomass balanced raw materials which have lower emissions for cradle-to-gate as compared to conventional fossil-based raw materials used in tesa® 4965 Original. For the PV0 hand roll dimension (50m x 50 mm), this results in a product carbon footprint of 0.72 kg CO_2 eq./m^2 for tesa® 4965 Original Next Gen as opposed to 1.20 kg CO_2 eq./m^2 for the predecessor version tesa® 4965 Original.

The reduced carbon footprint originates primarily from two major changes:

1. The Next Generation replaces much of the fossil-based material with biomass balanced (BMB) material. An amount of biomass balanced material equivalent to 67% of the adhesive was allocated (using a mass balance approach) to tesa® 4965 Original Next Gen and certified according to ISCC PLUS.[3]

2. The PET backing from primary sources was substituted with a 90% post-consumer recycled PET carrier film of virgin grade quality.[4]

[2] Quantis, a leading sustainability consultancy, developed the carbon footprint model, supported by data and process inputs received from tesa's R&D department. The comparative CFP study was performed by Quantis as a third party and it has been critically reviewed (refer to Annex D: Critical review statement) by an independent expert according to ISO/TS 14071:2014. The study conforms to the methodological approach of ISO 14067 using ISO 14040/44 for additional guidance. The present customer facing report by tesa SE is based on the CFP technical study report.

[3] The new generation tesa® 4965 Original Next Gen uses biomass balanced monomers, purchased from tesa's trusted ISCC PLUS certified monomer suppliers. Our monomer suppliers utilize bio-naphtha/biomethane to substitute parts of their fossil counterparts, which were used by the predecessor version, tesa® 4965 Original, for the past 40 years. As a result of the mass balance approach, the new generation, tesa® 4965 Original Next Gen, is based on bio-attributed biogenic carbon. A biogenic carbon content is synonymously referred to as a carbon dioxide uptake, which occurs during plant growth. Importantly, the biomass balanced monomers are identical to conventional monomers from a technical perspective and are undergoing the same production processes in our ISCC PLUS certified plant in Hamburg (refer to Annex C: ISCC PLUS Certificate).

[4] The PCR PET carrier film is comparable in its optical and mechanical properties to virgin grade PET films. The recycling process is done via glycolysis (chemical recycling) of post-consumer waste. The certified recycled content of the carrier film is 90%, following a segregated recycling process. A certificate/statement of the recycled content in tesa® 4965 Original Next Gen can be provided upon request.

All product components (refer to **Figure 1**) were considered in the study, i.e. tesa® 4965 Original and tesa® 4965 Original Next Gen both consisting of the carrier film (backing), adhesive layers, liners, core and packaging. The comparison was done on the specifics for the typical hand roll dimension (50 m x 50 mm) and for the log roll dimension (50 m x 1372 mm).

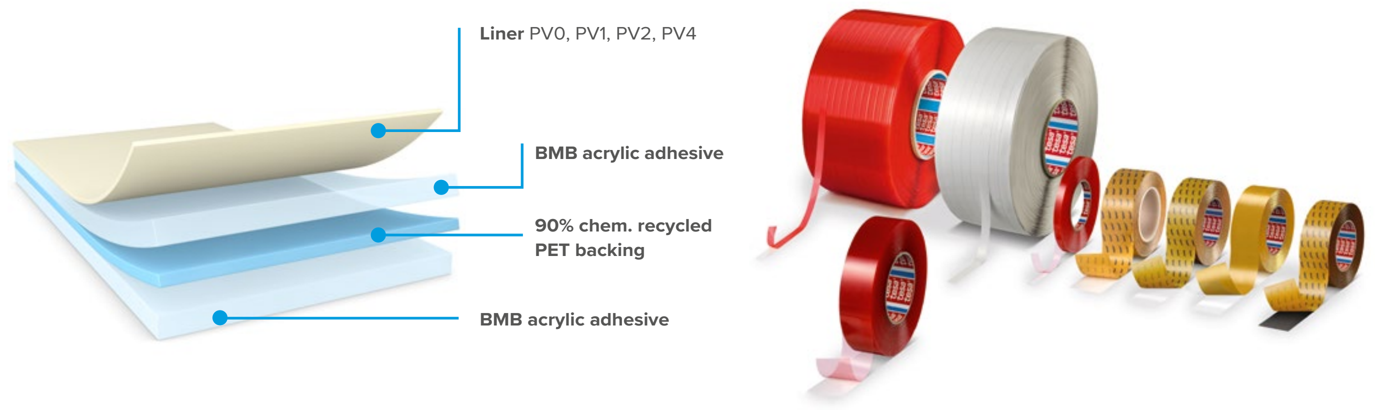

Figure 1. Product design of tesa® 4965 Original Next Gen, utilizing lower emission raw materials.

