



Advancing Data-Driven Solutions
to Reduce Food Loss and Waste

Target, Measure, Act – With the Aid of Technology



Our Mission

We're a nonprofit working to end food loss and waste across the food system by advancing data-driven solutions to the problem.

Our Vision

We envision a sustainable, resilient, and inclusive food system that optimizes environmental resources, minimizes climate impacts, and makes the best use of the food we grow.



DATA & INSIGHTS

Leveraging data and insights to highlight supply chain inefficiencies and economic opportunities



CAPITAL & INNOVATION

Catalyzing capital to spur innovation and scale high-impact initiatives



STAKEHOLDER ENGAGEMENT

Mobilizing and connecting supporters to take targeted action

ReFED Insights Engine

An interactive knowledge hub for food loss and waste launched in 2021, the Insights Engine lets users:

1. Understand the Problem

2. Explore the Solutions

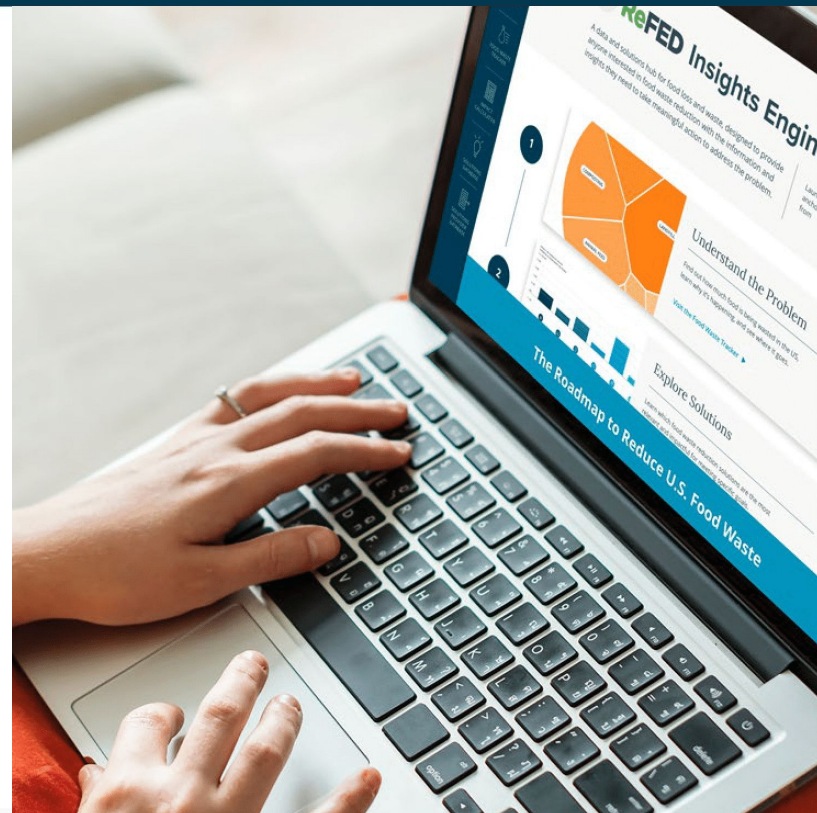
3. Find Solution Providers

4. Calculate Impact

5. Track Capital

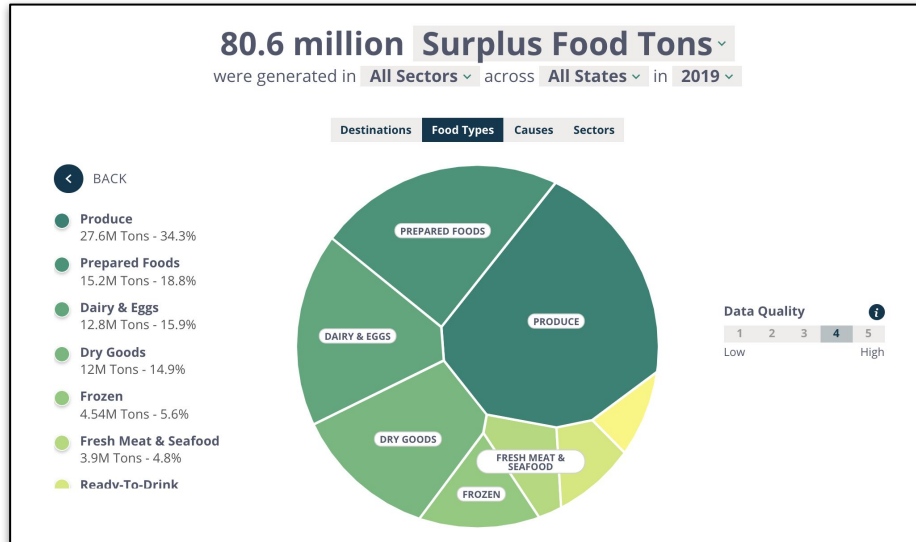
6. Review Policies

Launch the Insights Engine



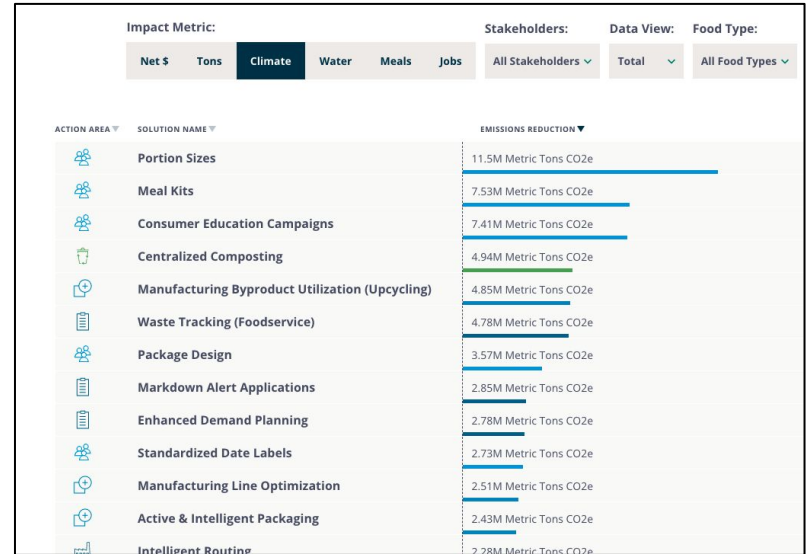
Food Waste Monitor

Quantifying the Problem



Solutions Database

Quantifying Solutions Potential



DEFINITION

Surplus vs Waste

What is “Surplus Food”?

All food that goes *unsold* or *unused* by a business or that goes *uneaten* at home – including food and inedible parts (e.g., peels, pits, bones) that are fed to animals, repurposed to produce other products, composted, or anaerobically digested. It also includes food that is *donated*.

