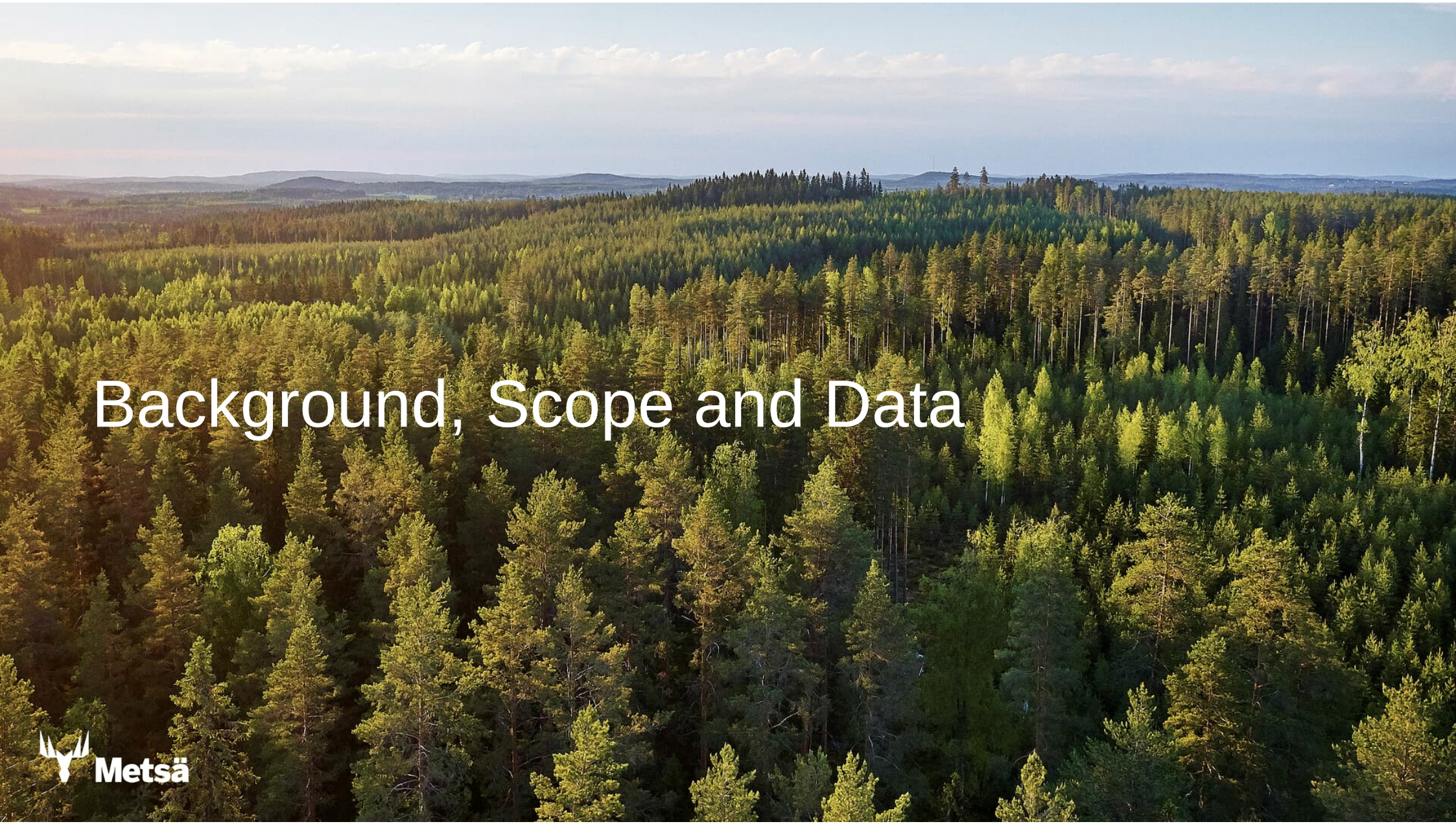
Metsä Tissue
Comparison of environmental performance indicators of Fresh and Recycled fibre based tissue products

