

September 2022

NIKE Forward Carbon Footprint Assessment

INTRODUCTION:

NIKE Forward is an apparel construction technology that utilizes recycled content non-woven materials and needle-punching processing to provide superior performance for fleece product. This results in material construction with significantly less process steps and lower energy use as compared to standard knit materials.

GOAL & SCOPE:

The goal of the study is to conduct cradle-to-gate carbon footprint analysis of NIKE Forward as compared to standard polyester knit materials used in fleece product (i.e., fleece materials). The intention of the study is to also communicate externally the carbon footprint results and relative reduction as compared to a benchmark material. We are focusing on climate change impact as this is one of our most material impact categories as a company.

INTENDED AUDIENCE:

The intended audience of this study and results are the consumers of apparel items that incorporate NIKE Forward technology. This information will also be used for internal purposes to understand and drive impact reduction opportunities.

FUNCTIONAL UNIT:

The Functional unit is the provision of warmth resistance and material properties that allow for a certain look and feel associated with fleece material used in the production of a typical fleece apparel product using 3 m² of material.

The Heat Resistance (RCT) of NIKE Forward has a higher measured value (and therefore a higher heat resistance) per kilogram of material as compared to benchmark Fleece materials. Therefore, the NIKE Forward thermal efficiency is higher and translates to less material required to provide the same function. The reference flow is the amount of fabric (in kgs of material) that is needed to fulfill this function as applied to a fleece product (3 square meters of fabric). The need for 3 square meters of fabric is derived from the typical width and length of fabric material needed to produce 1 apparel garment.

Material type	RCT (hight = more warmth)	Thermal Efficiency (higher = more warmth per area)	Basis weight of material (Grams/square meter)	Amount material needed per reference flow (square meters)	Amount of material used in 1 Fleece Product (kg)
NIKE Forward	71	0.392	180	3	0.54
Fleece material average	57	0.207	273	3	0.82

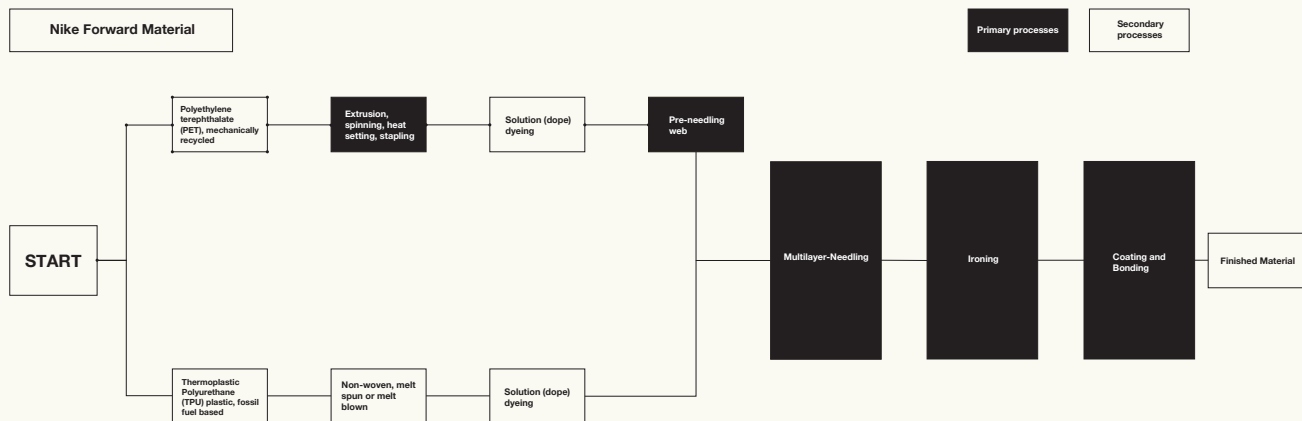
For the benchmark fleece material, we assumed the weighted average of comparable fleece materials such as Surrey, Metro, and Resist materials based on purchase volume. The comparable fleece materials were selected based on those materials used in similar Fleece apparel products. We chose this list of materials as benchmarks as they represent our top volume ‘lifestyle/sportswear’ fleece category materials that are intended to be replaced with NIKE Forward material. These fleece materials use construction methods, such as spacer knits (i.e. Metro) or French terry/loop back (i.e., Surrey), to provide insulation properties while NIKE Forward uses a non-woven method of make for insulation properties. We also included our highest volume ‘performance’ fleece material (Resist) to ensure incorporated 100% polyester fleece made via a brushed/raised surface method for insulation properties. We calculated the weighted average of the properties using volumes (million yards) of materials purchased in 2021 and their respective material basis weight for fleece apparel product.