The results of the study presented below are based on a cradle-to-gate approach (sourcing raw material to production) with high-quality modeling by Quantis followed by a critical review by an independent third party. To meet the ISO 14067 requirements, we have provided information related to the stored biogenic carbon content (refer to **Table 3**). Herein, biogenic carbon refers to bio-based as well as bio-attributed carbon content, which are treated equally in the calculation.

It is important to note that the stored biogenic carbon in the cradle-to-gate footprint will be released during the product's EoL treatment. Furthermore, the distribution and use phases are the same for both tape versions and have an insignificant impact and are therefore not included. For transparency, this report also reports on the complete product life cycle – cradle-to-grave – excluding the distribution and use phase for the reasons given above. This technical document summarizes the study's goals, method, system boundaries, functional unit, data sources, activities considered and climate change impact results. It is intended to provide the results of the study in a clear and useful manner to support the communication of the carbon footprint of tesa® 4965 Original Next Gen for internal and external audiences, including partners, suppliers, customers, and other interested parties.

Life cycle assesment and carbon footprint of a product

Life Cycle Assessment (LCA)

A leading tool for assessing the environmental performance of a product is a Life Cycle Assessment (LCA). LCA is an internationally recognized approach that evaluates the potential environmental impacts of products and services throughout their life cycle, beginning with the raw material extraction and including all aspects of transportation, manufacturing, use, and end-of-life treatment. It is important to note that LCA does not exactly quantify the real impacts of a product or service due to data availability and modeling challenges. However, a Life Cycle Assessment allows to estimate and understand the potential environmental impacts, which a system might cause over its typical life cycle, by quantifying (within the current scientific limitations) the likely emissions and resources consumed. Hence, environmental impacts calculated through LCA should not be interpreted as absolute, but rather as relative values within the framework of the study. Ultimately, this is not a limitation of the methodology since LCA is generally used to compare different systems performing the same function, where the relative differences in environmental impacts are key for identifying the solution, which performs best.

A LCA study typically includes several impact categories (such as climate change, water use, and acidification), to assess different environmental impact categories and avoid the burden shift across them. However, as climate change is one of the most pressing issues (United Nations Trust Fund for Human Security, 2017) and one of the most robust indicators with the highest level of recommendation (Fazio, 2018), this study focuses only on the Carbon Footprint of a Product (CFP).

Carbon Footprint of a Product (CFP)

Among other uses, a CFP can identify opportunities to improve the environmental performance of products, inform decision-making, and support marketing, communication, and educational efforts, considering only one single indicator. The importance of the life cycle view in sustainability decision-making is sufficiently strong that over the past several decades, it has become the principal approach to evaluate a broad range of environmental problems, identify social risks, and help make decisions within the complex arena of socioenvironmental sustainability.

ISO standards

The study conforms to the methodological approach of ISO 14067 using ISO 14040/44 for additional guidance. This customer facing report by tesa SE is based on the original CFP study report. The study has been critically reviewed by a third-party consultant (refer to Annex D: Critical review statement).

Goal and scope of the study

Goal

The objective of this Carbon Footprint study is to evaluate the environmental impacts of tesa® 4965 Original Next Gen and compare them to the previous tape version tesa® 4965 Original.

The comparative CFP study was performed according to ISO 14067 using ISO 14040/44 for additional guidance.

The specific goals of this study are as follows:
- Compare the potential climate change impact of the original tape version with the newly developed next generation.
- Highlight the product improvements of the new product, i.e. tesa® 4965 Original Next Gen.
- Serve as support for communication and claims of tape carbon footprint information to various stakeholders, public and B2B.

Scope

The scope of the study calculates the carbon footprint based on the **functional unit of 1 m² of tape** and a system boundary of **cradle-to-gate + EoL**.

Functional Unit
Specifically, the functional unit for this study is 1 m² of tape for a hand roll (50m x 50mm) for the main study. The same functional unit is used in the log roll calculation (50m x 1372mm). This functional unit is in alignment with the most common reporting of sales volumes in the tape market.

System Boundaries
The system boundaries of the comparative CFP study of tesa®4965 Original Next Gen and its predecessor tesa® 4965 Original are shown in **Figure 2**.

System Boundaries: The system boundaries include the production of all main components shown in **Figure 1**. The double-sided tape tesa® 4965 Original Next Gen is produced in tesa plant Hamburg (Germany). The production process in our plant includes the polymerization, adhesive formulation, coating and converting steps, while the backing/carrier film and liners are produced at our trusted suppliers own manufacturing facilities.

The system boundary of this CFP study is **cradle-to-gate + EoL**; life cycle stages that are identical for both versions of the product are left out of the assessment (e.g., distribution and use phase). The distribution impacts are expected to be insignificant compared to the other impacts of the study. The use phase is not expected to have significant impacts, as there are no direct emissions associated to the use of tapes. Therefore, the conclusions are limited to the impacts of cradle-to-gate + EoL. The exclusion of the use and distribution phases is allowed under ISO 14067, as both stages are identical for tesa® 4965 Original and tesa® 4965 Original Next Gen.