External report

NOVEMBER 2021

Content

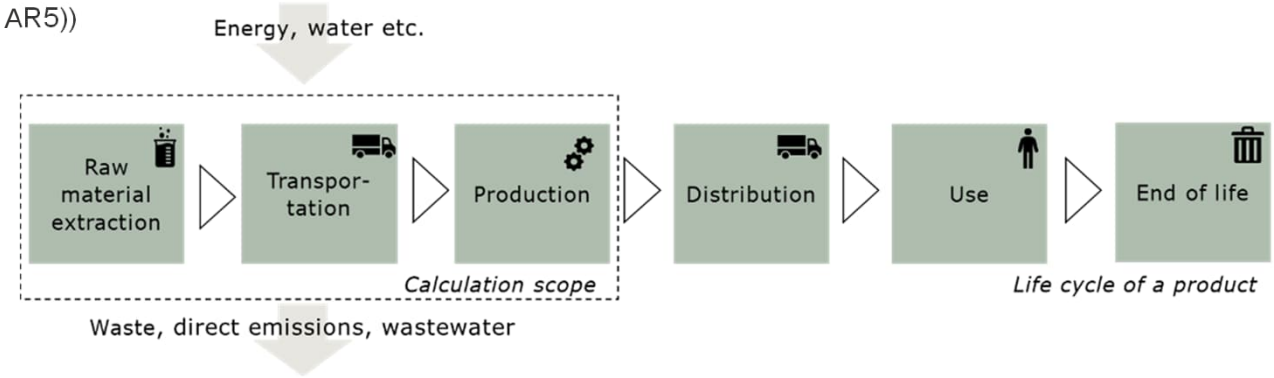

Background, Scope and Data
Metsä

Background and goals

- The target of this study was to **calculate the carbon footprint of tissue production** and compare **virgin fibre based and recycled fibre-based products** produced at Metsä Tissue mills.
- The calculation was performed by AFRY in 2021, based on 2020 data. The data was supplied by Metsä Tissue mills. The calculations have not been third party verified.
- **The carbon footprint in this report refers only to fossil emissions.**
- This report summarises the results of the study, including data from 8 separate mill reports (Krapkowice (PL), Kreuzau (DE), Mariestad (SE), Mänttä (FI), Nyboholm (SE), Paulistrom (SE), Raubach (DE), Zilina (SK)
- The recycled and fresh fibre product comparison is based on one fresh fibre and one recycled fibre product per each mill. The products were selected by Metsä Tissue so that they represent the typical specifications produced at each mill and are as comparable to each other as possible.
- AFRY has made the expert estimates of greenhouse gas emissions (carbon footprint) of tissue production at the Metsä Tissue mills and for the selected virgin and recycled fibre-based products.

Scope and method of the calculation

- The scope for product calculations was **cradle-to-outlet gate,** considering the carbon footprint of the production and transportation of raw materials as well as the manufacturing of the product.
- Emissions (fossil CO_2e including CO_2, CH_4 and N_2O, (IPCC AR5)) were calculated for
  - **Production of each mill site in 2020**
    - ton CO_2e/a and ton CO_2e/ton (of base paper)
  - **Virgin fibre based product**
    - kgCO_2e/ton (of base paper and per roll of product)
  - **Recycled fibre based product**
    - kgCO_2e/ton (of base paper and per roll of product)



- The product calculations were done by applying the ISO-14067:2018 standard. Product Environmental Footprint (PEF) Category Rules (PEFCRs) for Intermediate Paper Product was applied for GWP calculation. Other impact categories of PEFCR were not included in the study. On top of the production stages in cradle-to-gate approach in PEFCR, also converting was considered in this study.
- The calculations were done by using Excel.
- The declared unit in this study was 1 ton of base paper. The reference flow is 1 ton of pulp.
- The calculations have not been third party verified.
- The study report has not been critically reviewed.
- This external study report does not include sensitivity analysis of the results.

Selected products for calculations

Mill	VIRGIN FIBRE PRODUCT	Product	Rolls/pack
Krapkowice	VIRGIN FIBRE PRODUCT	216665	36
Kreuzau	KATRIN PLUS WHITE 3P 9X8 250 VF	220121	8
Mariestad	LAMBI SENSITIVE 4P 6/6x150 2019	226733	6
Mänttä	LAMBI WHITE 3P 5/8x153 19	226364	8
Nyboholm	LAMBI WHITE 3P 5/8x165 165 2020	227385	8
Paulistrom	LAMBI WHITE 3P 30/24x165 2020	227400	24
Raubach	KOKETT 3P 126/10X200 PEFx	226375	10
Zilina	FLORALYS AROMA VF 3P 7/8x200	221217	8

Mill	RECYCLED FIBRE PRODUCT	Product	Rolls/pack
Krapkowice	RECYCLED FIBRE PRODUCT	218016	36
Kreuzau	KATRIN CLASSIC WHITE 3P 9X8 250 Eco	220130	8
Mariestad	SERLA CLASSIC 6-pack	228288	6
Mänttä	SERLA YELL 3P 5/8x153 2019	225620	8
Nyboholm	-		
Paulistrom	-		
Raubach	KOKETT 3P 180/8X200 RC	229427	8
Zilina	FLORALYS RC 3P 180/8X200 CEE	228208	8