SYSTEM BOUNDARY:

The product system is cradle to gate, including the following life cycle stages:

- 1-Raw material extraction / acquisition
- 2-Transportation associated with raw materials in background data
- 3-Material processing

Process flow diagram:



Transportation of raw materials is implicitly included in Higg MSI data (background data). However, for the subsequent value chain processes, the Higg MSI does not require explicit modeling of transportation in the materials life-cycle. According to the Higg MSI methodology “exclusion of foreground system transport modeling will not strongly affect the conclusions or results”. In addition, the NIKE Forward product is produced in a single facility which further minimizes the relative impact of transportation-related emissions.

LIFE CYCLE INVENTORY (LCI) DATA SOURCES:

The inventory for raw materials and some processing steps were sourced directly from SAC’s Material Sustainability Index (MSI) version 2.0. These data are verified cradle-to-gate material production life cycle impact assessment (LCIA) midpoint data.

Primary energy data for manufacturing steps unique to NIKE Forward were collected directly from Nike Suppliers and converted into GWP based on country of manufacture using electricity grid conversion factors from IEA’s “CO2 emissions from fossil fuel combustion.” The primary energy collection was conducted by the Nike supplier during the manufacturing validation run. The manufacturing validation run is a full-scale line that is directly representative for the actual production. There is no specific information related to GHG removals through the use of renewable electricity in the foreground data and therefore we do not factor in any GHG removal information.

For benchmark materials, Higg MSI process-level secondary data was used to model impacts associated with the material life-cycle from cradle-to-gate.

LCIA METHODOLOGY:

All carbon footprint data and analysis has been conducted following ISO 14040/14044 guidance.

Global warming potential (GWP) midpoint factors sourced from Higg MSI utilize IPCC 2013 GWP 100 characterization factors.

The IEA emissions factors are the most recent values published in 2020, and include CO₂, CH₄, and N₂O. The factors also include the transmission and distribution losses as well as the correction for electricity trade. The IEA emissions factors use the IPCC 2006 GWP assessment report (AR4), while the Higg MSI uses the IPCC 2013 GWP assessment report (AR5). The conversion factors for CH₄ and N₂O to CO₂ equivalents are slightly different in the two reports. The electricity emissions factors in CO₂e are dominated by CO₂ emissions (representing about 90% of the total emissions factor). Using the AR4 factors, the Taiwan electricity grid emissions factor is 0.5787 kg CO₂eq/kWh. When using the AR5 factors, the Taiwan electricity grid emissions factor is 0.5785 kg CO₂eq/kWh, a difference of 0.03%. Therefore, the discrepancy in IPCC assessment reports has limited effect on the conclusions of this study.

ALLOCATION PROCEDURES:

In the foreground data, no multi-functional processes were included so there is no need for allocation. In the background data, we leverage the Higg MSI methodology allocation procedures – please refer to the Higg Methodology section on “Handling of multi-functional processes” for more information.

The electricity grid conversion factors from IEA include allocation for combined heat and power. From the IEA 2020 methodology document, the fixed-heat-efficiency approach was used. The standard heat efficiency of a typical boiler was used, 90%.

CUT-OFF CRITERIA:

No significant cut-offs (< 5 % of total mass and energy inputs/outputs) were needed. We have excluded infrastructure and capital equipment.

GEOGRAPHIC AND TIME COVERAGE:

We have collected electricity consumption kWh on a trial production line which will be used at scale for manufacturing. The energy data represents production of roughly 3000 yards of produced material. No other energy forms were used beyond electricity in the production of NIKE Forward material. The validation trial is representative of bulk production and is representative of manufacturing production in Taiwan, reference year 2021.

Materials are representative of Higg MSI data depending on the raw material between 2011-2016. For benchmark fleece materials, we leveraged Higg MSI data exclusively to represent the process-level impacts from cradle-to-gate and therefore did not collect any primary manufacturing data.