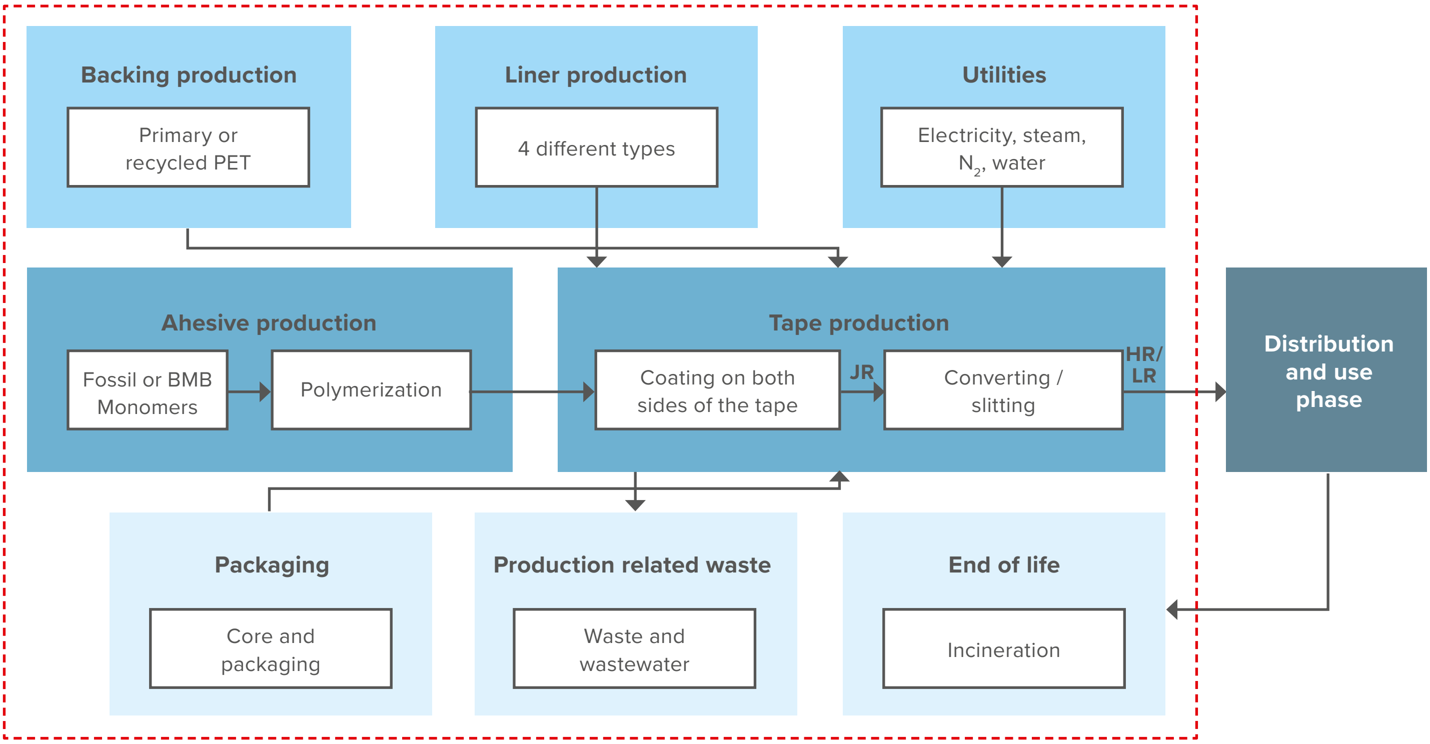

Figure 2. System boundaries for the current CFP study are shown within the red dashed lines. JR: Jumbo Roll; HR: Hand Roll; LR: Log Roll.

Process Detailed Description: The process starts with the transport of the liners and the backings from suppliers' facilities to tesa's production facility in Hamburg, Germany, where the Jumbo roll of tesa® 4965 is produced. The Jumbo roll (1 m diameter and 1.4 m width) is the main dimension produced and is then converted into the specific dimensions for sale, e.g., the hand roll (50 m x 50 mm) and the Log roll (50 m x 1372 mm). The liner is the tape component that is removed when the tape is applied on any surface/component. The backing is the carrier of the adhesive part. The liners and the core do not remain in the final application of the tape, only the backing with the coated adhesive (polymerization of monomers).

Raw materials, energy and utilities, direct emissions, internal transportation, packaging, core, waste treatment, and wastewater treatment are included within the system boundaries. It is assumed that adhesive tapes end up in various applications and international markets with different waste management infrastructure and will currently in practice often not be recycled. Therefore, incineration without energy recovery was considered as a conservative approach for the EoL calculation.

