CASE STUDY

Using Artificial Intelligence to Reduce Food Waste in Grocery Retail

Progress on the Path to Cut Food Waste in Half by 2030

SHELF ENGINE Afresh

PACIFIC COAST Food Waste Commitment

Fall 2022

Executive Summary

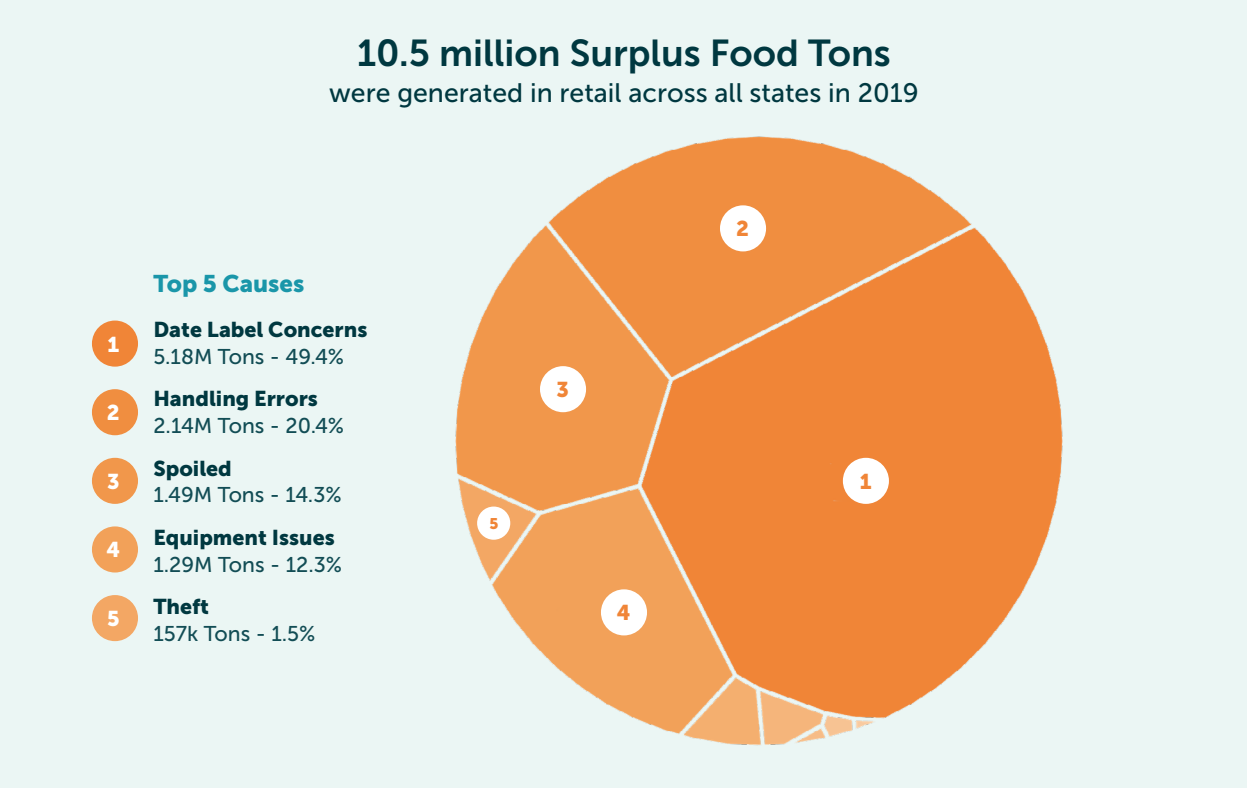
- Two large retailers used artificial intelligence (AI) solutions Shelf Engine and Afresh to improve their order accuracy, which led to a **14.8% average reduction in food waste per store**. While the two pilots were conducted at large retailers, the AI solutions also work for smaller chains.
- All pilot stores saw positive results in terms of reduced shrink and greater profits that more than covered the cost of the AI solution. With the amount of food waste saved in the pilots, **26,705 tons of CO_2e** emissions from landfills were prevented.
- Beyond food savings, labor efficiencies in reduced ordering time, managing shrink, restocking, and more were increased by up to 20% per store.
- Key benefits were increased food waste prevention, reduced shrink, increased sales, higher margins, and greater labor efficiency—all of which could measurably be seen as early as eight weeks into the pilots.
- In both cases, the successful pilot led to the retailer significantly scaling its adoption of the AI solution across more of its stores.
- Key challenges were organizational buy-in, traditional retail mindsets, and seasonality.
- **If the entire grocery sector were to implement these solutions, an estimated 907,372 tons of food waste could be prevented, representing 13.3 million metric tons of avoided CO_2e emissions and more than $2 billion in financial benefits for the sector.**