SOFTWARE:

SAC HIGG MSI version 2.0 and Excel

ASSUMPTIONS AND LIMITATIONS:

As we did not collect primary data to represent the benchmark materials and relied on a weighted average impact across all our fleece materials, the accuracy of the impact of our benchmark contains some uncertainty. Also, the study has only incorporated climate change as an impact category and thus did not evaluate other environmental impacts associated with NIKE Forward or benchmark materials. One component of the NIKE Forward material technology is the use of a “carrier” for the non-woven material to be transported within the production process. The “carrier” is not part of the final material construction but is included in the overall impact assessment of NIKE Forward. The carrier is assumed to be used 1 time currently. A sensitivity was performed to understand the impact of the carrier. A sensitivity analysis is included on this assumption.

DATA QUALITY ASSESSMENT:

For Higg MSI processes, we’ve listed below the DQR as described in the Higg MSI data for the most relevant Higg processes used in the NIKE Forward assessment. Processes for which the average is 1 are Excellent but processes with an average score of at least 3 are considered acceptable.

DQR for relevant background data processes from Higg MSI:

Higg Process	Precision	Time Representativeness	Geographical Representativeness	Technological Representativeness	Uncertainty Score (average)
Polyethylene terephthalate	2	1	1	3	1.75
(PET) mechanically recycled					
Solution (dope) dyeing	3	1	2	2	2
Thermoplastic Polyurethane (TPU) plastic, fossil fuel based	3	2	3	3	2.75
Polypropylene (PP) plastic, fossil fuel based	3	2	2	2	2.25
Non-woven, melt spun or melt blown	3	1	3	2	2.25
Batch Dyeing	2	1	3	3	2.25

For primary data processes – according to the DQR system, we have self-assessed scores for our manufacturing processes.

Manufacturing Process	Precision	Time Representativeness	Geographical Representativeness	Technological Representativeness	Uncertainty Score (average)
Pre-needling web (Chute feeder/weighing/ carding/cross lapper/ drafter/loom/detecting/ cutting/winder) - 50gsm	1	1	1	1	1
Multilayer-Needling	1	1	1	1	1
Ironing	1	1	1	1	1
Coating	1	1	1	1	1

THIRD PARTY REVIEW:

This study has been reviewed by a single external advisor, PRé Sustainability B.V.. We have developed a robust carbon footprint analysis following ISO standards and leveraging high quality secondary data. In order to communicate appropriately to our consumers, we are also communicating the relative reductions of NIKE Forward against a benchmark suite of similar functioning materials using the same methodology. We understand there is some risk associated with a single reviewer for this type of study, but since we are making a comparative assertion to our own volume-average fleece material, we have opted to engage with a single reviewer.

