

Apeel 2021 Impact Metrics Methodology

Introduction

Apeel's shelf life-extension technology for fresh produce gives more time in the supply chain so that produce stays fresh for longer, compared to produce without Apeel. This additional time can enable changes to the food system that result in positive environmental impact. These so-called "impact drivers" can potentially include, for example:

- Food waste prevention at various stages of the supply chain
- Transition to less carbon intensive modes of transportation
- Changes in packaging

These impact drivers enable positive environmental impact by delivering a given result - for example, 1 kilogram of avocados consumed in the home - more efficiently, such that in the absence of the Apeel technology, more inputs would be required and greater environmental burdens would result to deliver the same end result. Due to differences between supply chains, baseline produce shelf life, and location of Apeel product application, these positive impact drivers manifest differently for each of Apeel's products. As such, Apeel strives to measure a change directly in-market prior to quantifying and communicating the associated environmental benefits.

To-date, Apeel's in-market data collection on impact drivers has focused on waste reduction in retail stores. As such, ***the results shared in Apeel's 2021 Impact Metrics are based exclusively on the prevented waste and resulting positive environmental impact enabled by such retail waste reduction.*** The Impact Metrics include only products that Apeel has launched into the market, and also excludes any products for which Apeel was still in the process of measuring in-market impact at the time of reporting. The Impact Metrics are based on Apeel produce shipped to retail customers from January through December 2021. Additional data collection on the produce supply chain and the Apeel product inputs was constrained to the same time period.

Throughout this document, the term "impact" or "positive impact" is meant to encompass the environmental benefits enabled by Apeel's products. Apeel's "2021 Impact Metrics" refer to the cumulative positive impact enabled by Apeel's products over the 2021 calendar year that are reported on the Apeel website. The term "environmental burdens" describes negative impacts to the environment that can be attributed to the produce supply chain or to the Apeel technology itself. It may also refer to those "avoided environmental burdens" enabled by the use of Apeel's products.

Prevented Waste Quantification

Retail Pilot Methodology

As noted in the introduction, Apeel's 2021 Impact Metrics focus on the avoided waste and environmental impacts enabled by the prevention of waste in retail stores. The term used to

describe food waste within a produce retail environment is “shrink,” and shrink rates can vary significantly between different types of produce, between retail stores, between global regions, and between different times of the year. This is driven by the fact that the shelf life and waste rates of fresh produce can be affected by multiple factors such as underlying produce quality, supply chain length or disruptions, storage and transport conditions, packaging, retail stocking behavior, and consumer preference, among others.

In order to isolate the effect of the Apeel technology on retail waste, Apeel has designed and executed “pilot programs” with retail customers. These programs are A/B tests where the shrink rates in retail stores with and without Apeel over the same time period are compared to tease out the Apeel-enabled change to retail waste. Depending on the retailer footprint and number of regions or distribution centers, each group can include dozens or even hundreds of stores.

Apeel has leveraged this methodological approach for retailers of diverse store sizes and formats, in both North American and European markets, and for all of the produce products included in the Apeel's 2021 Impact Metrics. These produce products included:

- Apeel-Protected Avocados in the North American and European markets
- Apeel-Protected Limes in the North American market
- Apeel-Protected Organic Apples in the North American market
- Apeel-Protected Mandarins in the European market
- Apeel-Protected Oranges in the European market

Given the complexities and waste drivers highlighted previously, care is taken to select the appropriate “test” and “control” stores. As much as is possible, pilots attempt to control for variability in:

- Store type and size
- Consumer demographic makeup
- Produce supplier
- Produce variety
- Pre-pilot program shrink rates

In doing so, Apeel strives to ensure that, in the absence of Apeel, it would be reasonable to assume that there would be no difference in retail shrink between the test and control stores over the pilot program time period, had Apeel not been present.

Retail pilot programs typically take place over a series of months. The participating retailer shares inventory, sales, and shrink data on the produce type being studied with Apeel. Such data will cover the prior year, months leading up to, and months during the pilot program. This allows for close tracking of shrink rates in both the test and control stores over the time period, as well as year-over-year and prior months to current months changes.