Introduction

Up to 35% of food goes unsold or uneaten across the spectrum of food production and consumption. Retail is responsible for more than 10% of surplus food in the U.S. (approximately 10.5M tons per year).[1] While some waste in supermarkets will always be unavoidable, one underutilized solution can make significant progress in reducing supermarket-level fresh food waste right now – artificial intelligence.

To the untrained eye, supermarkets may already seem optimized in terms of stocking rates and waste reduction. This is far from reality. In practice, more than 30% of fresh produce becomes surplus.[2] Despite growth over the past decade in the "ugly produce" movement, most consumers still want "picture perfect" produce, as well as the appearance of abundance, from grocery stores.[3] This can cause stores to over-order produce and have more on hand to avoid the perception of empty shelves, which subsequently leads to waste.

FIGURE 1: Causes of Surplus Food at Grocery Retail



[1] https://insights-engine.refed.org/food-waste-monitor?break_by=sector&indicator=tons-surplus&view=detail&year=2019

[2] https://insights-engine.refed.org/food-waste-monitor?break_by=food_type&indicator=tons-waste&sector=retail&view=detail&year=2019

[3] https://www.imperfectfoods.com/online-grocery-shopping-trends/

Up to 35% of food goes unsold or uneaten across the spectrum of food production and consumption.

The top reasons for surplus food in grocery stores (which includes food that will be donated and used for animal feed, in addition to food that goes to a landfill and other waste destinations) include date label concerns, handling errors, and spoilage.[4] This surplus also means higher labor costs when employees have to remove and stock out produce that has gone bad or is off-spec but still edible. Technology solutions to date for grocery retail have worked well for packaged goods with long shelf lives but not as well for fresh goods with different stocking needs and shelf lives. The result is overall high waste and inefficiency for fresh goods, leading to increased costs for supermarkets and higher greenhouse gas emissions due to the amount of food waste that ends up in landfills.

[4] https://insights-engine.refed.org/food-waste-monitor?break_by=cause&indicator=tons-surplus&sector=retail&view=detail&year=2019

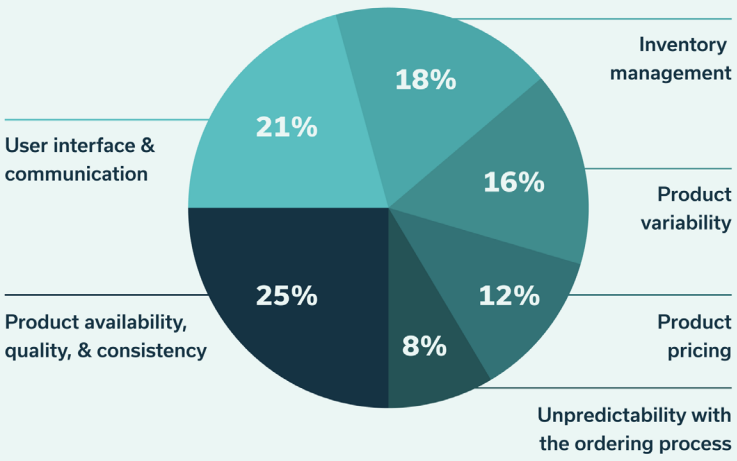
Retailers' Most Significant Ordering Challenges

While some parts of this equation can't be fixed overnight—such as consumer preference, which is notoriously tricky—inventory, stocking, and ordering optimization are areas that can be addressed right now. AI is a readily available solution that can make an impact in a short time on reducing food waste in supermarkets.

Given this potential, the Pacific Coast Food Waste Commitment (PCFWC) worked with two AI providers—Shelf Engine and Afresh—to develop a business case and analysis based on pilots conducted along and outside the West Coast with two supermarket chains in select fresh departments over the past several years. Across the solutions piloted these two different large-scale retailers, food waste was reduced by 14.8% per store on average. If this level of waste reduction were scaled to a national level across fresh produce alone, this could lead to more than **$2 billion in savings and nearly 13.3 million metric tons of CO_2e emissions avoided.**

Scaling these pilot results nationally would produce nearly $2 billion in savings and avoid 13.3 million $MTCO_2e$ in emissions.