Fresh fibre products

100% fresh fibre content

Recycled fibre products

RCF content between 70-100%

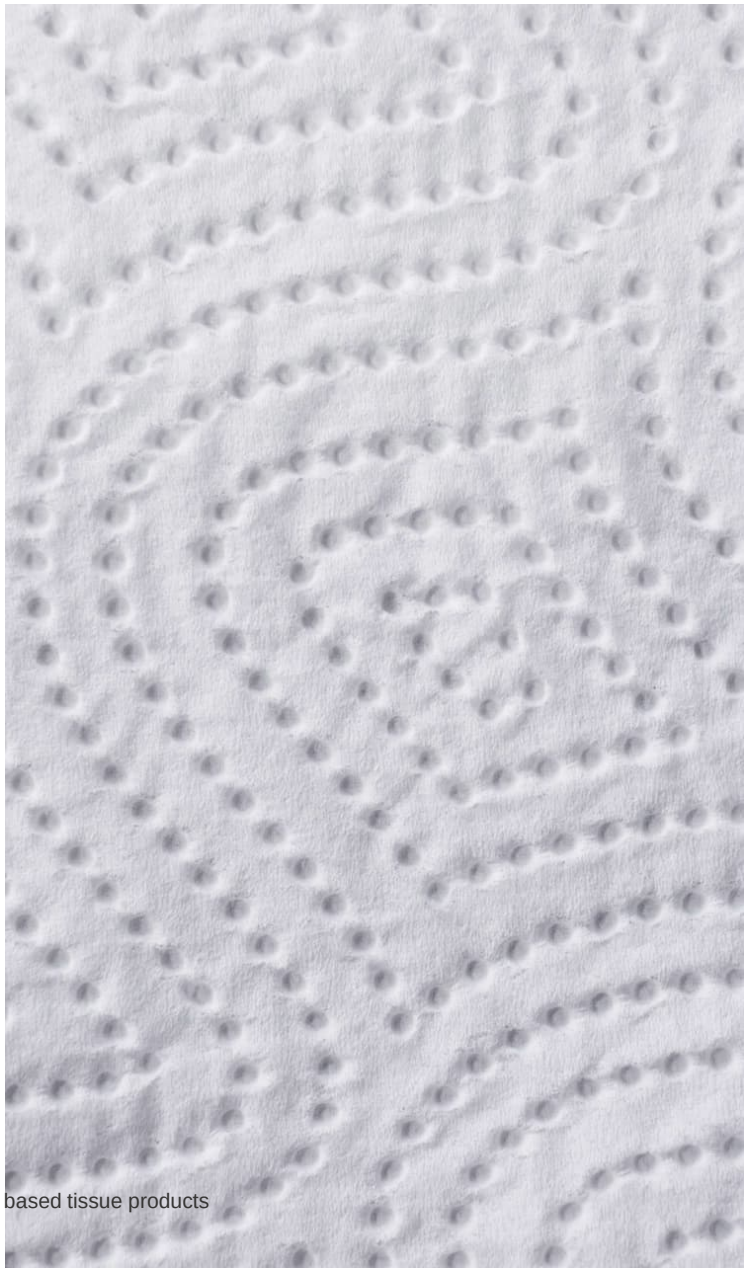
Initial data

- The initial data required for the study was provided by Metsä Tissue mills in Excel sheets.
  - AFRY has not verified the accuracy of the input data. Certain generalisations or estimates have been made for some of the input data.
- Mill level calculations were done based on annual data from year 2020.
- Product calculations are based on product specific bill of materials (BOM).
- Calculation of each mill has been done based on the supplied data by the mills. Due to variations in the initial data, the results between the mills may not be fully comparable.
  - Variations in water, wastewater, product specific energy consumptions, transportations of material inputs, waste and vehicle data


Carbon Footprint
Metsä

Carbon Footprint in general

- In the recent years, carbon footprint has become an essential tool for developing responsible business.
- Carbon footprint provides practical information on greenhouse gas emissions.
- Climate impact describes the generated greenhouse gases (GHGs) such as
  - Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).
- Carbon footprint is an indicator to calculate the climate impact of a product. It is expressed as carbon dioxide equivalents (CO_2e) in which the various greenhouse gas emissions are converted into a comparable form.
- The results of the calculation indicate the most critical contributors to the climate impact so that emission reduction measures can be properly targeted.
  - Often the reduction of climate impact also brings savings as the energy use or logistics become more efficient.
- The carbon footprint is also a relevant indicator for developing value chain and operational efficiency.
- The results of the calculations can be utilised in strategic planning, purchasing, marketing and sales, HR, environmental reporting and building an environmentally friendly corporate image.



Emission factors, assumptions and cut-offs

- The used emission factors have been taken mainly from international Ecoinvent emission factor 3.7. database. Also, publicly available sources have been used (Statistics Finland Fuel classification, German Umweltbundesamt, GHG Protocol stationary combustion tool, Defra, VTT's LIPASTO database, AIB, WWF's climate calculator factors, HSY emission factors).
- Calculation specific assumptions and cut-offs are listed on the following page.
- This report presents the fossil emission results of the study.
- No land use change is expected to occur as all used pulp originates from sustainably managed forests.
  - 91% of the virgin fibres used in Metsä Tissue's production come from FSC or PEFC certified forests. Rest 9% are also traceable to sustainably managed forests.
  - All of the company's sites are chain-of-custody certified.
  - All of the company's primary virgin fibre suppliers are chain-of-custody certified.

Initial data, assumptions and cut-offs

Emission source	Life cycle phases included	Fossil emissions included	Notes and cut-offs regarding fossil emissions
RCP	Sorting and transportation	Yes	
Virgin fibre	Forestry, production and transportation	Yes	Calculated mainly based on secondary data from Ecoinvent as primary producer specific data was not available for all pulps. Emissions of purchased pulps produced in Äänekoski and Kaskinen, fossil emissions are based on Metsä Group's own calculation. Primary data on transportations used if available.
Chemicals and materials	Production and transportation	Yes	Depending on the data availability, the transportation was considered based on primary data or secondary data (through Ecoinvent market datasets). Therefore, in all cases PEFCR may not have been fully followed in this respect. Emissions of chemicals have been calculated based on main component. Concentration has not been considered.
Purchased base paper	Production and transportation	Yes	Purchased base paper has been considered only in the mill level calculations. Source of purchased base paper was not reported. Purchased base paper expected to be purchased from other nearby Metsä Tissue mills. Emissions from purchased base paper have been evaluated on average transportations and mill emissions from base paper production.

Electricity	Production and use	Yes	Depending on the production method and data availability.
			• Country level residual fossil emission factor has been used for grid electricity.
			  • Finland: 310 $kgCO_2e/MWh$
			  • Poland: 811 $kgCO_2e/MWh$
			  • Germany: 439.6$kgCO_2e/MWh$
			• If mill uses 100% hydropower, emission factor of 0 kg/MWh has been used for the calculation.