Description of Main Items Included/Excluded in the Model

The CFP comparative assessment of tesa® 4965 Original Next Gen and its predecessor tesa® 4965 Original looks at two backing options:

1. primary fossil PET for the original tape and
2. 90% recycled PET for the Next Generation tape.

For the adhesive production, two options are examined:

1. fossil monomers and
2. biomass balanced monomers (BMB, ISCC PLUS certified chain-of-custody).

Table 1 shows the processes that are included in or excluded from the study.

Included	Excluded
Production and upstream transport of raw-, auxiliary-, and utility materials	Overhead of non-production-related operations (e.g., office, staff canteen) – Not directly related to the production.
Manufacture of main tape components included: backing, adhesive, liner, core, and packaging.	Storage of raw materials and final products (assumed to be immaterial) – Assumed to be insignificant.
Electricity, nitrogen, and steamhesive + metal fillers	Production, use and end-of-life of equipment and capital goods (of foreground processes) – Assumed to be insignificant.
Direct Process emissions	Staff lodging, commuting etc. – Assumed to be insignificant.
Waste treatment	Overhead of manufacturing facilities (e.g., lighting, heating, ventilating, air conditioning) – Not directly related to the production.
Water usage, effluents treatment, and emissions to waterliner	Pipeline transportation of Nitrogen and further internal transportation. – Assumed to be insignificant.
End-of-Life	

Table 1. Included and excluded processes.

Any stored biogenic carbon is modeling in the production stage as a carbon uptake and emitted in the EoL. Therefore, results excluding the EoL stage (i.e., cradle-to-gate) consider a biogenic CO_2 uptake in the product, but do not consider the CO_2 that will likely be emitted at the EoL.

The double-sided tape tesa® 4965 is available in various product variants (PV's), which differ in the selected liner:

- PV0: red MOPP film (80µm)
- PV1: brown glassine paper (69µm)
- PV2: brown glassine paper (78µm)
- PV4: branded white PE coated paper (104µm)

The same liners are used for both versions of the tape. Due to the different liner options available for the same combination of backing and adhesive (base components), one liner option (Product Variant 0 - PV 0) is included as part of the comparison. The other liners results (PV1, PV2, and PV4) are provided separately from the remaining components of the tape and are not included in the main comparative study (refer to summarizing **Table 2** for PV-specific results).

In this study, exclusions could be made if they were expected to be within the below cut-off criteria:

- Mass: if a flow is anticipated to be less than 1% of the mass of the product, it may be neglected;
- Energy: if a flow is anticipated to be less than 1% of the cumulative energy, it may be neglected;
- Environmental significance: if a flow is anticipated to be less than 1% of the key impact categories, it may be excluded.
- The total of all flows excluded must not exceed 5% of the total energy usage, mass, or environmental significance of the product life cycle.

Critical review

To ensure that all relevant methods, data, and calculations conform with ISO 14067, a critical review was conducted by an independent external expert according to ISO/TS 14071:2014 (refer to Annex D: Critical review statement). The reviewer was included in the discussions from the beginning of the project, received the draft report and presentations of the software model. Spot checks were performed. The critical review report is annexed to this report. The critical review statement refers only to the technical report, as the critical reviewer has not reviewed this public facing report.

Matt Fishwick was chosen as a reviewer based on his background and experience. Matt has 15+ years of experience in life cycle assessment. Past clients include 3M, Lonza, BP, The American Petroleum Institute, Honeywell, Jotun, GSK, and Johnson & Johnson. He has PhD, MRes, MSc and BSc degrees in environmental chemistry and is a member of the Royal Society of Chemistry (MRSC).

Environmental Indicators Considered

The ISO 14067 impact assessment method focuses on one impact category: Global Warming Potential over 100 years. The ISO 14067 considers both the biogenic carbon uptake and release.

Data Collection & Modelling

Data Quality

Data quality is assessed according to five parameters: technological, geographical, and temporal representativeness, reliability/uncertainty, and completeness (Ciroth A, Muller S, Weidema B P, & Lesage P, 2016). The overall data quality of the study has been evaluated as „good" and fulfills the goal and scope of the study.

Data Collection
Both primary and secondary data were used, and where data was not available, assumptions or equivalences based on expert judgment were made. Primary industrial data to produce tesa® 4965 Original were collected by tesa, for the Hamburg site (Germany), covering a 12-month production period for the year of 2022. This time span is representative of the production of the tape, and the same Bill-of-Materials is applied for both tape versions. Sphera MLC 2022.2 and ecoinvent 3.9 cut-off databases are applied as background data and to estimate dataset approximations.

For tesa® 4965 Original Next Gen the same amounts of material are considered as for tesa® 4965 Original. However, the datasets applied to represent the main raw materials are specific to the raw material used for the different tape variants. For example, biomass balanced material for the adhesive and recycled PET for the backing in tesa® 4965 Original Next Gen instead of the tesa® 4965 Original's primary/virgin fossil-based material and PET respectively.