SURPLUS FOOD

FOOD LOSS & WASTE FROM ALL SECTORS

Food
Donation

Animal
Feed

Biomaterial/
Processing

Co/anaerobic
Digestion

Compost

Controlled
Combustion

Land
Application

Landfill

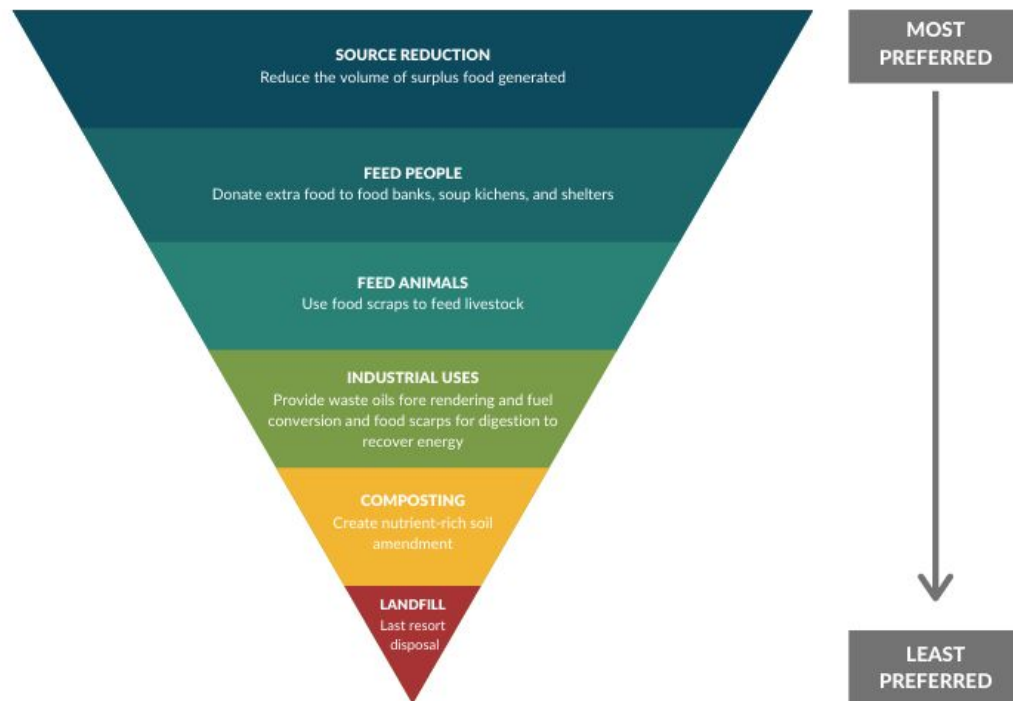
Refuse/
Discards

Sewer

Not
Harvested

DEFINITION

Food Recovery Hierarchy



Diversion Potential

ANNUAL FOOD WASTE DIVERSION POTENTIAL (TONS)

The amount of food surplus that ReFED estimates a particular solution could avoid if fully implemented along with other ReFED-proposed solutions. It is applied only to the portions of food surplus that are considered addressable by that solution

The solution diversion potential is equal to the Addressable Surplus multiplied by the Solution Diversion Rate

Total Applicable Surplus (Tons)

The total amount of food surplus that a solution *has the ability to address*, regardless of what other higher priority solutions might also address the same bucket of food surplus.

Total Addressable Surplus (Tons)

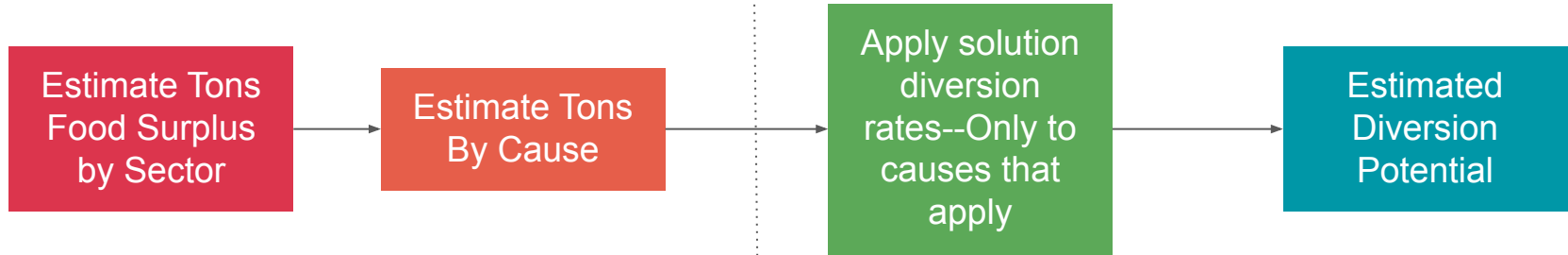
The total amount of food surplus that a solution *should feasibly address*, according to ReFED's prescribed priority of solutions.