Steam	Production and use	Yes	Depending on the production method and data availability
Gas	Production and combustion	Yes	Either LPG, LNG or natural gas
Water and wastewater	Production and treatment	Yes	Wastewater treatment have been calculated based on Ecoinvent data (average wastewater treatment in Europe).
Waste	Treatment and transportation	Yes	Waste from production goods (such as screens and felts) and maintenance related waste have been excluded from the study. Consideration of emissions from deinking waste differs depending on the treatment method: • Used as a material: Emissions from transportation of deinking sludge considered in calculation • Used for energy at own site: Emissions included in energy production (fossil emissions) • Incineration outside of own site: Emissions from transport and handling of waste considered in calculation
Vehicles	Fuel production and combustion	Yes	

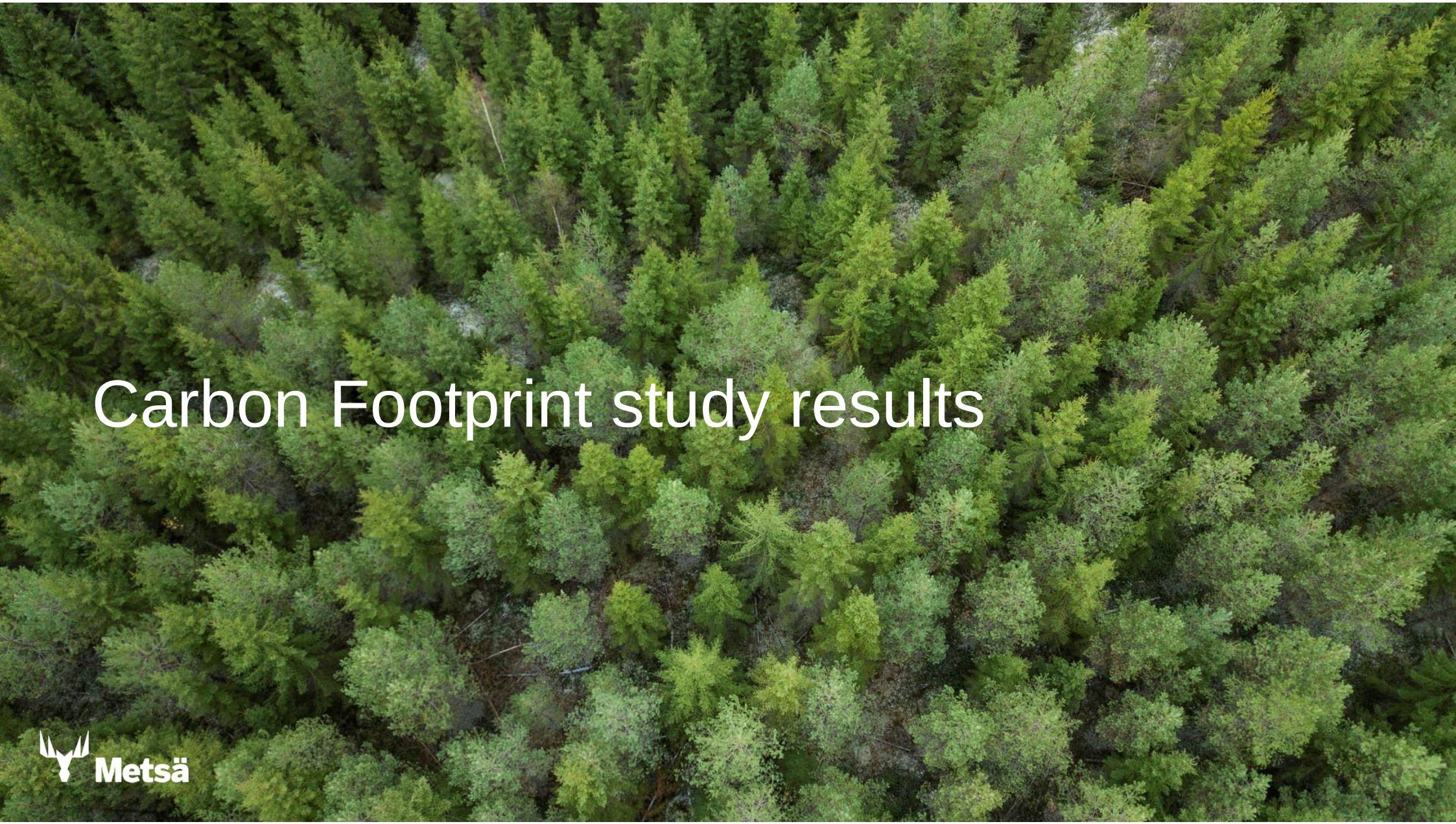
Note:

- The calculation excludes energy used for heating the mill and other organization related emissions that are not directly linked to the production of tissue products.
- The calculation excludes fossil emissions from peat at Mäntän Energia Oy as the use of peat has ended in 2020. Peat has been replaced with wood-based biomass which has been taken into account in the calculations.

Phase descriptions in product specific and mill level calculations

To describe, where fossil emissions are coming from calculations are divided into different production phases.