Modelling & Alternative Liners & Dimensions
The carbon footprint model is created using the LCA FE software (2023.1 version), developed by Sphera. The Life Cycle Impact Assessment (LCIA) results are calculated using this software.

Calculations were conducted for the hand roll and log roll dimensions as well as for various liners.
As the biogenic removals and emissions calculated by the datasets do not always reflect the biogenic carbon content stored in the product, an additional table with the carbon content is provided in this report.

Hand roll vs Log roll: A jumbo roll is the mother reel that is produced at the coating step and then converted into the specific dimensions for sale. Typical dimensions for tesa® 4965 Original Next Gen are the hand roll format (50 m x 50 mm) and the log roll format (50 m x 1372 mm). The hand roll format was selected as the main dimension for the comparative study, while the log roll dimension was analyzed as an additional scenario.

Liner variants: The present study and the comparative assertion of the new generation with the previous tape version is focused on the most commonly used product variant PV0, composed of a liner made from MOPP (monoaxially oriented polypropylene / tensilized polypropylene) (refer to Goal & Scope Section 3). Different tape dimensions and liner variants were analyzed in this study. The liner results are provided as an add-on number so they can be exchanged and the overall results can be calculated. Results for the other product variants are included in the summary table (refer to Table 2 below).

Study Limitations & Assumptions

The following limitations should be considered along with the context described in earlier sections of this report when interpreting the information presented in this study:
This study is a carbon footprint study, which means that other environmental impact categories are not assessed.
Datasets used for the two versions of tesa® 4965 are largely representative of the specific region in which a product/material is produced. For example, as the tapes are produced in Germany, a Germany-specific CHP energy dataset is chosen for the manufacturing.

Consistency Check

The consistency check assesses whether assumptions, methods, and data for each product system are consistent with each other as well as with the goal and scope of the study. The applied data, the used methods, and the assumptions are consistent with the goal and scope of the study. Foreground data is collected at the same level of detail. Mainly Sphera MLC datasets are applied for background data. The LCIA method was applied consistently for all products. The cut-off criteria, described in section 3, are followed consistently.

Results and discussion

In the following, an in-depth evaluation and discussion of the results are presented. The main comparison of tesa® 4965 Original with the new tesa® 4965 Original Next Gen is done for product variant PV0 (red MOPP liner) and for the hand roll dimension.

Hand Roll Carbon Footprint

As illustrated in **Figure 3**, the comparison on a cradle-to-gate basis shows a significant reduction in the carbon footprint upon changing to the lower emission biomass balanced materials for the tesa® 4965 Original Next Gen - providing our customers reduced upstream emissions for their own product footprint.

A 40% reduction of GHG emissions is achieved in the Next Generation as compared to the original tape version. Most of the carbon footprint stems from the base components of the tape, their upstream production, and the manufacturing process in tesa plant Hamburg. The liner's impact makes up +20% of the carbon footprint due to its production, but this does not change between the two product versions.

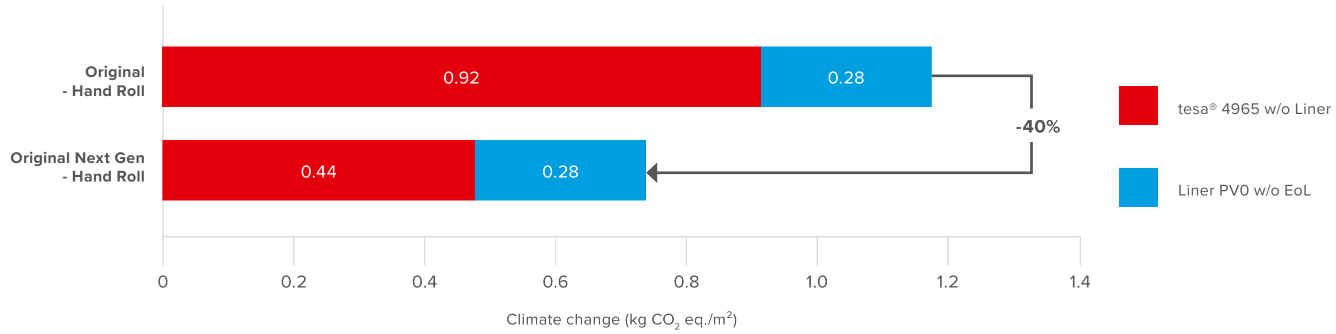

Figure 3. The bar-graph depicts the difference in carbon footprint of the two tape versions tesa® 4965 Original and tesa® 4965 Original Next Gen on a cradle-to-gate basis, including the carbon dioxide uptake during plant growth, which will be released again at the EoL. The climate change assessment is based on the typical dimension for the PV0 product variant and the hand roll dimension (50 m x 50 mm).