Food Waste Monitor

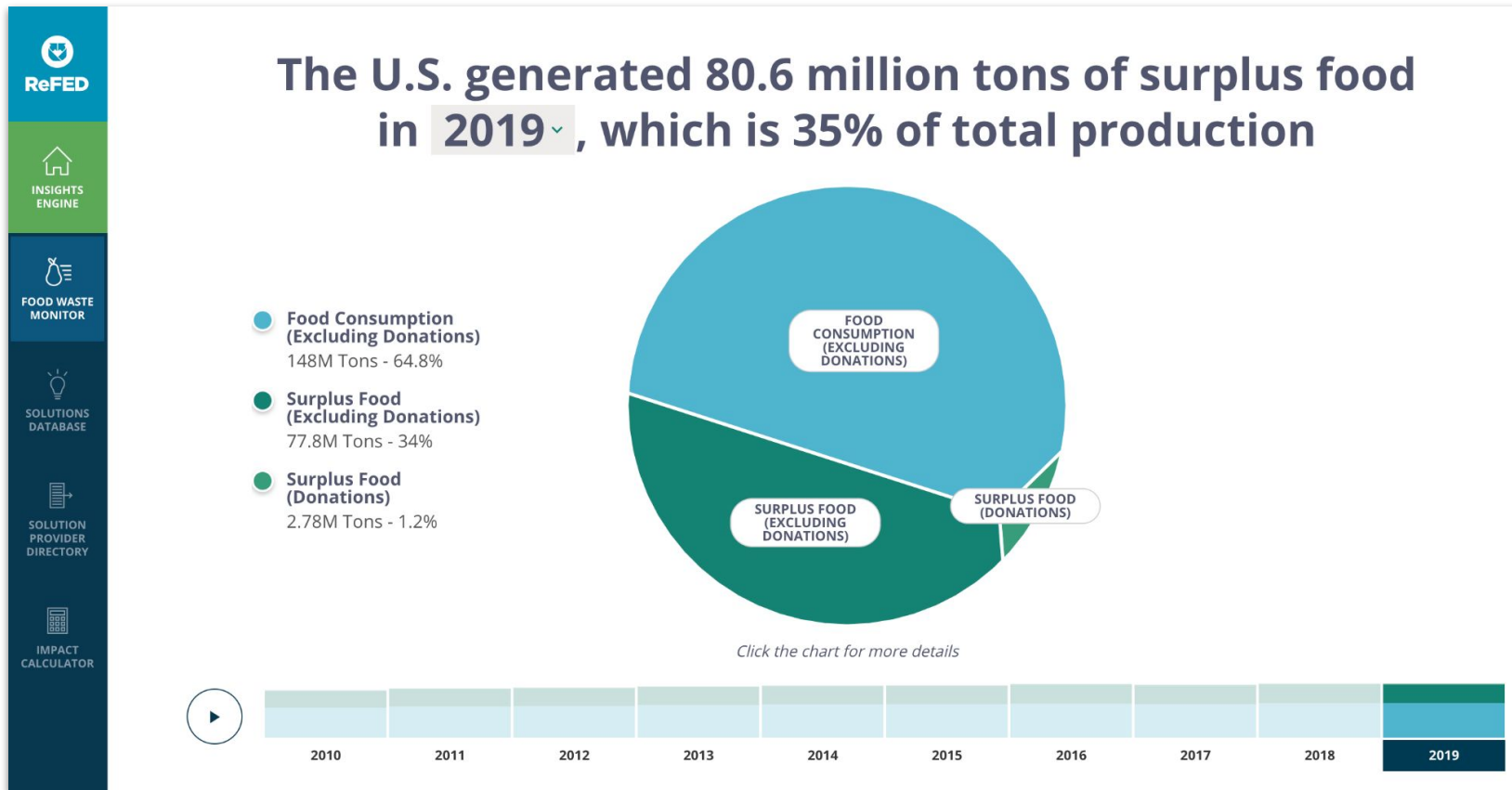
Quantifying the Problem

Solutions Database

Quantifying Solutions Potential



Food Waste Monitor



Surplus Food Numbers by Food Type

80.6 million Surplus Food Tons ▾

were generated in **All Sectors** ▾ across **All States** ▾ in **2019** ▾

Destinations **Food Types** Causes Sectors

< BACK

Produce
27.6M Tons - 34.3%

Prepared Foods
15.2M Tons - 18.8%

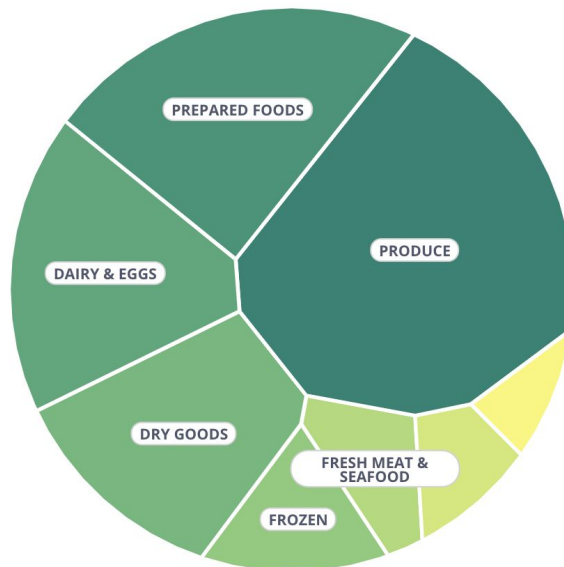
Dairy & Eggs
12.8M Tons - 15.9%

Dry Goods
12M Tons - 14.9%

Frozen
4.54M Tons - 5.6%

Fresh Meat & Seafood
3.9M Tons - 4.8%

Ready-To-Drink

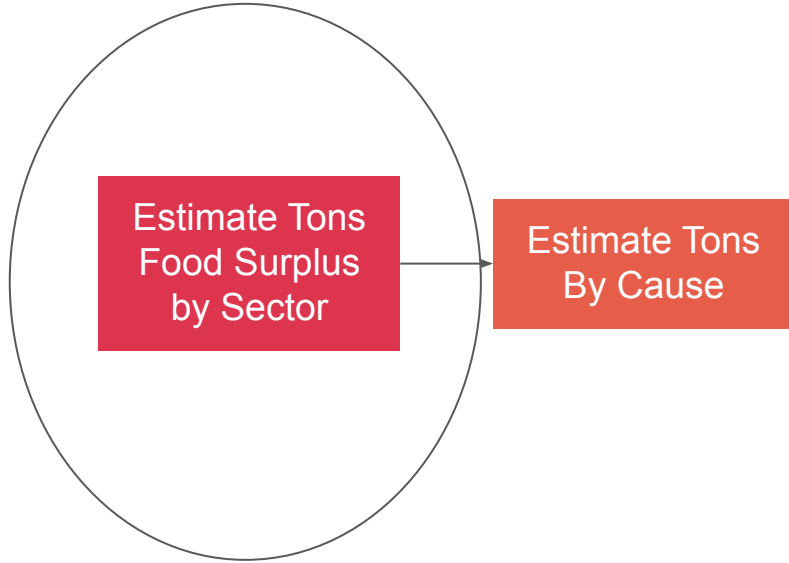


Data Quality

1 2 3 4 5
Low High

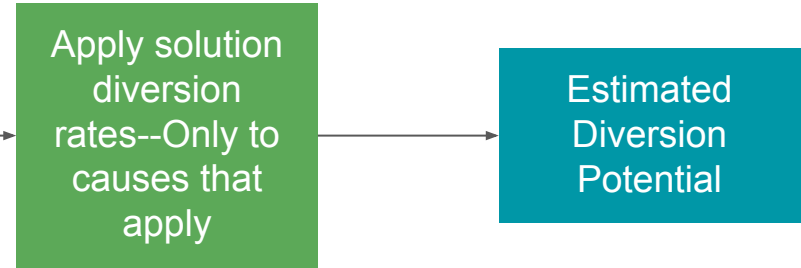
Food Waste Monitor

Quantifying the Problem



Solutions Database

Quantifying Solutions Potential



Food Waste Monitor

Quantifying the Problem

Total Sales by Item
(Dollars)

X

Conversion to
Weight

X

Item Surplus Rate

=

Estimate Tons
Food Surplus
by Sector

Retail Sales Strawberries	X	Conversion to Weight	X	Produce Surplus Rate	=	Total Surplus Strawberries
						+
Retail Sales Broccoli	X	Conversion to Weight	X	Produce Surplus Rate	=	Total Surplus Broccoli
						+
Retail Sales 2% milk	X	Conversion to Weight	X	Milk Surplus Rate	=	Total Surplus 2% Milk
						+
Retail Sales Deli Turkey	X	Conversion to Weight	X	Deli Surplus Rate	=	Total Surplus Deli Turkey
						+
Retail Sales Vanilla Yogurt	X	Conversion to Weight	X	Yogurt Surplus Rate	=	Total Surplus Vanilla Yogurt
						+
Retail Sales Cottage Chz	X	Conversion to Weight	X	Yogurt Surplus Rate	=	Total Surplus Cottage Cheese

To date, we only have a surplus rate for broad categories. Sometimes we use proxies.