FIGURE 2: Retailers' Most Significant Ordering Challenges[5]

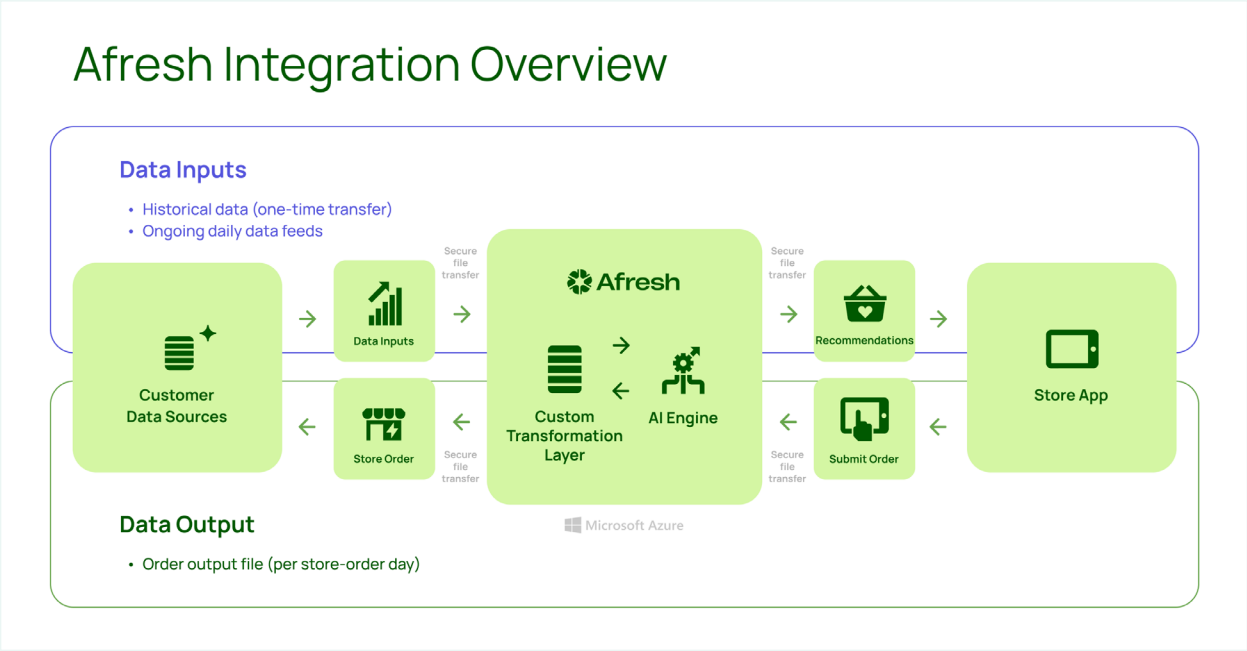


[5] https://www.shelfengine.com/resources/ordering-challenges-infographic/

The Solution

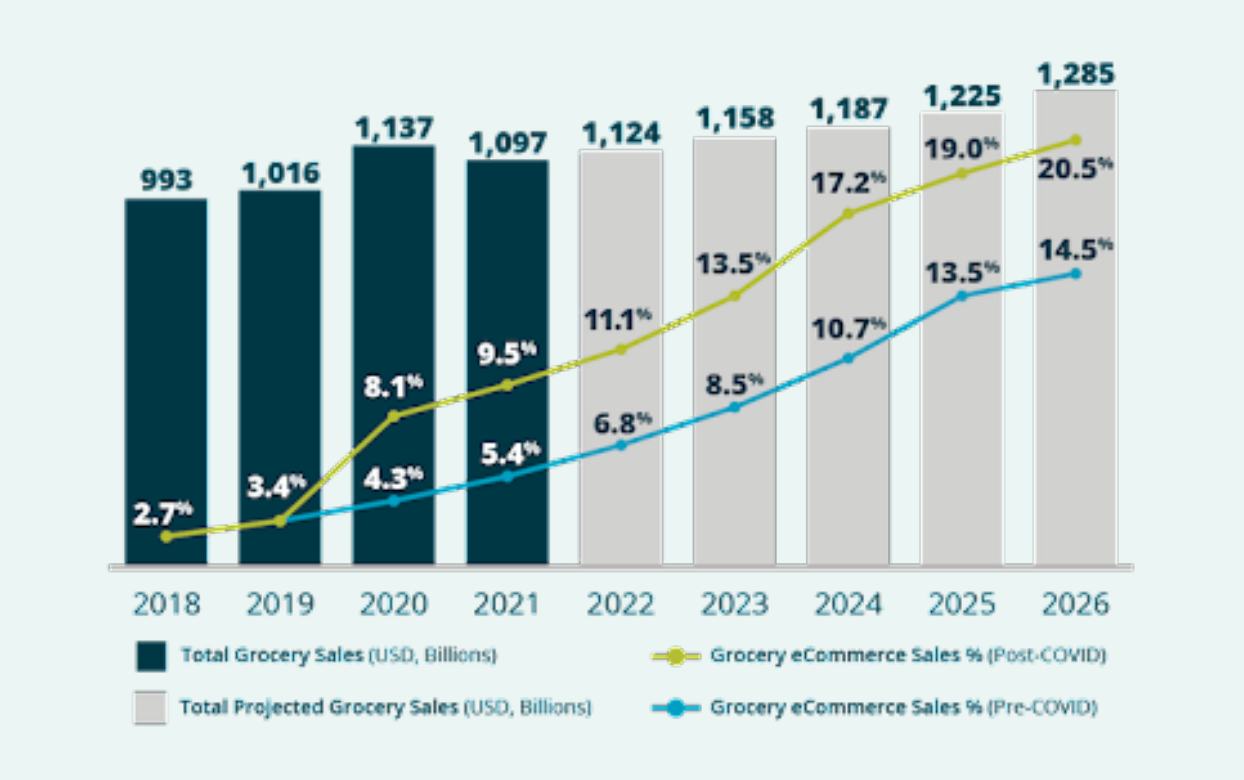
Artificial intelligence in a grocery retail environment works by taking daily sales data to feed into an algorithm that then predicts demand. In many retail settings, the work of inventory management and demand forecasting is done by experienced staff. While staff members may have certain expectations for what level of inventory and ordering is required, inherent bias and human error can lead to over- or under-ordering. AI, depending on the solution design, can take into account back room inventory, demand forecasting, real-time sales data, and wider trends (such as weather and seasonality) to more accurately project demand for each product. It's simply more accurate and efficient at predicting consumer demand than humans are, which enables more precise ordering and inventory management over time. This in turn positions stores to have the right products in stock at the right time, higher sales, and less frequent out-of-stock goods. By right-sizing what is actually brought to a store based on more accurate demand anticipation, stores can lower their waste and increase food waste prevention.

FIGURE 3: Afresh AI System Process Map