Biogenic carbon is counted as uptake (-1) during the cradle-to-gate life cycle stage and as emission (+1) during the EoL. As a result, when assessing the impact of the End-of-Life in addition to the cradle-to-gate life cycle stages, the total carbon foot-print reduction is 24%. The cradle-to-gate + EoL scenario is illustrated in **Figure 4**.

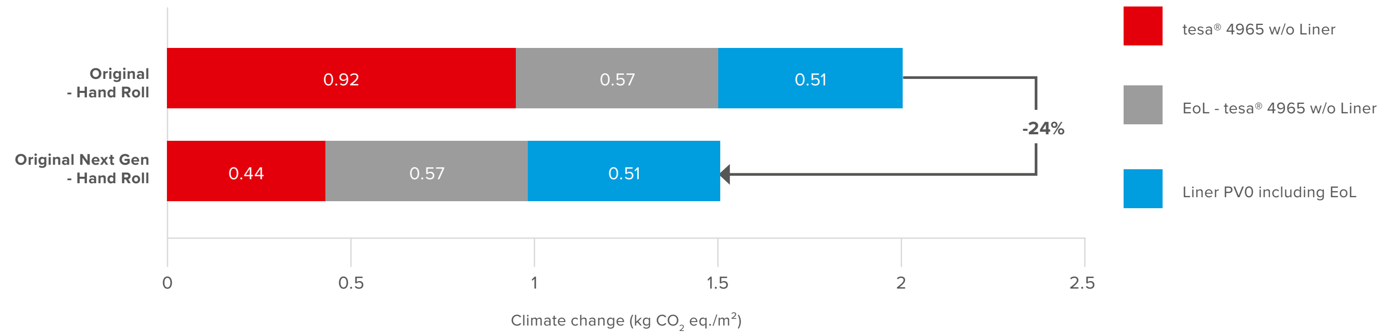

Figure 4. The bar-graph depicts the difference in carbon footprint of the two tape versions tesa® 4965 Original and tesa® 4965 Original Next Gen on a cradle-to-gate + EoL basis. Only the use and distribution phases are excluded. The climate change impact assessment is based on the typical dimension for the PV0 product variant and the hand roll dimension (50m x 50mm).

Summary Table – Hand Roll vs Log Roll & Product Variants

The results shown in **Table 2** can be used by customers interested in conducting their own carbon footprint studies, utilizing the next generation of tesa® 4965 Original Next Gen as a mounting solution for their own products. The PCF data do not constitute an agreed quality of the product(s) nor a guarantee. The information is non-binding and may be subject to change.

The data are provided as cradle-to-gate + EoL for the base component (adhesive & backing), the individual product variants (liner options PV0, PV1, PV2 & PV4) and the hand- and log roll dimensions. The stored biogenic carbon is listed in **Table 3.**

			PV0	PV0	PV1	PV1	PV2	PV2	PV4	PV4
	tesa® 4965 w/o Liner	EoL - tesa® 4965 w/o Liner	Liner	EoL – Liner	Liner	EoL – Liner	Liner	EoL – Liner	Liner	EoL – Liner
tesa® 4965 Original Hand Roll	0.9152	0.5749	0.2821	0.2282	0.0462	0.1167	0.0558	0.1305	0.1187	0.2406
tesa® 4965 Original Next Gen Hand Roll	0.4396	0.5749	0.2821	0.2282	0.0462	0.1167	0.0558	0.1305	0.1187	0.2406
tesa® 4965 Original Log Roll	0.9607	0.5749	0.2821	0.2282	0.0462	0.1167	0.0558	0.1305	0.1187	0.2406
tesa® 4965 Original Next Gen Log Roll	0.4883	0.5749	0.2821	0.2282	0.0462	0.1167	0,0558	0.1305	0.1187	0.2406

Table 2. The table summarizes the results of the carbon footprint study of tesa® 4965 Original and tesa® 4965 Original Next Gen in kg CO_2 eq/m^2.

The separately listed stored biogenic carbon in **Table 3** transparently shows how much CO_2 eq. is saved in the cradle-to-gate life cycle stage.

Tape/Liner	Product total grammage (g/m²)	Raw materials biogenic carbon stored (kg C /m²)	Raw materials biogenic carbon stored (kg CO_2 eq/m²)
tesa® 4965 Original w/o Liner	217.00	0.046	0.168
tesa® 4965 Original Next Generation w/o Liner	217.00	0.136	0.498
PV0	72.00	-	-
PV1	82.50	0.036	0.130
PV2	92.20	0.040	0.145
PV4	122.00	0.036	0.130

Table 3. Biogenic carbon stored in tesa® 4965 Original and tesa® 4965 Original Next Gen as well as in each liner variant. *The biogenic content of recycled PET is considered 0.