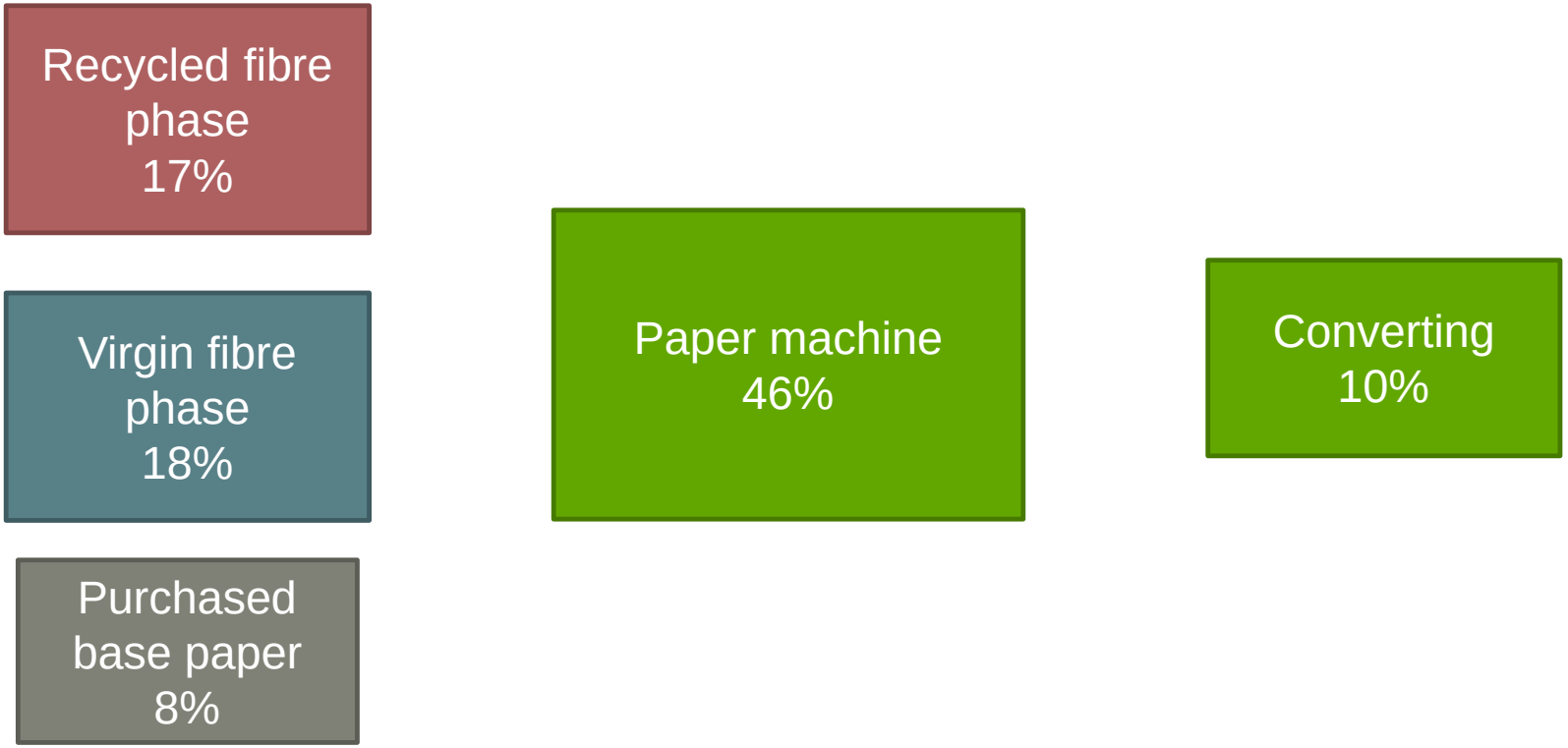
- Deinking phase, includes
  - Recycled paper's sorting and transportation
  - Chemicals (incl. transportation)
  - Energy used at deinking (=cleaning process for recycled fibre at a paper mill)
  - Waste
  - Vehicles
  - If data available, water and wastewater
- Virgin fibre phase, includes
  - Pulps and pulp transportation
  - Chemicals (incl. transportation)
  - Energy used at kraft pulping and refining
  - If data available, waste, vehicles, water and wastewater
- Paper machine phase, includes
  - Chemicals (incl. transportation)
  - Energy used at paper machines
  - If data available, waste, vehicles, water and wastewater
- Converting phase, includes
  - Chemicals (incl. transportation)
  - Packaging materials (incl. transportation)
  - Energy used at converting line
  - If data available, waste, vehicles, water and wastewater
- Annual mill level calculations include also purchased base paper and its transportation


Carbon Footprint study results
Metsä

Summary of the annual mill level carbon footprint results

	Annual mill level emissions	Annual average per ton of product
	Total fossil emissions	**Total fossil emissions** (own base paper production)
Unit	**tCO_2e**	**tCO_2e/ton**
Krapkowice	**123 333**	**2,284**
Kreuzau	**258 525**	**1,815**
Mariestad	**54 960**	**0,661**
Mänttä	**83 905**	**0,963**
Nyboholm	**23 603**	**0,766**
Paulistrom	**34 822**	**1,052**
Raubach	**147 135**	**1,470**
Zilina	**97 653**	**1,268**