These advantages can further help stores to optimize their omnichannel operations across in-store and ecommerce purchases. During the COVID-19 pandemic, online sales in the grocery category increased dramatically; while the rate of growth is not the same as the early days of the pandemic, the increase over pre-COVID online sales has continued (see Figure 2).[6] AI systems holistically take into account ordering volumes in store and online and do a better job of knowing how much product is on shelves and in back rooms (outperforming manual estimation by humans). This enables more agile inventory management that's better synced up with demand, fewer out-of-stock items, and greater customer satisfaction. It also allows stores to move more products straight to the shelves (taking up less back room space) and to see which products are poorer performers (taking up precious shelf space without adequate financial returns).

FIGURE 4: Projected eCommerce and Grocery Sales[7]



[6] https://www.supermarketnews.com/online-retail/e-commerce-account-20-us-grocery-market-2026

[7] https://www.supermarketnews.com/online-retail/e-commerce-account-20-us-grocery-market-2026

The Pilots

The case study pilots were conducted between 2020-2022 by two different AI providers (Afresh and Shelf Engine) with two different retail national chains (one AI provider for each retailer) over the course of 18 months for one retailer and eight weeks for the other.[8] More than 1,300 stores across the two AI solutions participated in the pilots, both along and outside the West Coast. The produce department was the focus area for the pilots, although one of the participating retailers also addressed the deli department.