**Total Retail
Surplus Food**

Cause Numbers

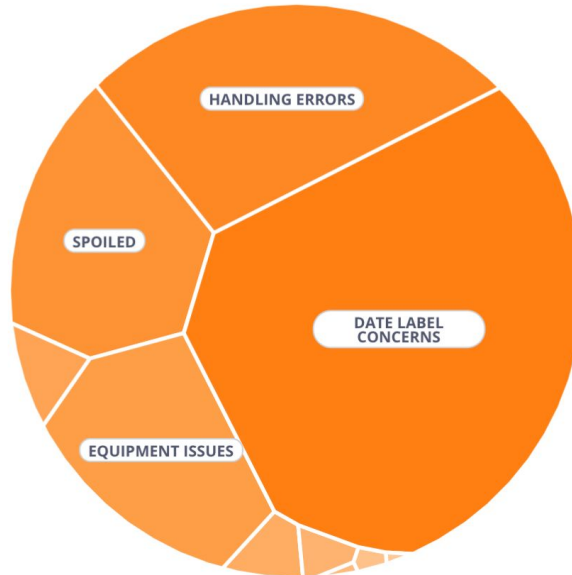
10.5 million Surplus Food Tons ▼

were generated in **Retail** ▼ across **All States** ▼ in **2019** ▼

Destinations **Food Types** **Causes**

◀ BACK

- Date Label Concerns**
5.18M Tons - 49.4%
- Handling Errors**
2.14M Tons - 20.4%
- Spoiled**
1.49M Tons - 14.3%
- Equipment Issues**
1.29M Tons - 12.3%
- Theft**
157k Tons - 1.5%
- Trimmings & Byproducts**
133k Tons - 1.3%

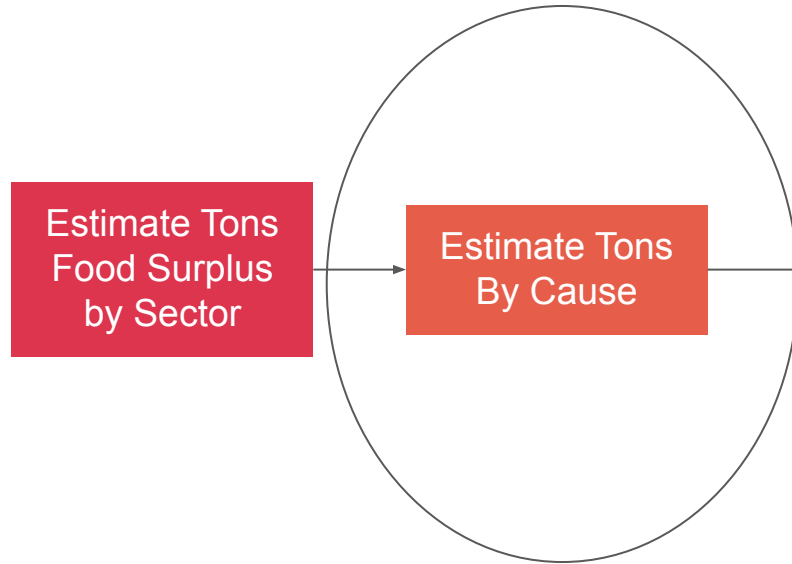


Data Quality

1 2 3 4 5 i
Low High

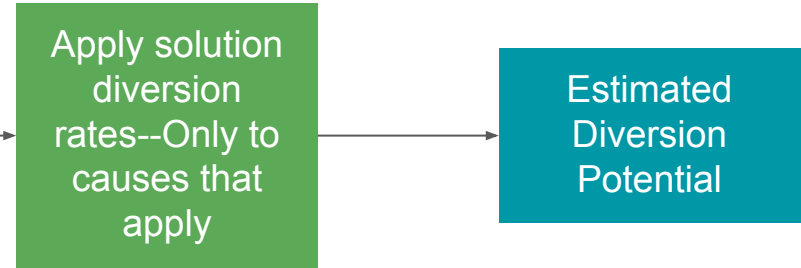
Food Waste Monitor

Quantifying the Problem



Solutions Database

Quantifying Solutions Potential



Total Surplus Strawberries	X	% date label concerns for retail produce	=	Total strawberries to date label cause
Total Surplus Strawberries	X	% handling errors for retail produce	=	Total strawberries to handling errors cause
Total Surplus Strawberries	X	% spoiled for retail produce	=	Total strawberries to spoiled cause
Total Surplus Strawberries	X	% equipment issues produce	=	Total strawberries to equipment cause

Total strawberries to date label cause
+
Total broccoli to date label cause
+
Total 2% milk to date label cause
+
Total deli turkey to date label cause
<hr/>
Total Retail to date label cause

Destination Estimates

10.5 million Surplus Food Tons ▾

were generated in **Retail** ▾ across **All States** ▾ in **2019** ▾

Destinations

Food Types

Causes

< BACK

- Landfill**
3.19M Tons - 30.4%
- Donations**
2.05M Tons - 19.5%
- Composting**
1.92M Tons - 18.3%
- Animal Feed**
1.8M Tons - 17.2%
- Anaerobic Digestion**
516k Tons - 4.9%
- Industrial Uses**
449k Tons - 4.3%
- Incineration**



Data Quality

i

1 2 3 4 5
Low High

Surplus Food Was Responsible For...