Annual mill level carbon footprint average results by phase

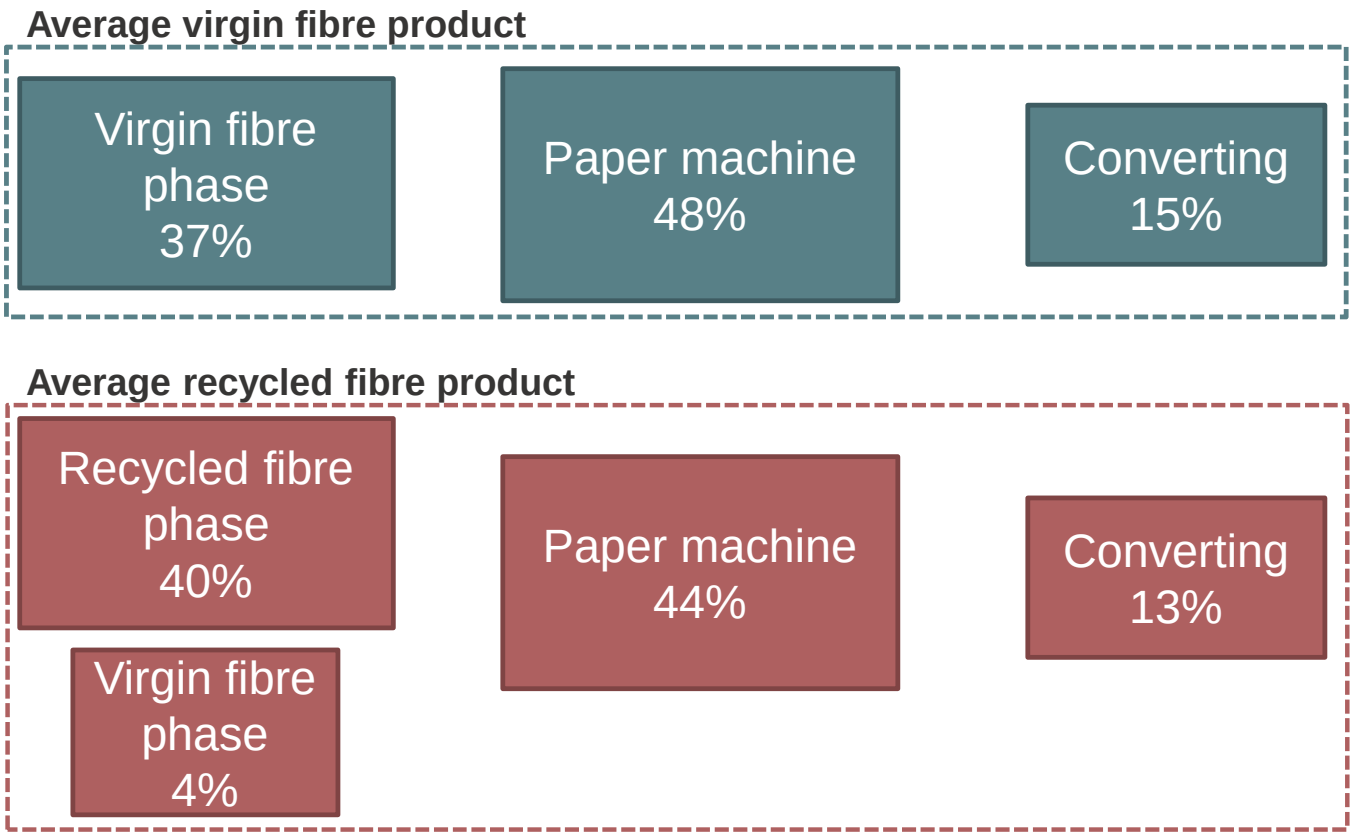


Summary of product specific carbon footprint results

	Virgin fibre product		Recycled fibre product	
	Virgin fibre product, per ton (base paper and converting)	**Virgin fibre product, per tissue roll** (base paper, without converting)	**Recycled fibre product, per ton** (base paper and converting)	**Recycled fibre product, per tissue roll** (base paper, without converting)
Unit	**($kgCO_2e/t$)**	**($kgCO_2e/roll$)**	**($kgCO_2e/t$)**	**($kgCO_2e/roll$)**
Krapkowice	**1 896**	0,169	**2 227**	0,242
Kreuzau	**1 588**	0,159	**1 495**	0,175
Mariestad	**753**	0,067	**640**	0,068
Mänttä	**756**	0,056	**807**	0,071
Nyboholm	**822**	0,074	**-**	-
Pauliström	**827**	0,078	**-**	-
Raubach	**1 466**	0,147	**1 740**	0,206
Zilina	**1 067**	0,097	**1 163**	0,132

- Per ton of base paper, the carbon footprint is in most cases higher for recycled based product.
- On average 15%* less rolls are obtained from 1 ton of recycled base paper compared to fresh fibre base paper. (*based on Metsä Tissue production)
- Per roll of tissue, the carbon footprint is in all cases higher for recycled products.