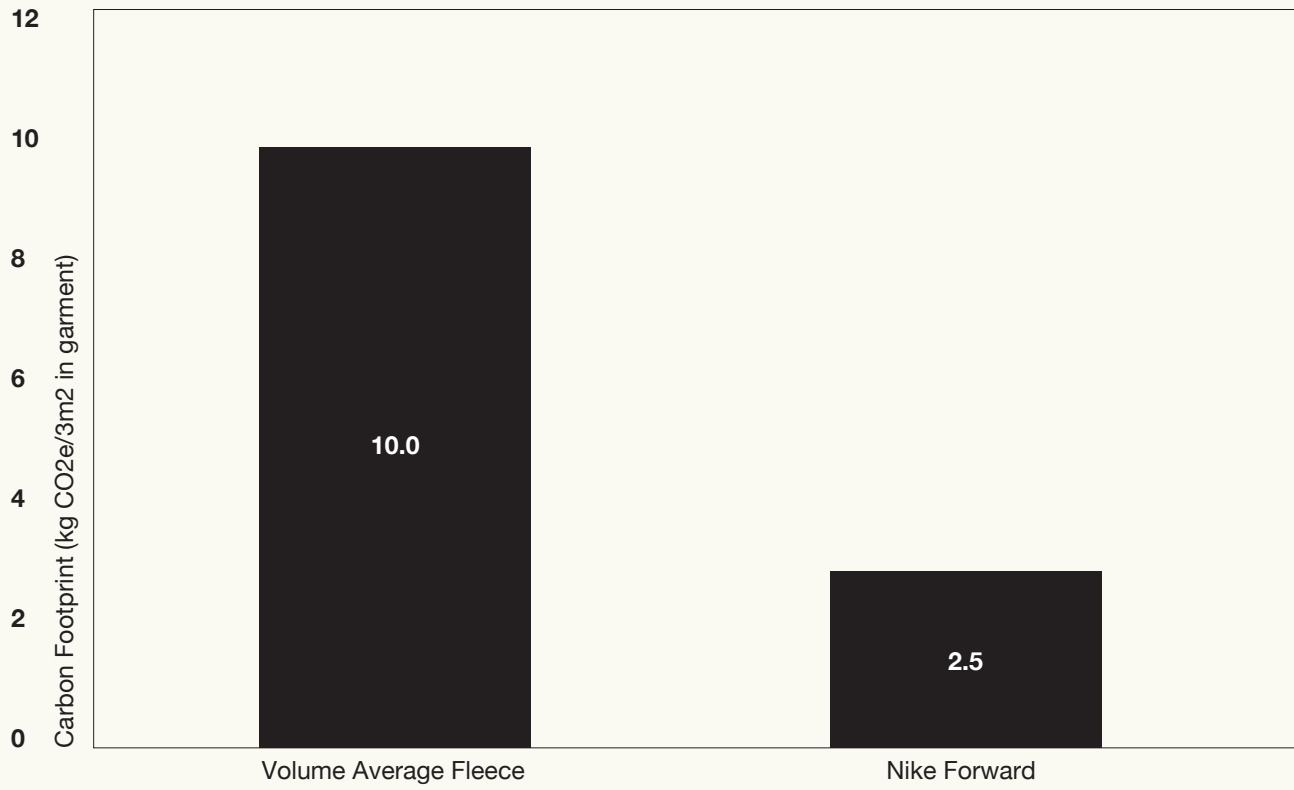
RESULTS:

The following are results from our carbon footprint study for NIKE Forward and benchmark fleece materials average. NIKE Forward material contributes 4.71 kg CO₂e / kg at the material level. Per the functional unit and as used in an apparel product, the contribution is 2.54 kg CO₂e / product. NIKE Forward translates to a per kg of material reduction of 61% for NIKE Forward compared to the volume average fleece material. Per 3m² in garment and per m², the kg of CO₂e of NIKE Forward is 75% lower than the volume average fleece garment.