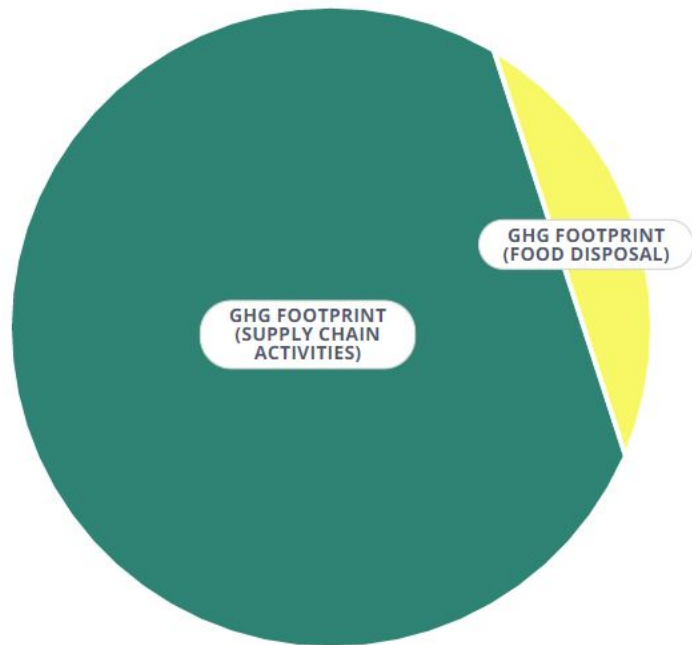
380 Million MTCO₂e in 2021, or



6%
of U.S. GHG
Emissions

Equivalent to driving
84 million cars
over the year

Predominant GHG Footprint Is Upstream



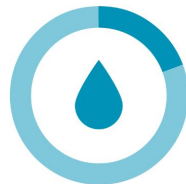
Just **7%**
of food surplus
emissions come from
disposal (e.g. landfill
methane emissions)

Surplus Food Is Responsible For...



16%
of U.S.
Cropland Use
(EPA Estimate)

An area the size of
**California and
New York**
combined (EPA)



22%
of all
Fresh Water Use

As much water as
**California, New
York, and Texas**
combined



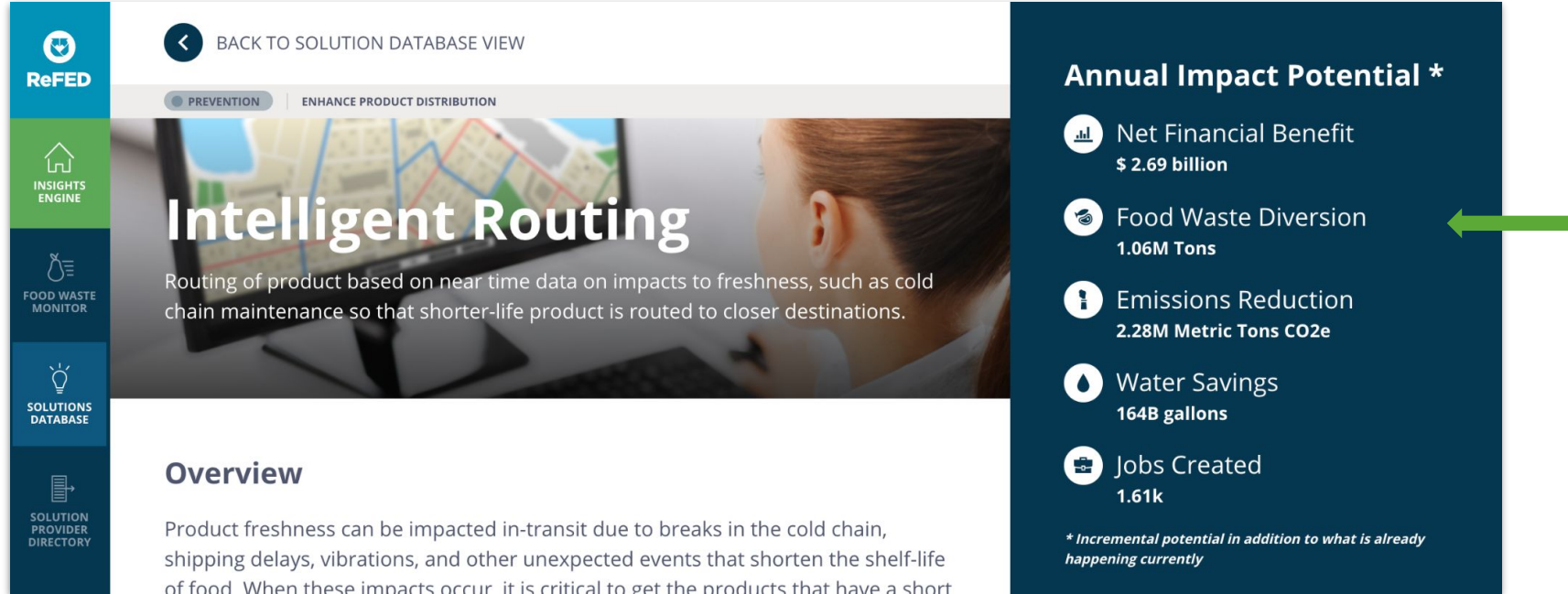
24%
of Landfill Inputs
(EPA Estimate)