SHELF ENGINE

SHELF ENGINE

Shelf Engine helps grocers maximize results by using AI to predict shopper demand, determine on-hand inventory, and fully automate the optimal order to reduce waste, grow profits, and decrease labor costs. Its primary model covers the cost of all inventory ordered, only charging retailers the wholesale cost and a small service fee for the items that are sold in an effort to help eliminate the cost of shrink.

Afresh

AFRESH

Afresh helps grocers make stronger decisions throughout their fresh supply chain with AI solutions that help them navigate hard-to-predict demand and error-prone fresh data. The solution is optimized for omnichannel operations and focuses on inventory, forecasting, ordering, and store operations.

A key part of the pilots was detailing the existing data structure and available data for the retailers. By understanding and mapping data, the AI providers could then feed it into their systems to allow for the algorithms to appropriately predict demand for each store. Over time, the additional data added to the system each day makes the demand forecast more and more accurate, leading to reduced shrink – and therefore reduced food waste – and increased sales.

[8] Due to confidentiality, the participating retailers cannot be disclosed. Pilot information has been aggregated and anonymized.

The Results

After the pilots, stores saw reductions in food waste of 14.8% on average, with results varying depending on the initial shrink level of the store. For example, one pilot showed measurable results in as early as eight weeks, while another achieved a notable difference within just the first week of using the solution. All pilot stores saw positive results in terms of reduced shrink and greater profits that more than covered the cost of the AI solution. With the amount of food waste diverted in the pilots, **26,700 tons of CO_2e emissions from landfills were avoided**.

The pilots saw food waste reduced by an average of 14.8% per store, which in total avoided 26,700 tons of CO_2e emissions from landfills.

In addition to cost savings from avoided shrink and reduced waste disposal costs, both pilots found that having more of the right products available at the right time due to increased predictive capabilities led to financial benefits. Shelf Engine's pilot stores increased sales anywhere from 3% to 63%, with up to a 610% margin dollar expansion depending on the fresh product. While Afresh did not have access to sales data for this specific pilot retailer, their average customer similarly sees a 2.5% increase in sales. Furthermore, improved demand forecasting and inventory management enabled fresher produce on shelves, leading to increased customer satisfaction.

COVID-19 created dramatic peaks and valleys in sales, but the stores in the pilot that implemented the AI solutions were more able to keep up with those shifts due to their ability to better incorporate such swings into forecasting models than human estimation. This added resilience enabled the retailers to take advantage of greater sales and prevent being caught in out-of-stock positions, as seen elsewhere.

Beyond food savings, labor efficiencies in reduced ordering time, managing shrink, restocking, and other factors increased by up to 20% per store. With fewer repetitive tasks and less time spent managing waste, AI solutions save valuable employee time. In a time where labor availability has been challenging due to issues related to COVID-19 and other factors, this secondary gain can't be underestimated.

Challenges

For solutions like Shelf Engine and Afresh, the biggest barrier to implementation is organizational buy-in and alignment. Depending on the retailer implementing the solution, there may be conflicting goals for various teams within the organization. For example, in one of the pilots, the goals of the merchandising team (how much product is purchased for the stores) conflicted with those of the finance (saving money) and operations (reducing shrink) teams. In this instance, the biggest barrier was aligning team goals to implement the solution. If the decision to implement the AI solution does not come from an organizational level above those departments, conflicts can arise around the cost allocation of the solution, complicating how enthusiastically the AI solution is adopted.

> The biggest barrier is often buy-in and alignment across various teams' conflicting goals (such as merchandising, finance, operations).