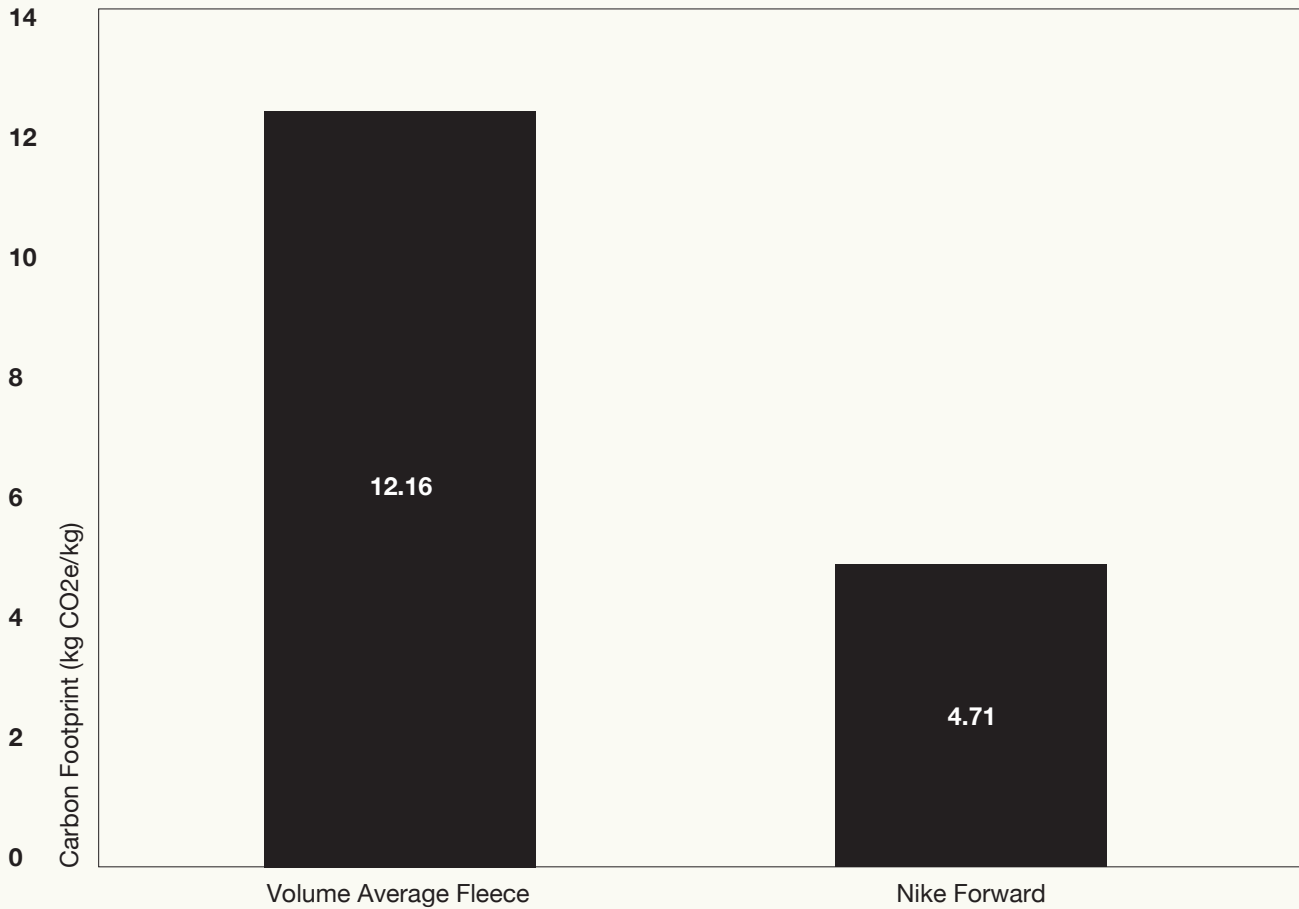
The main drivers for the reduction seen in the NIKE Forward material are the use of recycled materials (recycled polyester), the lower process energy use, and the lower material basis weight (gsm) for NIKE Forward (light-weighting made possible by the better heat resistance). The lower processing energy is due to the fact that NIKE Forward utilizes solution dyed fibers rather than traditional dye methods. Per garment, another reason for the large reduction is that less NIKE Forward material is needed to fulfill the functional unit requirements due to the higher heat resistance value. The updated energy measurements were slightly lower than on the trial line, resulting in a slightly lower carbon footprint for NIKE Forward.

Material	Kg CO ₂ e/kg	NIKE Forward Savings Per KG	Kg CO ₂ e/3m ² in Garment	NIKE Forward Savings Per 3m ² Garment	Kg CO ₂ e/m ²	NIKE Forward Savings Per m ²
NIKE Forward	4.71	X	2.54	X	0.85	X
Benchmark Fleece Avg	12.16	61%	9.97	75%	3.32	75%