A **top source of
methane** in landfills

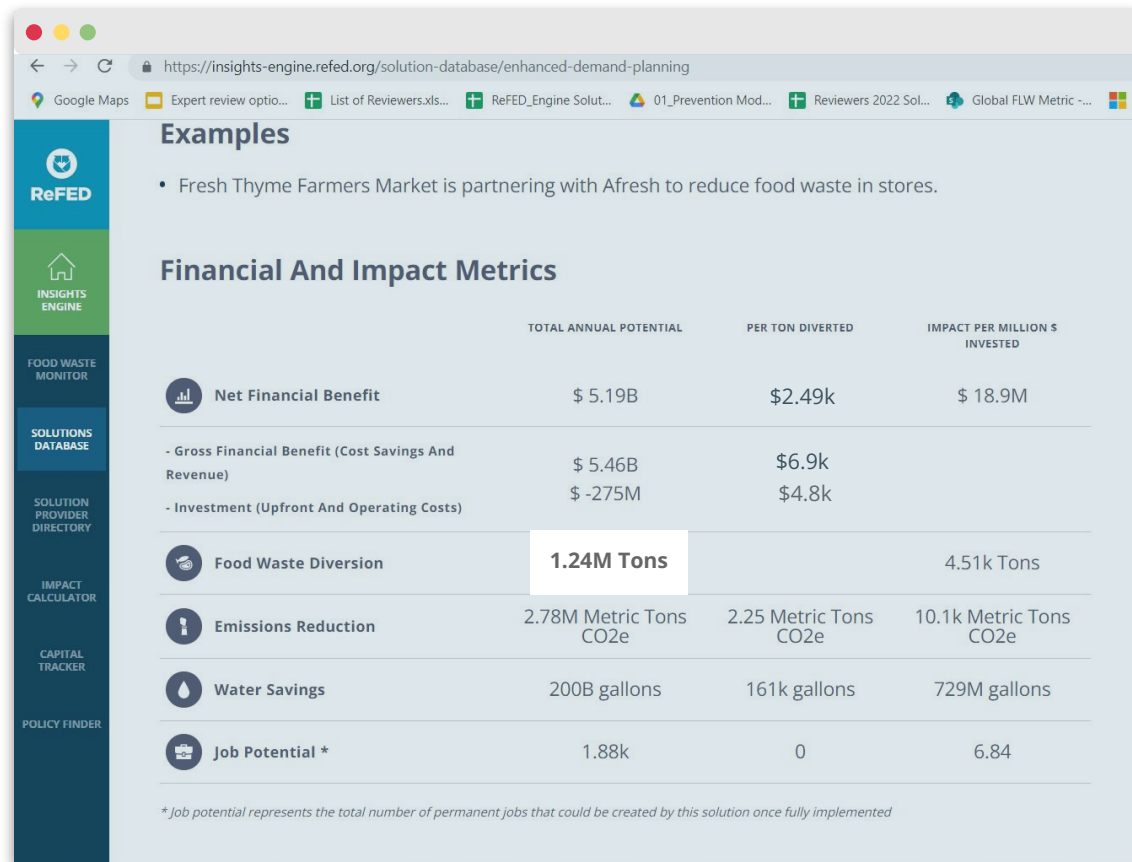
Solutions Database



Solution Diversion Potential



Annual Diversion Potential (Tons)



The annual amount of food surplus that ReFED estimates a particular solution could prevent if fully implemented along with other ReFED-proposed solutions. It is applied only to the portions of food surplus that are considered addressable by that solution.

Equation

*Addressable Surplus * Solution Diversion Rate*

Key Indicators* to Evaluate

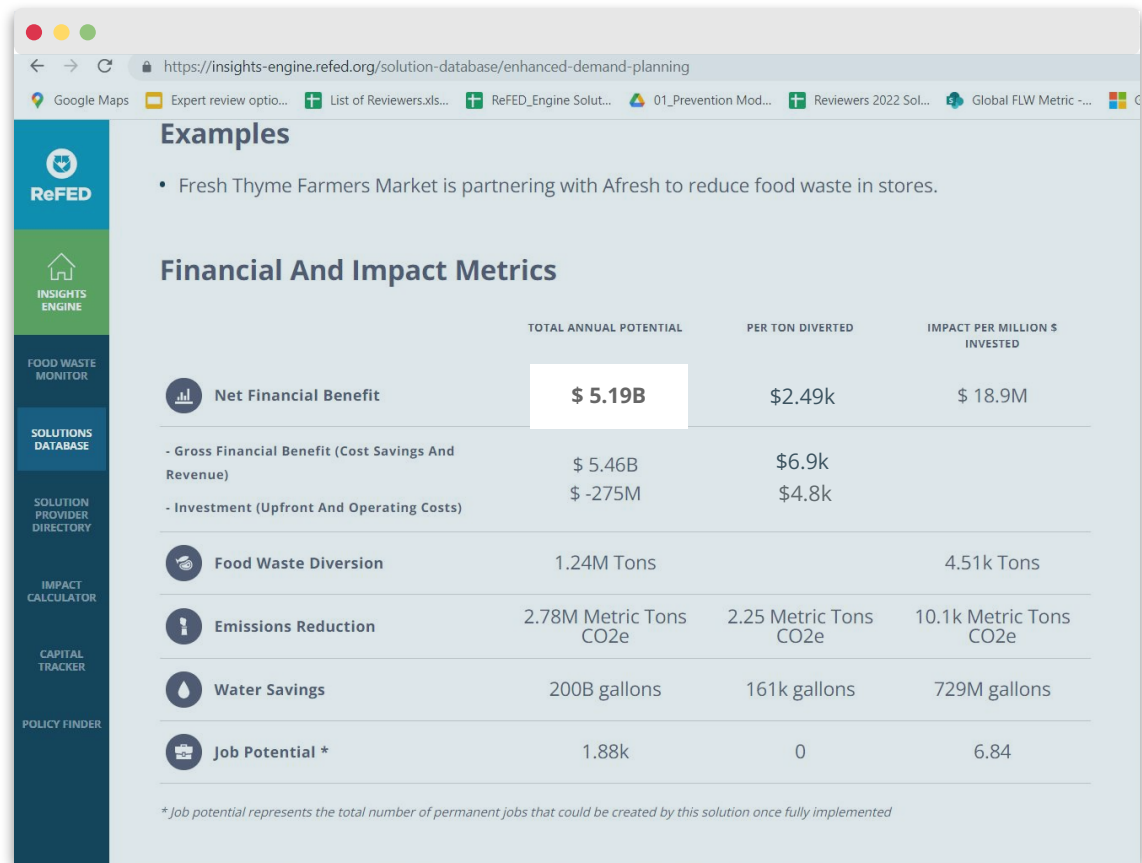
APPLICABILITY | SECTOR - CAUSE

APPLICABILITY | FOOD TYPE

DIVERSION RATE

**Note: See Appendix A for definitions*

Net Financial Benefit



Net Financial Benefit

The financial benefit that ReFED estimates a particular stakeholder (or all stakeholders combined) could acquire after incurring the necessary costs to implement the solution as well as any potential cost savings, added revenue generation, etc.

Equation:

Net Financial Benefit = Gross Financial Cost - Financial Benefit

Key Indicators* to Evaluate

FINANCIAL COST (\$/TON)

FINANCIAL BENEFIT (\$/TON)

*Note: See Appendix A for definitions

Food Waste Monitor

Quantifying the Problem

Estimate Tons
Food Surplus
by Sector



Estimate Tons
By Cause



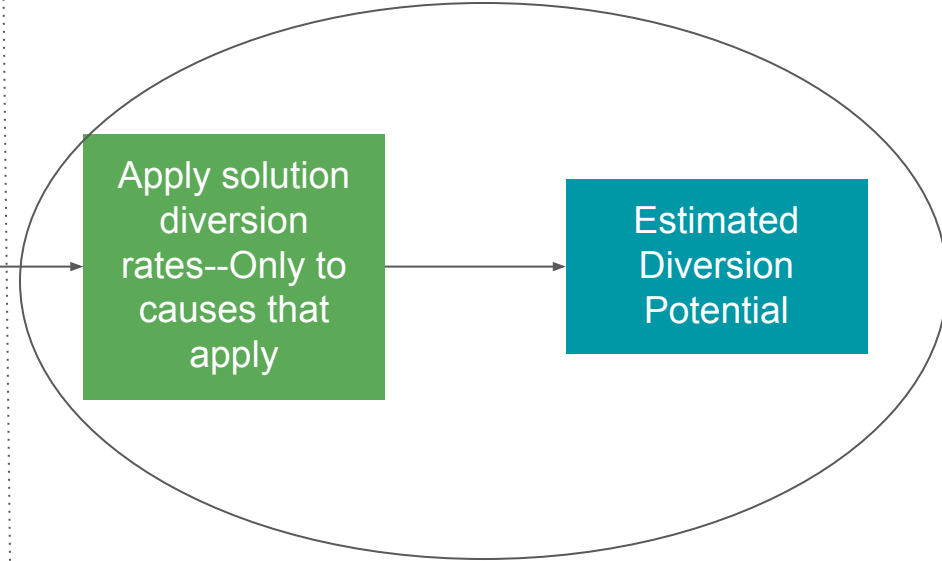
Apply solution
diversion
rates--Only to
causes that
apply