This holistic picture of trends in shrink over time is used to deepen the analysis beyond a simple comparison between test and control stores. In the data analysis, Apeel strives to answer the question *“what would have happened had the Apeel technology not been present in this group of test stores?”* This involves comparing shrink trends over time in the control stores, which

receive untreated produce, to trends over the same time period in the test stores, which receive Apeel-treated produce. To give an illustrative example:

Results of Apeel retail pilot program

	Control Stores	Test Stores
Pre-Pilot Period Shrink	10%	9%
Pilot Period Shrink	11%	5%
% Change in Shrink	+10%	-50%

Apeel Shrink Rate: 5%

Baseline Shrink Rate: $9\% * (1 + 10\%) = 9.9\%$

Apeel Shrink Reduction $(9.9\% - 5\%) / 9.9\% = 49\%$

In this example, the “Apeel shrink rate” would be set by that which was observed in the test stores during the pilot: 5%. To answer that question, “*what would have happened had Apeel not been present?*” in this case, we take the rate of change observed over the pre-pilot to pilot period in the control store and apply it to the starting, pre-pilot waste rate in the test store. In other words, we assume that in the absence of Apeel, shrink in the test stores would have increased at the same rate as it did in the non-Apeel stores - from 9% to 9.9%. This sets the “baseline shrink rate.” The “baseline” and “Apeel” shrink rates are compared to determine the relative % reduction enabled by the Apeel technology. In this example, that would be 49%.

Retail Pilot Results Extrapolation

Once a retailer decides to expand with Apeel-treated produce into additional stores and enters a “post-pilot” period, there is no longer a “control group” to provide waste rate comparison. As such, the shrink analysis conducted during the pilot program is the best source of truth for continuously determining the waste prevention enabled by Apeel in that retailer’s stores. While shrink rates may fluctuate over time, without a control, it is difficult if not impossible to determine what the shrink rate may have been without the Apeel technology.

For this reason, the retail shrink rates for baseline and Apeel-treated produce measured during the pilot program are utilized when calculating cumulative, ongoing waste prevention attributable to the Apeel technology. Such shrink rates are extrapolated onto shipped volumes over a given period of time to quantify the waste prevented over those months or years. This approach is consistent across Apeel retail customers and products.

Some retail customers chose to not pursue an Apeel retail pilot program and move straight to an expanded program. In these instances, Apeel cannot establish specific “baseline” and “Apeel” waste rates for those retailers, given the lack of shrink data. However, it is fair to assume that the Apeel technology still continues to enable a waste reduction in stores since the shelf life extension benefit still exists for those customers. Thus, to estimate waste prevention for those non-pilot program retailers, the weighted average values for baseline shrink rate and Apeel

shrink reduction can be quantified using all past pilot program results for a given produce type. Taken together, these two values can be used to calculate the average Apeel shrink rate for that produce type. These average shrink rates are weighted based on the volumes shipped during each pilot program and are updated each time Apeel conducts a new pilot program.

Pilot results extrapolation and the use of weighted averages both have drawbacks. They do not yield a perfectly accurate measurement of the avoided waste enabled by the Apeel technology in the market. However, Apeel still feels confident in its utilization of these approaches given the consistency in observed shrink reduction results across retailers and products, the robust methodology employed in the pilot programs, and the consistency in the shelf life extension days for a given product seen in Apeel's performance monitoring programs in 2021.

Quantifying Prevented Waste

Apeel's "prevented food waste" impact metric was calculated based on retail pilot results extrapolated onto volumes shipped to Apeel's retail customers in 2021. Specifically, all shipped Apeel-treated produce was expected to go to waste at the "Apeel retail shrink rate" measured in customers' retail pilots. This yields the volume of the estimated amount of produce sold in 2021 for each retailer. From this value, the amount of produce that would have had to have been shipped to deliver the same result in a higher retail waste scenario without Apeel can be calculated using the "baseline retail shrink rate" from those same retail pilot programs. Subtracting the actual amount of Apeel-treated produce shipped in 2021 from this extrapolated baseline shipped volume yields the amount of produce prevented from waste by the Apeel technology.