Product specific carbon footprint average results by phase



Results’ summary

Main factors impacting mill level results

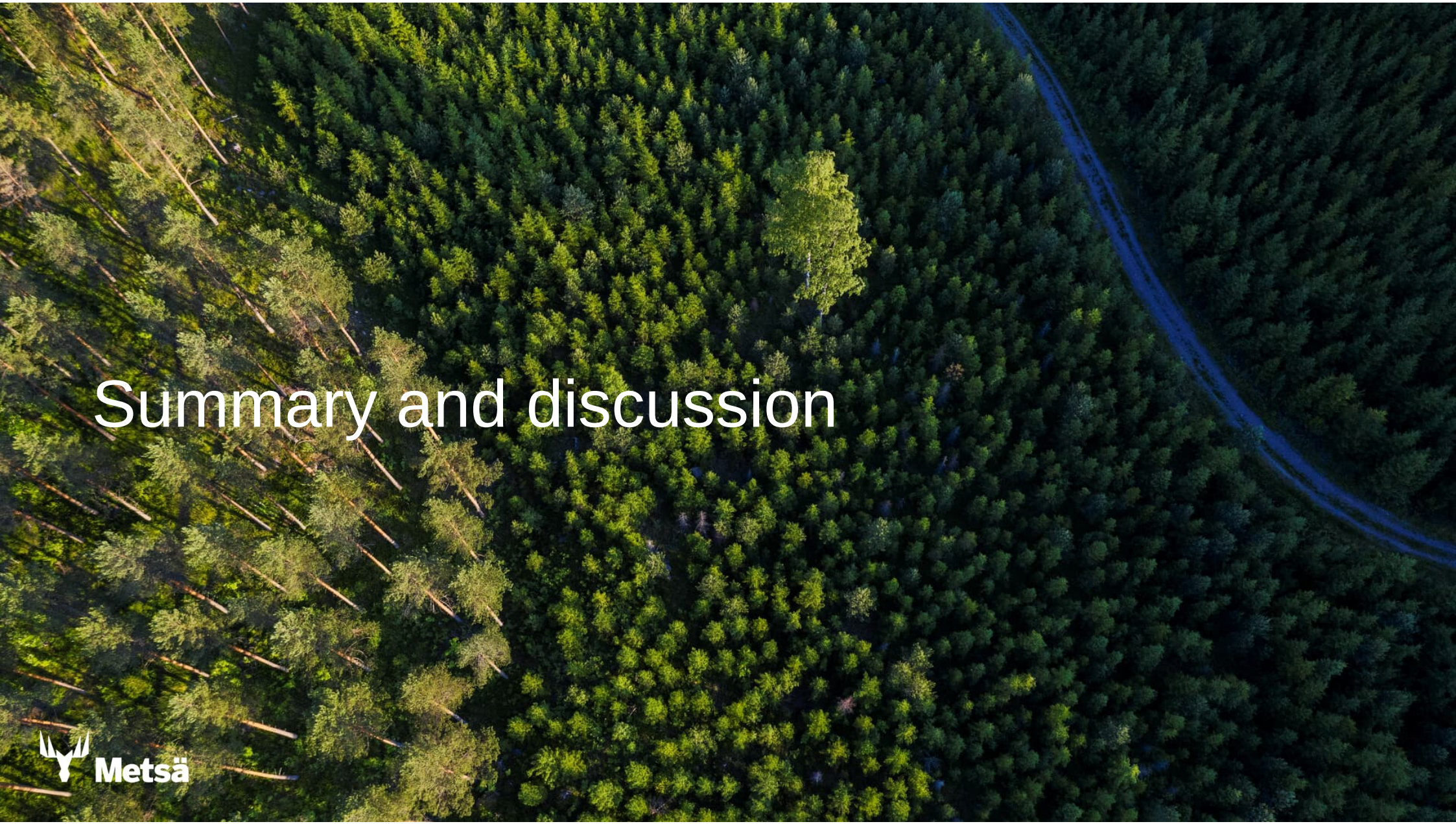
- **Electricity**
  - Carbon neutral electricity in use in some mills
- **Steam & gas**
  - Methods of steam production differ between mills (fossil- or bio-based fuels)
- **Purchased virgin fibres**
  - Emissions from transportation and production of virgin fibres differ based on producer and country of origin.
  - Due to lack of producer specific data in majority of the cases, Ecoinvent data was used. Ecoinvent data for virgin fibres may show higher values than what emissions of virgin fibre production in reality currently is.
- **Consideration of deinking sludge**
  - Deinking sludge from mills are treated in several different ways depending on the mill. This impacts how the emissions of deinking waste have been considered.

Virgin fibre based (VF) product vs. Recycled (RCF) fibre-based product

- Based on the calculations of selected products, the carbon footprint is in most cases higher for RCF based product, when calculated for ton of base paper.
  - Products differ between mills and therefore results are not fully comparable
- For same product, in average 15%* less rolls are obtained from 1 ton of RCF based base paper compared to VF based base paper.
- When calculating emissions for roll of toilet paper, the results show that for products under review, the carbon footprint is in all cases higher for RCF based products.
- Overall sustainability of choices have not been considered (e.g. replacement of materials or energy sources outside of sites).

Note: Some differences occurred in available initial data and therefore mill level results are not fully comparable.

* Calculation done by Metsä Tissue with SAP based number of consumer packs from one ton of base paper