Estimated
Diversion
Potential

Solutions Database

Quantifying Solutions Potential



DIVERSION RATE

Quantifying Applicable FLW (Food Waste Monitor)

TONS SURPLUS BY SECTOR	TONS SURPLUS ATTRIBUTED TO CAUSES OF FLW SPECIFIC TO SECTOR...	
Farm	Date Label Concerns	×
	Catering Overproduction	×
	...	×
Manufacturing	Buyer Rejections	×
	Unshipped finished prod.	×
	...	×
Retail	Date label concerns	×
	Overproduction	×
	...	×
Foodservice	Date label concerns	×
	Catering Overproduction	×
	Plate Waste	×
Residential	Date label concerns	×
	Didn't taste good	×
	...	×

Quantifying Solution Diversion Potential (Solutions Database)

SECTOR-CAUSE APPLICABILITY

0

0

0

0

0

0

0

0

0

0

0

1

1

0.1

0

0

0

FOOD TYPE APPLICABILITY

Ready to drink Beverages

Breads & Bakery

Dairy & Eggs

Dry Goods

Fresh Meat & Seafood

Produce

Frozen

Prepared Foods

×

×

×

×

×

×

×

×

1

1

1

1

1

1

1

1

×

×

×

×

×

×

×

×

34.3%

34.3%

34.3%

34.3%

34.3%

34.3%

34.3%


34.3%


DIVERSION RATE

The fraction of the applicable surplus that the solution can theoretically divert from “food waste” (FW) to a higher-priority outcome, such as prevention, recovery, animal feed, or composting. Diversion rates are only applied to the portions of FW where a solution could logically be applied, not all food.

Note: where the diversion rates were obtained from a solution provider directly, a 25% “discount” was applied to account for case studies and results typically being selected to demonstrate best results.

Annual Diversion Potential (Tons): Example from Solutions Database


ReFED


**INSIGHTS
ENGINE**

**FOOD WASTE
MONITOR**

**SOLUTIONS
DATABASE**

**SOLUTION
PROVIDER
DIRECTORY**

**IMPACT
CALCULATOR**






**CAPITAL
TRACKER**

POLICY FINDER

Examples

- Fresh Thyme Farmers Market is partnering with Afresh to reduce food waste in stores.

Financial And Impact Metrics

	TOTAL ANNUAL POTENTIAL	PER TON DIVERTED	IMPACT PER MILLION \$ INVESTED
 Net Financial Benefit	\$ 5.19B	\$ 4.19k	\$ 18.9M
- Gross Financial Benefit (Cost Savings And Revenue)	\$ 5.46B	\$ 4.41k	
- Investment (Upfront And Operating Costs)	\$ -275M	\$ -222	
 Food Waste Diversion	1.24M Tons		4.51k Tons
 Emissions Reduction	2.78M Metric Tons CO2e	2.25 Metric Tons CO2e	10.1k Metric Tons CO2e
 Water Savings	200B gallons	161k gallons	729M gallons
 Job Potential *	1.88k	0	6.84

**Job potential represents the total number of permanent jobs that could be created by this solution once fully implemented*

Subtotal	+
Subtotal	+
Subtotal	+
Subtotal	+
Subtotal	+
Subtotal	+
Subtotal	+
Subtotal	+
=	
Total Annual Solution Diversion Potential (tons)	

Note: B= billions, M= millions, k = thousands

What Our Modeled Solutions Achieve



Would provide
16 years of water
for New York City

Equivalent to taking
24 million cars
off the road

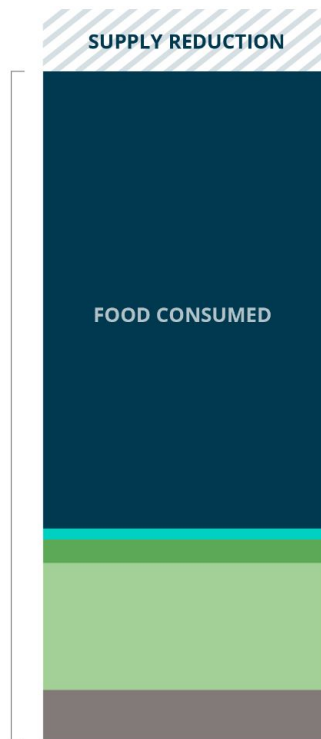
Source: ReFED, 2023

241 M
Tons Total



2021
Status Quo

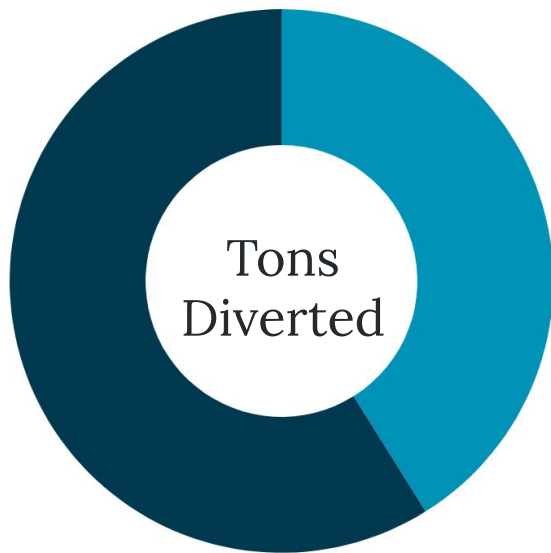
220 M
Tons Total



2021
If ReFED's Solutions
Are Implemented

- 9% OVERALL SUPPLY
- +99% FOOD RESCUED
- 17% LIVESTOCK FEED & INDUSTRIAL USES
- +134% COMPOST & ANAEROBIC DIGESTION
- 73% WASTE TO OTHER PATHWAYS

Prevention (& Rescue) Solutions Drive Most of the Climate Benefits



83%

of the GHG benefits
can be attributed to
prevention+rescue
solutions while
accounting for just

41%

of tons diverted

There Are Many More Solutions Out There

Roadmap to 2030: Reducing U.S. Food Waste | Find Details on Each Solution in the ReFED Insights Engine | insights.refed.org