Liner Variants – Carbon Footprint Reduction Impact

Figure 5 illustrates the two tape versions and their comparative carbon footprint assessment once they are equipped with the individual liner options (PV0, PV1, PV2 & PV4). Specifically, all product variants show a significant (over 10%) reduction of the carbon footprint upon the transition to the next generation of tesa® 4965 Original. The individual stacked bar charts show a breakdown of the impact into cradle-to-gate values of tesa® 4965 Original and tesa® 4965 Original Next Gen without a liner as well as the cradle-to-gate values for the respective liner option.

PV0 was selected for the main comparative assessment of the two tape versions, as it is the top-selling product variant. However, the tape product variants equipped with a glassine paper liner (PV1, PV2) or PCK-Liner (PV4) result in an even lower carbon footprint compared to the MOPP product variant PV0 as the glassine paper exhibits biogenic carbon content, resulting in biogenic removals.

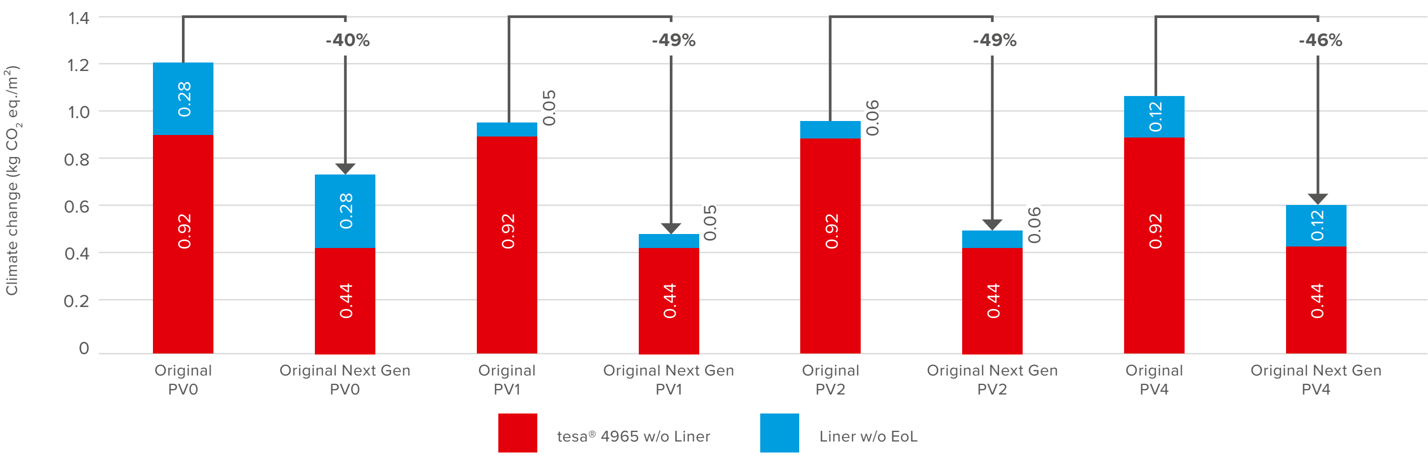

Figure 5. The graph depicts the changes in carbon footprint for the individual product and liner variants (PV0, PV1, PV2 and PV4) on a cradle-to-gate basis for the hand roll dimension.

Conclusion

In conclusion, the new generation tesa® 4965 Original Next Gen significantly reduces greenhouse gas emissions compared to its predecessor tesa® 4965 Original.[5]

This significant CO_2 eq. reduction is realized primarily by implementing lower emission raw materials in the form of biomass balanced monomers for the adhesive and a 90% post-consumer recycled PET backing. Most of the CO_2 eq. reduction stems from the incorporation of the biomass balanced monomers in the adhesive.

For the hand roll tape dimension, tesa® 4965 Original Next Gen shows a decrease in its cradle-to-gate carbon footprint by 0.5 kg CO_2 eq/m^2; a reduction of 40% compared to tesa® 4965 Original. Even when including the release of the stored biogenic carbon emissions during the End-of-Life, the overall carbon footprint reduction remains significant at 24% compared to tesa® 4965 Original.

The product variants and their respective liners have a significant impact on the product carbon footprint as the raw materials contribute different (biogenic) carbon contents and the liner production process varies amongst them. As a result, the glassine liners show a reduced carbon footprint compared to the MOPP liner due to their biogenic carbon contents, i.e. PV1 and PV2 exhibit a carbon footprint reduction of 49% on a cradle-to-gate basis and the PCK-liner option PV4 results in -46% compared to the original tape version.

In summary, the carbon footprint study results clearly show the importance of evaluating and overhauling an existing product assortment, substituting conventional fossil/primary raw materials with lower emission materials and driving positive change in the industry.

Questions?

For more information about this document, please contact tesa Corporate Sustainability: **sustainability@tesa.com.**

[5] Anything over 10% difference is considered significant and aligned with industry practice.