Carbon Footprint Per 3m2 in Garment



Carbon Footprint Per kg

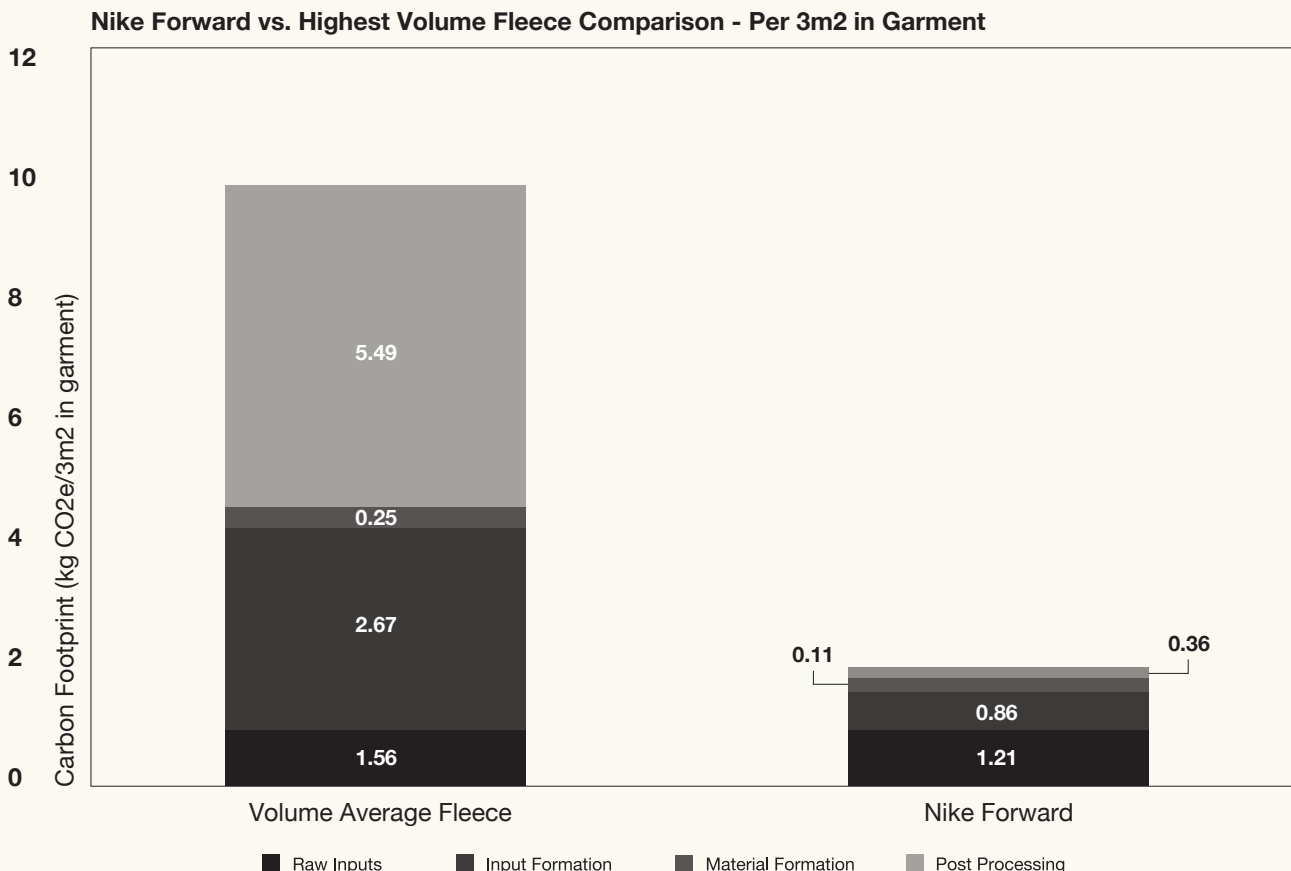


CONTRIBUTION ANALYSIS:

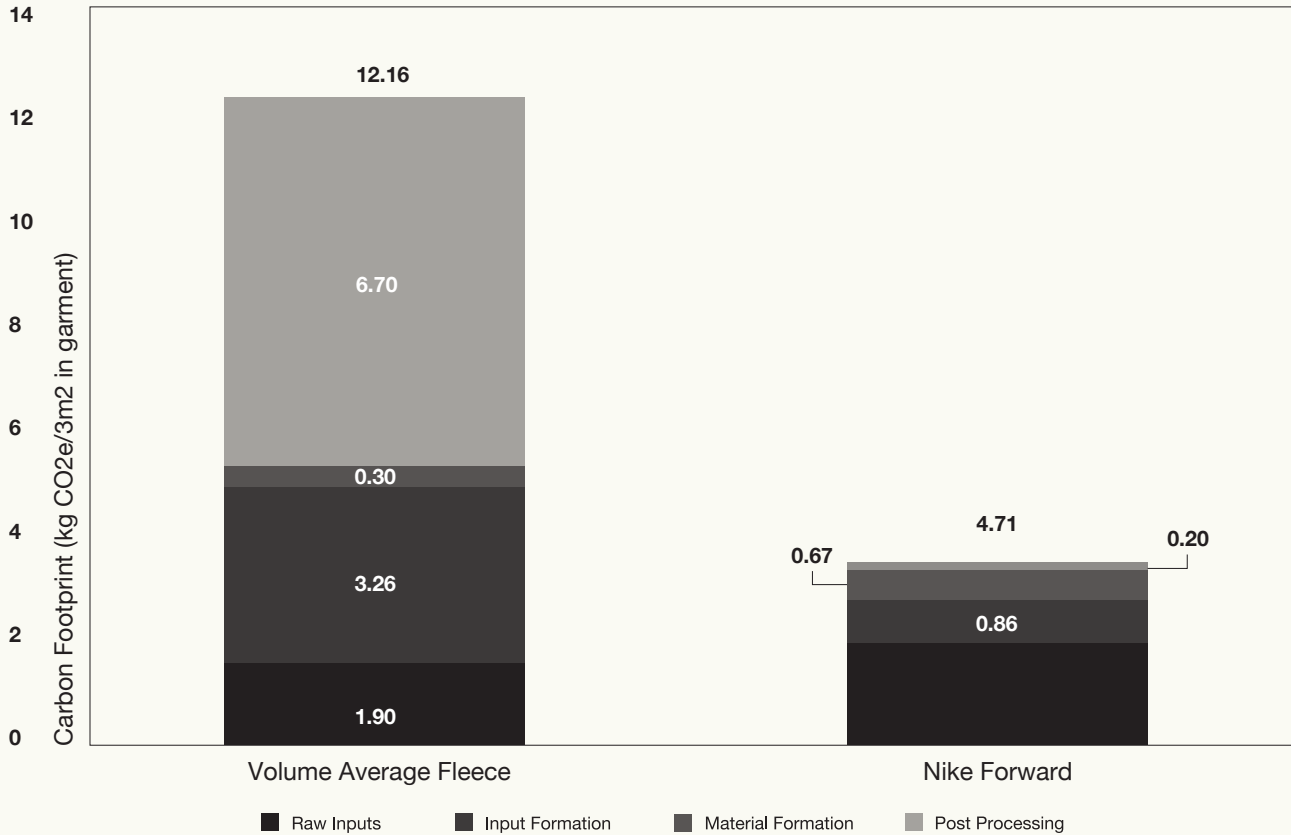
The contribution of the stages included in the carbon footprint are shown per garment and per kg in the graphs below. The raw materials/input stage includes all raw materials used. The input formation stage includes all processes that transform the input raw material into the form needed for the fleece or NIKE Forward material, such as extrusion, spinning, heat setting, stapling, solution (dope) dyeing, pre-needling, and ironing. Material formation includes the knitting of the material. Finally, post processing for NIKE Forward includes bonding and coating operations. Post processing for the average fleece material includes batch dyeing and drying.

The raw material inputs and input formation stages have the highest contribution to the NIKE Forward cradle-to-gate carbon footprint, contributing 48% and 34% respectively. The TPU material in the functional layer of NIKE Forward contributes 62% to the raw materials stage, and 29% to the overall impact. The recycled polyester raw material impact contributes 28% to the raw materials stage, and 14% to the overall NIKE Forward kg CO₂e. For the input formation stage, the extrusion of PET to fiber is the largest contributor at 30% of the input formation impact (10% to the overall impact). The non-woven process of making the functional layer is the next highest contributor to the formation stage at 27% of the formation impact (9% to the overall impact).

For the weighted volume fleece average impact, the post processing stage is the highest contributor with 55% of the carbon footprint. Input formation follows with 27% of the carbon footprint for the weighted volume fleece average material. The batch dyeing processes contribute about 40% to the overall carbon footprint of the average fleece material. The use of solution dyed fibers rather than traditional dye methods is a main reason why the input formation and post processing stages are lower for NIKE Forward than the volume average fleece.



Nike Forward vs. Highest Volume Fleece Carbon Footprint Comparison - per kg



SENSITIVITY, AND SCENARIO ANALYSIS:

Several scenarios and sensitivities were examined to understand the impact of certain assumptions on the overall results.