See an illustrative example of this context below:

Desired end result: 90 apples sold from a retail store

Baseline, non-Apeel waste rate: 10%

Apeel waste rate: 5%

In order to sell 90 apples in a baseline scenario, the store will have to source 100 apples to account for the fact that 10% of those 100 – 10 apples – will go to waste as the apples sit on the store shelf. If the store was to aim to sell 90 apples treated with Apeel, since the retail waste rate is lower at 5% with the Apeel technology present to slow spoilage and extend shelf life, the store only needs to source 95 apples since only 5 apples will go to waste. Thus, the Apeel technology is able to prevent 5 apples from going to waste by enabling the avoidance of a more wasteful scenario that would deliver the same end result.

Lastly, Apeel's food waste prevention impact metric presents results in terms of number of pieces of produce prevented from waste. This requires setting assumptions around the average weight of different types and sizes of produce. When available, Apeel gets this produce size information directly from supplier and retail customers. In the absence of such data, average produce sizes are used. These assumptions are as follows:

- 0.23 kg/avocado

- 0.091 kg/lime
- 0.184 kg/apple
- 0.19 kg/orange
- 0.09 kg/mandarin

GHG and Water Metrics Quantification

As noted in the introduction, the Apeel technology helps to avoid environmental burdens by preventing a less efficient scenario from occurring. Apeel's 2021 Impact Metrics focused exclusively on the environmental burdens avoided by waste prevention in retail stores. By preventing waste, the Apeel technology effectively increases yields across the supply chain, simultaneously avoiding the embodied emissions and resource consumption associated with food that would have otherwise gone to waste.

Apeel uses life cycle assessment (LCA) to quantify these avoided environmental burdens, employing an LCA methodology that has been third-party assured by Quantis to produce results in line with ISO standards 14040 and 14044. This methodology was designed to take the unique supply chains of Apeel's retailer and supplier customers in 2021 into account. Such unique inputs include, for example:

- Produce country of origin(s), including production irrigation water use data if available
- Transport mode and distance from farm to Apeel application location
- Apeel product application inputs
- Transport mode and distance from Apeel application location to retail stores
- Retail waste rates, baseline and Apeel (from retail pilots)
- % breakdown of retail food waste treatment destinations (e.g., compost, landfill)
- Waste rates in and waste treatment destinations from consumer homes (informed by literature)

Taking these, and other, inputs into account, the LCA methodology generates a unique product system for each Apeel retail customer and produce type for both an "Apeel" scenario and the "baseline" scenario that is altered with the use of the Apeel technology. The functional unit for this analysis is 1 kg of Apeel-treated produce consumed in North American (NA) or European (EU) households, compared to 1 kg of produce (without Apeel) consumed in NA or EU households. The only difference between the two is a lower waste rate in retail stores, informed by Apeel's retail pilot programs, and the inclusion of the inputs related to the Apeel technology.

The avoided greenhouse gas emissions and water use shared in the Apeel 2021 Impact Report are net the environmental burdens associated with manufacturing, distributing, and applying the Apeel product itself. Data was collected from all sites where produce was treated with Apeel in 2021.

The ILCD 2.0 2018 midpoint LCIA (life cycle impact assessment) methodology and life cycle inventory data were used to quantify the greenhouse gas emissions and cumulative water withdrawal, respectively, that resulted from each of the product systems. The OpenLCA 1.10.3 open-source software program, developed by GreenDelta, was used to facilitate the modeling,

link the reference flows, and foreground data from Apeel with ecoinvent v3.7.1 regionalized background data, compute the complete life cycle inventory for the system and utilize the ILCD 2.0 2018 methodology to compute the LCIA results.

For more details on Apeels life cycle assessment methodology, see the Apeel Produce LCA report also available on the Apeel website.