Summary and discussion
Metsä

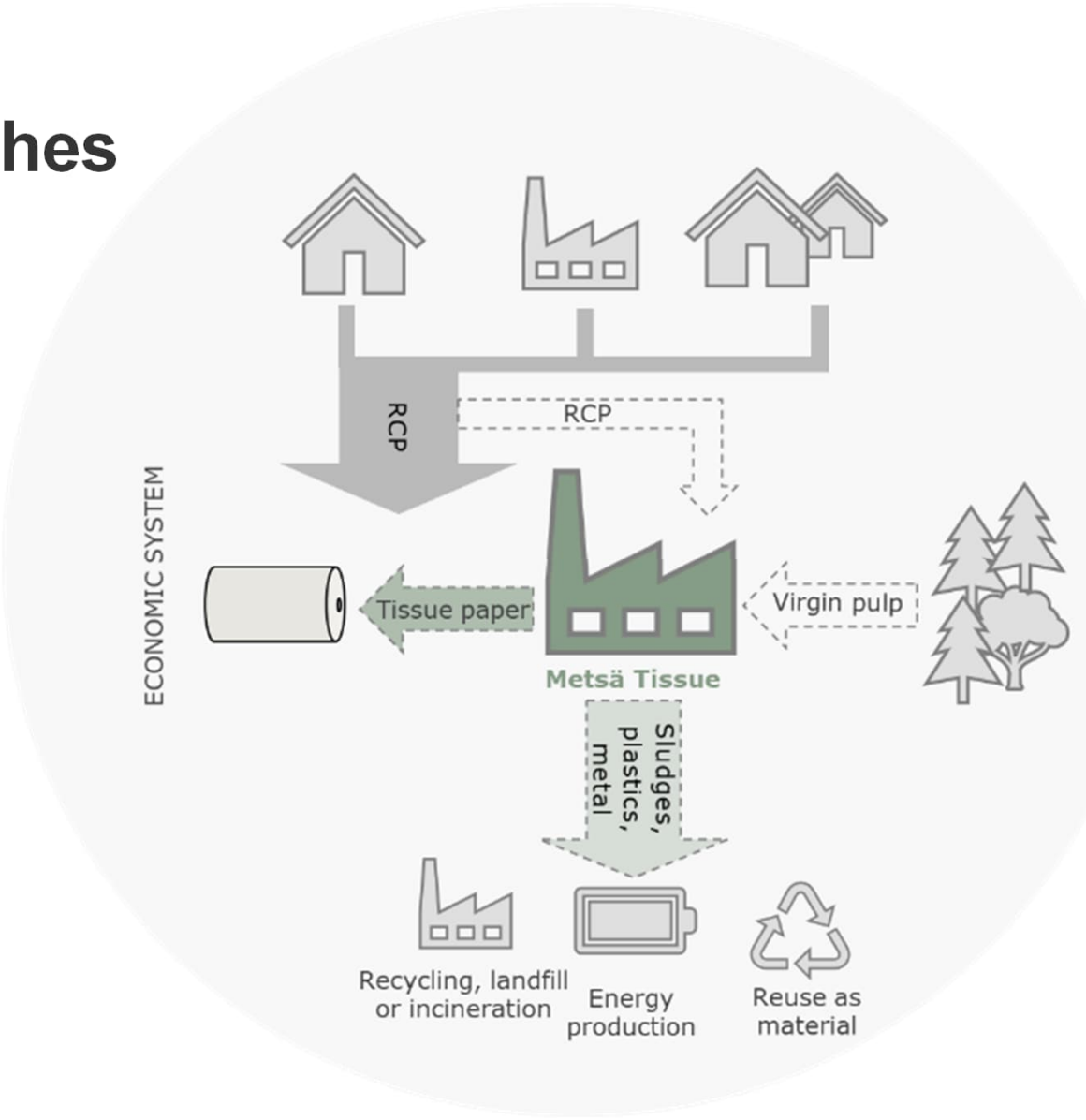
Summary

- Metsä Tissue, in co-operation with AFRY, calculated the carbon footprint of tissue production in its eight European mills, and explored also the differences in the footprints of toilet papers made of fresh and recycled fibres.
- The average carbon footprint of tissue papers produced at Metsä Tissue's mills was 1.4t CO_2e per ton of paper (including converting)
- The average European consumes around 12.8 kg of toilet paper a year*, which is equivalent to approximately 17.92 kg of CO_2. This corresponds to around 0.27% of each European's overall annual carbon footprint.**
- The results for the products analysed indicate that a roll of toilet paper made of fresh fibre has a carbon footprint that is approximately one fifth smaller than a roll made of recycled fibre
- However, this is not to indicate that the use of recycled paper should be avoided but instead discussion can be raised on whether recycled paper would have better utilisation opportunities in use-cases where purification demands are less high than in hygiene and food contact papers.
- It is critical that when fresh fibre is used, it comes from sustainable sources.

*Source: RISI Q2-2021, incl. Napkins
**Source: Eurostat "The total carbon footprint of EU-27 was equal to 6.7 tons of CO_2 per person in 2019."

Circular economy approaches

- This study considered a cradle-to-gate scope. To fully understand the impact of waste utilization and circular economy approaches, a holistic system view would be required.
  - This study did not include a system expansion to study the impacts of possible waste stream utilisation of tissue production.
- Circular economy is an economic model that aims to maximise utilization of already existing materials in the economy and increase longevity of products and components.
- Using recycled paper as an input material supports circular economy.
- However, it is important not only to look at the carbon footprint of products but also the circularity of incoming and outgoing material flows



List of abbreviations

Abbreviation	Explanation
AIB	Association of Issuing Bodies
CFP	Carbon footprint
a	Annum
BCTMP	Bleached Chemi Thermomechanical Pulp
BOM	Bill of Material
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon dioxide equivalents
DIP	Deinked Pulp
Ecoinvent	International LCI Database
Excl.	Excluded
Fossil emissions	Emissions derived from fossilized material
FSC	Forest Stewardship Council
GHG	Greenhouse gas
GWP	Global warming potential
HSY	Helsinki Region Environmental Services HSY
Incl.	Included

Abbreviation	Explanation
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MWh	Megawatt hours
N/A	Not available
N_2O	Nitrous oxide
PEF	Product Environmental Footprint
PEFC	Programme for the Endorsement of Forest Certification
PEFCRs	Product Environmental Footprint category Rules
PM	Paper Machine
RCF	Recycled fibre
RCP	Recycled paper, Paper for recycling
tCO_2e	Ton of carbon dioxide equivalents
VF	Virgin fibre
VTT Lipasto	VTT Technical Research Centre of Finland Ltd, LIPASTO calculation system for traffic exhaust emissions and energy use in Finland


Metsä