WEIGHTED AVERAGE VS VOLUME AVERAGE FLEECE MATERIAL:

The fleece material carbon footprint used in the comparison to NIKE Forward is a purchased volume averaged impact of the standard fleece materials traditionally used. A sensitivity was performed to understand the comparison if a weighted average carbon footprint was used as the basis of comparison. The total weight of each material and its weighted contribution were determined by using the total length used, the width, and the GSM of the material. Using the weighted average calculation, the average fleece material for comparison now has an impact of 12.32 kg CO2e/kg, which is 1.3% higher than the purchase volume average impact. The NIKE Forward impact remains similarly reduced compared to the weighted average fleece impact as compared to the purchase volume average. The result is similar when comparing the results per kg (62% reduction) and the same comparing per garment (75%). Based on these results, using either purchase volume average or weighted average all fleece impact for comparison shows the same reductions for NIKE Forward.

	Metro	Surrey	Resist	Volume Average	NIKE Forward
Total kg CO2e/kg material	13.37	11.78	12.03	12.16	4.71
Total kg CO2e/ 3 m² in garment	12.24	9.86	8.42	9.94	2.54

FLEECE MATERIAL USED IN COMPARISON:

The purchase volume average fleece product of the top comparable fleeces was used as the benchmark material for comparison. To understand the impact of taking the purchase volume average, the top 3 highest volume fleece material impacts were assessed individually. The results are shown in the table below.

The overall results and conclusions of the study that NIKE Forward has a lower impact than a traditional fleece material do not change significantly if comparing to a specific fleece material. The reduction of 61% of NIKE Forward on a per kg basis varies from 60-65% reduction depending on the fleece material. Per garment, NIKE Forward shows a reduction between 70-79% depending on the fleece material.

IDEAL FLEECE COMPARISON:

The volume average fleece material consists primarily of virgin polyester products. A sensitivity is done to understand the comparison of NIKE Forward to a traditional but optimized recycled polyester fleece material. The Resist rPoly material also uses the same dyeing method as NIKE Forward, which was noted to be a driver of the lower impact of NIKE Forward. The Resist rPoly material still requires a post processing stage of scouring and heat setting that the NIKE Forward material does not need. The reductions seen compared to the purchase volume average fleece material are much reduced when comparing to the recycled polyester materials. On a per kg basis, the reductions are 33-42% depending on the material for comparison. On a per garment basis, the reductions of NIKE Forward are 66% for the Metro rPoly and 48% reduction compared to the Resist rPoly. NIKE Forward still shows a lower impact compared to the recycled polyester fleece materials.

	Metro rPoly	Resist rPoly	NIKE Forward
Total kg CO2e/kg material	8.18	7.00	4.71
Total kg CO2e/ 3 m² in garment	7.49	4.90	2.54

NO CARRIER IMPACT:

The carrier is expected to be able to be reused in the production process or completely eliminated, but not before launch in FA22. This sensitivity analysis shows the total impact of NIKE Forward at launch excluding the carrier impact compared to the purchase volume average fleece material. The impact of NIKE Forward on a per kg basis is 64% lower than the volume average fleece product. On a per garment basis, NIKE Forward without the carrier has a 76% lower carbon footprint than the volume average fleece product. By removing the carrier impact, the overall conclusions of the study do not change greatly from the basecase (61% reduction per kg, and 75% reduction per garment). Therefore, it can be concluded that the impact of the carrier does not change the overall results that NIKE Forward has a lower impact than the volume average fleece product.

DQR INTERPRETATION:

The DQR presented earlier showed that the Higg MSI processes used had an average data quality above 3, meaning that they are acceptable for use. The primary data used was shown to be high quality. Overall the main drivers of the carbon footprint of NIKE Forward (recycled PET and TPU) and the average fleece material (batch dyeing) have good to fair average data quality. This level of data quality is not expected to influence the final results of the study. Several of the sensitivity and scenario analyses showed that, including the ideal fleece comparison which showed the average fleece carbon footprint using a different dyeing method than batch dyeing.

CONCLUSION:

Our analysis shows that NIKE Forward material contributes 4.71 kg CO₂e / kg at the material level. Per the functional unit and as used in an apparel product, the contribution is 2.54 kg CO₂e / garment product. In comparison with traditional fleece materials as expressed as a purchase volume average, NIKE Forward has a 75% reduction in carbon footprint per 3 square meters or per m² used in a garment. The sensitivities and scenarios analyzed confirmed that the assumptions made did not affect this main conclusion. The main drivers for the reduced impact for NIKE Forward include the use of recycled materials (recycled polyester), the lower process energy use, and the lower material basis weight as measured by GSM (grams per square meter) for NIKE Forward.