42 Modeled
Solutions

31 Unmodeled
Solutions

Many Best
Practices

OPTIMIZE THE HARVEST	ENHANCE PRODUCT DISTRIBUTION	REFINE PRODUCT MANAGEMENT	MAXIMIZE PRODUCT UTILIZATION	RESHAPE CONSUMER ENVIRONMENTS	STRENGTHEN FOOD RESCUE	RECYCLE ANYTHING REMAINING
Buyer Spec Expansion	Decreased Transit Time	Assisted Distressed Sales	Active & Intelligent Packaging	Meal Kits	Donation Coordination & Matching	Centralized Anaerobic Digestion
Gleaning	First Expired First Out	Decreased Minimum Order Quantity	Manufacturing Byproduct Utilization (Upcycling)	Buffet Signage	Donation Education	Community Composting
Imperfect & Surplus Produce Channels	Intelligent Routing	Dynamic Pricing	Manufacturing Line Optimization	Consumer Education Campaigns	Donation Storage Handling & Capacity	Centralized Composting
Partial Order Acceptance	Temperature Monitoring (Pallet Transport)	Enhanced Demand Planning	Edible Coatings	K-12 Lunch Improvements	Donation Transportation	Co-digestion at Wastewater Treatment Plants
Field Cooling Units	Reduced Warehouse Handling	Increased Delivery Frequency	Improved Recipe Planning	Package Design	Donation Value-Added Processing	Home Composting
In-Field Sanitation Monitoring	Advanced Shipment Notifications	Markdown Alert Applications	In-House Repurposing	Portion Sizes	Blast Chilling to Enable Donations	Livestock Feed
Innovative Grower Contracts	Early Spoilage Detection (Hyperspectral Imaging)	Minimized On-Hand Inventory	Precision Food Safety	Small Plates	Donation Reverse Logistics	Waste-Derived Agricultural Inputs
Labor Matching	Inventory Traceability	Temperature Monitoring (Foodservice)	Discount Meal Plates	Standardized Date Labels	High-Frequency Reliable Pickups	Insect Farming
Smaller Harvest Lots	Modified Atmosphere Packaging System	Waste Tracking (Foodservice)	Employee Meals	K-12 Education Campaigns	Established Relationships with Businesses	Rendering
Improved Communication for Planting Schedules	Vibration & Drops Tracking	Low Waste Event Contracts	Larger Quantities for Take Home	Trayless	Culling SOPs	Waste-Derived Processed Animal Feed
Sanitation Practices & Monitoring	Optimized Truck Packing, Loading & Unloading (e.g., Cross-Docking)	Direct to Consumer Channels	Small and Versatile Menus	Home Shelf-life Extension Technologies		Waste-Derived Bioplastics
Optimized Harvesting Schedules	Enforcing Cold Chain SOPs	Online Marketplace Platform	Sous-Vide Cooking	Smart Home Devices		Waste-Derived Biomaterials
On-Farm / Near-Farm Processing	Regular Maintenance on Refrigerated Trucks	Online, Advanced Grocery Sales		Waste Conscious Promotions		Enabling Technologies (e.g. depackaging and pre-treatment)
Local Food Systems	Cross-Docking	Precision Event Attendance		Frozen Value-Added Processing of Fresh Produce		Separation & Measurement
Clear Product Ownership		Repackaging Partially Damaged Products		Customizable Menus/Options		Relationships with Waste Haulers
		Retail Automated Order Fulfillment		To-Go Offerings		Waste Audits by Waste Haulers
		SKU Rationalization		Free Items Offered Upon Request (e.g., bread, chips)		
		Markdowns		Storytelling (e.g. product impact, source, upcycled ingredient components)		
		Optimal Storage				
		Reduced Displays				
		Optimized Walk-in Layouts				



Solutions Data includes prioritized solutions most relevant for your business, related impact metrics, and a custom directory of solution providers.

Impact Metric:

Net \$

Tons

Climate

Water

Meals

Jobs

ACTION AREA ▼

SOLUTION NAME ▼

NET FINANCIAL BENEFIT ▼



Enhanced Demand Planning

\$ 4.92B



Decreased Transit Time

\$ 2.24B



Intelligent Routing

\$ 1.75B



First Expired First Out

\$ 1.59B



Imperfect & Surplus Produce Channels

\$ 1.41B

The prioritized solutions can be ranked based on a number of metrics - net financial benefit, tons diverted, emission reduction, etc.

ILLUSTRATIVE

Annual Impact Potential *



Net Financial Benefit
\$ 5.19 billion



Food Waste Diversion
1.24M Tons



Emissions Reduction
2.78M Metric Tons CO2e



Water Savings
200B gallons



Jobs Created
1.88k

4P Foods

SOLUTION TYPE: RECYCLING, PREVENTION, RESCUE

LEGAL STATUS: For-profit

SOLUTIONS: Direct To Consumer Channels, Partial Order Acceptance, First Expired First Out, Enhanced Demand Planning, Dynamic Pricing, Manufacturing Line Optimization, Decreased Transit Time, Donation Storage Handling & Capacity, Donation Coordination & Matching, Donation Transportation, Livestock Feed, Community Composting

4P Foods is a food hub that aggregates food from local and regional producers and delivers it widely, including to home cooks, restaurants, institutio...

[VIEW DETAILS](#)

BlueYonder

SOLUTION TYPE: PREVENTION

LEGAL STATUS: For-profit

SOLUTIONS: Enhanced Demand Planning, Retail Automated Order Fulfillment

Blue Yonder Replenishment Optimization is a predictive application that allows automated store replenishment, reducing out-of-stock rates by up to 80%...

[VIEW DETAILS](#)

Afresh Technologies

SOLUTION TYPE: PREVENTION

LEGAL STATUS: For-profit

SOLUTIONS: Enhanced Demand Planning, Minimized On-Hand Inventory

Afresh is on a mission to eliminate food waste and make fresh food accessible to all. Our first AI-powered solution optimizes ordering, forecast...

[VIEW DETAILS](#)

Botx Solutions, Inc.

SOLUTION TYPE: PREVENTION, RESCUE

LEGAL STATUS: For-profit

SOLUTIONS: Intelligent Routing, Enhanced Demand Planning, Increased Delivery Frequency, Waste Tracking (foodservice), Active & Intelligent Packaging, Package Design, Donation Value-added Processing, Donation Reverse Logistics

Botx Solutions has designed the ultimate meal delivery solution. Tracking everything important about a meal gives us unprecedented and actionable insi...

[VIEW DETAILS](#)

What it all means for you

- Strategic Planning
- Domain Expertise
- Methods Expertise
- Data Sources
- Technology
- Waste Estimates vs Solutions
Diversion



Stay Connected



@refed

refed.com

insights.refed.com