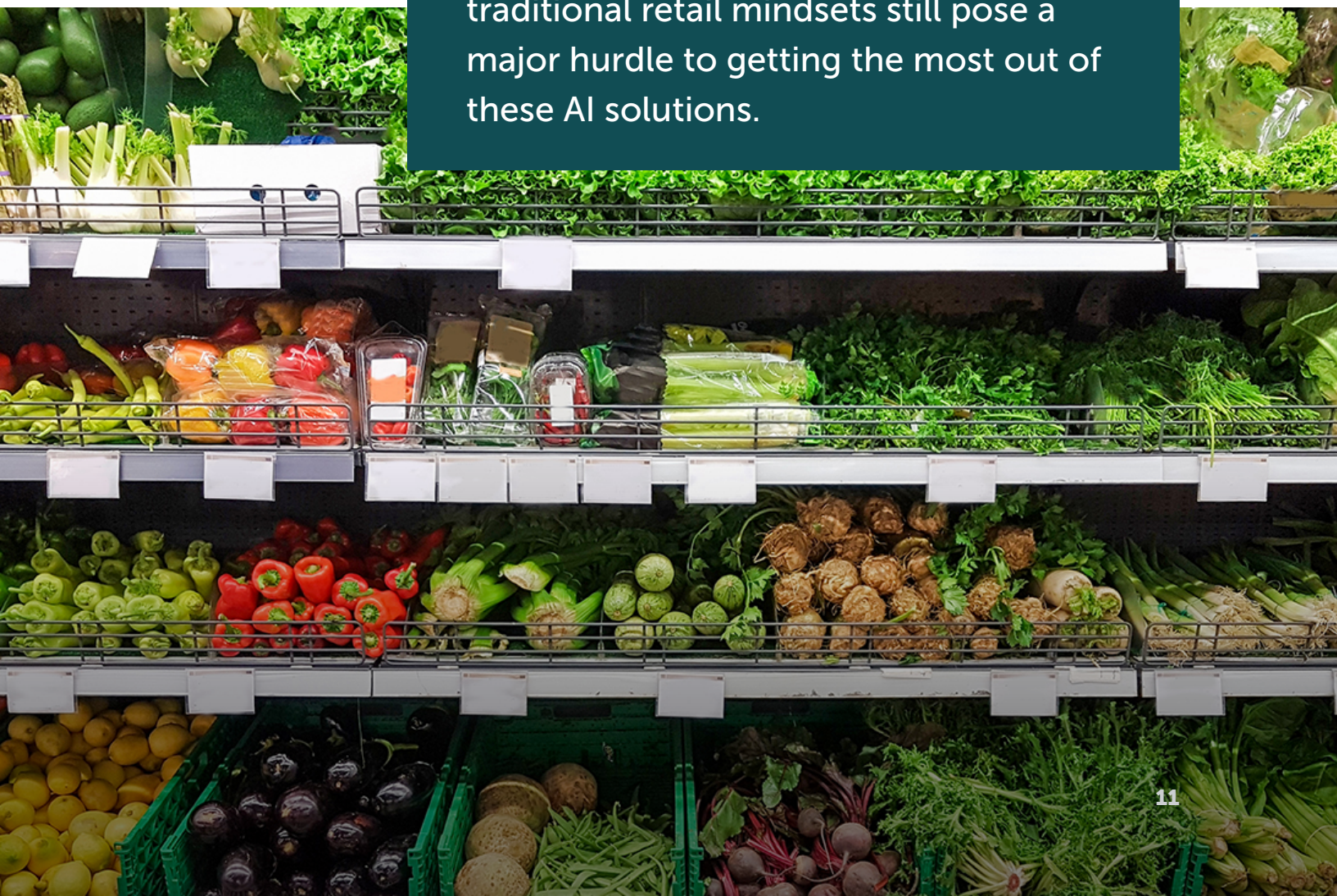
A second difficulty can occur during the data sharing and clean-up process ahead of a new pilot. Technology providers like Afresh and Shelf Engine need access to retailers' historical data to inform and train their machine learning models. Retailers' competing business priorities, and the fact that data on fresh products can be inconsistent and disjointed, can both delay this process—which in turn delays the pilot implementation. For instance, when one retailer needed additional time to provide historical data around ordering and inventory, rollout of the solution had to be paused until that information was finalized.

Another challenge is seasonality, where day-to-day data may not be indicative of sales volume for seasonal items. Prior to implementing AI, grocers may not have access to previous seasonal data, or such data may be messy and inconsistent. AI can solve for seasonal fluctuations by incorporating seasonality, perishability, and other key demand factors on an item-by-item basis, but this process can take longer for the algorithms to gather sufficient data to do so accurately.

Traditional retail mindsets represent another hurdle for getting the most out of the AI solutions. Historically, retailers have opted to

present a variety of products, regardless of how well those products sell, to present a multitude of options to the consumer. AI solutions have shown, however, that overall sales can be enhanced when shelf space is optimized for actual sales expectations rather than for the appearance of choice. Nevertheless, this is an area where, despite strong data proving these results, it is difficult to overcome long-standing expectations around what a store layout "should" look like. Holding shelf space for new product discovery creates a risk of taking up valuable shelf space while trying to prove sales potential for new items; although some risk is necessary in this discovery period, holding such risk long-term is not borne out by actual data. More research is needed into flexible solutions that optimize sales and accommodate merchandising preferences (such as visual abundance and diversity of product required), in an effort to ultimately both reduce shrink and increase sales.