Annex A: Glossary

This section includes terminology and definitions applied in the context of this study.

BMB	biomass balance; bio-attributed/bio-allocated products following a certified mass balance approach; herein: bio-circular feedstock category according to ISCC PLUS
MBA	mass balance approach
CFP	carbon footprint
PV	product variant, i.e. PV0, PV1, PV2, PV4
PCR	post-consumer recycled
PET	polyethylene terephthalate
EoL	end-of-life
Hand roll	tape dimension (50 m x 50 mm)
Log roll	tape dimension (50 m x 1372 mm)
Jumbo roll	tape dimension (mother reel from coating line)

Annex B: References

Ciroth A, Muller S, Weidema B P, & Lesage P. (2016). *Empirically based un- certainty factors for the pedigree matrix in ecoinvent. International Journal of Life Cycle Assessment.*

International Organization for Standardization. (no date). *Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification.*

Annex C: ISCC PLUS Certificate

SGS

ISCC PLUS Certificate

Certificate Number: ISCC-PLUS-Cert-DE100-15496123
SGS Germany GmbH
Europa Allee 12, D-49685 Emstek
certifies that

tesa Werk Hamburg GmbH

Heykenaukamp 10
21147 Hamburg
GERMANY

complies with the requirements of the certification system

ISCC PLUS

(International Sustainability and Carbon Certification)

ISCC CERTIFIED PLUS

Place of the audit:
see above

This certificate is valid from 03/07/2023 to 02/07/2024

The site of the system user is certified as:
final product refinement, polymerization plant

The scope of the certificate includes the following chain of custody options:
mass balance

Emstek, 03/07/2023
Place and date of issue

SGS Germany GmbH
Stamp, Signature

The issuing Certification Body is responsible for the accuracy of this document.
Version / Date: 1 (no adjustments) / 03/07/2023

Annex D:
Critical review statement

Comparative carbon footprint of two versions of tesa® 4965 – critical review statement and report

tesa SE

Prepared by Fishwick Environmental Ltd (Co. number: 12863179)
Mobile: 07909 573711
Email: matt@fishwickenvironmental.com
Address: 85 Great Portland Street, London, W1W 7LT
Website: fishwickenvironmental.com

Fishwick Environmental

October 2023 Private and Confidential

1

Annex D:
Critical review statement

This critical review assessed a product carbon footprint (PCF) of tesa® 4965 double-sided adhesive tape, which was prepared by Quantis for tesa SE in accordance with the international standard on PCF ISO 14067:2018. Details of this PCF study are provided below:

- **Title of study**: "Comparative carbon footprint of two versions of tesa® 4965".
- **Commissioner of the study**: tesa SE.
- **Practitioner of the study**: Quantis.
- **Version of the report which the review statement belongs**: "tesa_report_20231027_final_2_final.pdf".
- **Assurance type**: third party assurance via critical review.

A review was therefore undertaken by the following reviewer based on ISO 14067:2018 Section 8 and ISO-TS 14071. The reviewer was external and independent of the PCF project.

- **Matthew Fishwick** – *Principal Consultant at Fishwick Environmental Ltd* – Matt has 15+ years of experience in life cycle assessment. Past clients in the chemicals industry include 3M, Lonza, BP, The American Petroleum Institute, AkerBP, Honeywell, Jotun, The, GSK, and Johnson & Johnson. He holds PhD, MRes, MSc and BSc degrees in environmental chemistry and is a member of the Royal Society of Chemistry (MRSC)."

Details of the review are provided in this critical review statement, which has been prepared in accordance with ISO-TS 14071:2016 and ISO 14067:2018.

The critical review process ensured that:

- The methods used to carry out the LCA are consistent with ISO 14067:2018;
- The methods used to carry out the LCA are scientifically and technically valid;
- The data used are appropriate and reasonable in relation to the goal of the study;
- The interpretations reflect the limitations identified and the goal of the study; and
- The study report is transparent and consistent.

The critical review process involved a detailed review of the PCF report for conformance with ISO 14067:2018. The review was undertaken at the end of the study. The reviewer used a peer review template to log his comments, based on the example given in ISO-TS 14071. These comments were sent to and discussed with Quantis. Responses to these comments were sent back to

Annex D:
Critical review statement

the reviewer along with an updated version of the PCF report to check. The reviewer proceeded to check that he was satisfied with the responses or requested final changes.

The reviewer was provided with a detailed PCF report, details of individual datasets, calculations, and a screenshots of the Sphera model. Having re-read the final report and responses to final comments, the reviewer is confident that this study is in conformance with ISO 14067:2018.

Table 1 (ISO conformance comments) and Table 2 (general comments) comprise the critical review report, with comments from the reviewer and responses from Quantis.

Yours sincerely,

Matthew Fishwick

tesa SE
Phone: +49 40 88899 0
tesa.com/company/locations