AI has clear business benefits in addition to being a win for the environment. Yet traditional retail mindsets still pose a major hurdle to getting the most out of these AI solutions.



Conclusion

Implementing AI for supermarkets across the U.S. and beyond can reduce the low-hanging fruit of waste that's caused by inaccurate forecasting and ordering. Food waste sent to landfills emits methane, a greenhouse gas that's 80 times more potent than carbon dioxide,[9] meaning solutions that reduce food waste can have a near immediate climate impact.

These pilots were undertaken for the produce sections at the participating retailers (and deli for one), but the AI solutions can be applied to other fresh grocery departments with high waste levels, such as seafood, meat, prepared foods, and bakery. If the results from the pilot were replicated in these other departments with even half the shrink reduction levels seen from produce, then an estimated 1.1 million tons of food waste and 2.8 million tons of CO_2e emissions could be avoided. Furthermore, while the two pilots were conducted at large national retailers, AI solutions also work for smaller chains.

AI isn't a panacea, and some waste in grocery stores is unavoidable; this solution needs to be paired with further actions ranging from food recovery, waste-to-feed pathways, composting, and more. Business results and waste reduction could be even greater when retailers pair AI with educating consumers on the role they can play in reducing waste by learning proper food management skills. Additional retailer actions could include dynamic pricing models[10] that discount produce as it gets closer to the end of its shelf life, being more nimble in removing low sales or slow-growth items that often go to waste, and challenging traditional notions of stocking that project an abundance and variety of options at all times.

While other thornier challenges to food waste still abound (such as shifting consumer preferences or reducing upstream loss), it's time to cross easy-to-implement and straightforward solutions like AI off the list. AI has clear business benefits in addition to being a win for the environment. Supermarkets can and should stop wasting time, money, and food by implementing these solutions now.

[9] https://www.unep.org/news-and-stories/story/methane-emissions-are-driving-climate-change-heres-how-reduce-them

[10] https://insights-engine.refed.org/solution-database/dynamic-pricing

Acknowledgments

The PCFWC would like to thank Afresh, Shelf Engine, and the participating retailers for their collaboration in developing this case study over the past year. It serves as a example of the challenging, but critical pre-competitive collaboration required to expose best practices and accelerate progress on food waste prevention, which the PCFWC strives to support. The PCFWC would also like to thank Katherine Devine on the WWF Markets Team for her flexibility and leadership in serving as the lead author for this study.

About the Pacific Coast Food Waste Commitment

The Pacific Coast Food Waste Commitment (PCFWC) began in June 2016, when the PCC entered into the Pacific North American Climate Leadership Agreement and committed to advance organic waste prevention and recovery initiatives to reduce carbon emissions from the region's food waste stream. U.S. leaders in the food industry were invited to collaborate with area jurisdictions in a public-private commitment to cut the amount of wasted food in half by 2030 – a success metric aligned with United Nations Sustainable Development Goal 12.3 and other global, national, and regional commitments. To assist in moving the initiative forward, the PCC established collaborations with ReFED, WRAP, and World Wildlife Fund (WWF) as resource partners to provide expertise, additional philanthropic funding, and capacity for implementation. Cascadia Policy Solutions serves as facilitator for the effort and has provided foundational and ongoing critical support to the PCFWC since its inception.

Signatory Members

As of Fall 2022

About the Pacific Coast Collaborative

The Pacific Coast of North America represents the world's fifth-largest economy, a thriving region of 55 million people with a combined GDP of $3 trillion. Through the Pacific Coast Collaborative (PCC), British Columbia, Washington, Oregon, California, and the cities of Seattle, Portland, San Francisco, Oakland, Los Angeles, and Vancouver, British Columbia are working together to build the sustainable low-carbon economy of the future. King County in Washington and Alameda County in California have since joined alongside the PCC jurisdictions in signing on to and supporting the PCFWC. Formed in 2008, the PCC has established ambitious goals for reducing greenhouse gas emissions by at least 80 percent by the year 2050 through the transformation of energy systems, buildings, and transportation, and through food waste management – all of which would serve as a model for national and global action.