THE PATH AHEAD

Four Tools for Action

THE *ROADMAP* shows the wide array of scalable solutions that can generate significant Economic Value and Business Profit Potential. But as the report demonstrates, these solutions will not scale up without a concerted multi-stakeholder effort. To achieve the *Roadmap* vision, four tools are needed:

FINANCING
Corporate, Government, and Philanthropic

POLICY
Federal, State, and Local

INNOVATION
Technology and Business Model

EDUCATION
Awareness and Training

TWO PHASES FOR CHANGE

The Path Ahead has two phases. First, an initial investment of capital and resources is required to achieve the 20% waste reduction outlined in the core *Roadmap* economic analysis. This chapter identifies the specific tools to implement these solutions.

For the second phase, ReFED has taken the learnings from the *Roadmap* to envision what transformational changes are required to achieve the broader national goal of a 50% waste reduction by 2030. For each of the four tools, a set of hypotheses is presented to fuel future research and present a first look at the scale of the challenge and opportunity ahead.

KEY INSIGHTS

The Roadmap *will require an $18 billion investment, less than a tenth of a penny of investment per pound of food waste reduced, which will yield an expected $100 billion in societal economic value over a decade.*

- The estimated funding need is $8 billion of government support via mostly existing legislation, $7 billion of market-rate private investments, and $3 billion of philanthropic grants and impact investments.

Four crosscutting actions are needed to quickly cut 20% of waste and put the U.S. on track to achieve a broader 50% food waste reduction goal by 2030.

- ***Financing*** – To overcome the bottlenecks to unlocking $18 billion in financing, $100-$200 million annually is needed in catalytic grants, innovation investments, and low-cost project finance. Today, few investors or foundations focus explicitly on food waste.
- ***Policy*** – Commonsense policy adjustments are needed to scale federal food donation tax incentives, standardize safe handling regulations, and boost recycling infrastructure by expanding state and local incentives and reducing permitting barriers. The biggest lever to accelerate change is comprehensive federal legislation.
- ***Innovation*** – Key technology and business-model innovations are needed around packaging and labeling, IT-enabled transportation and storage, logistics software, value-added compost products, and distributed recycling. These could be accelerated through a national network of food waste innovation incubators.
- ***Education*** – Launching a widespread training effort to change the behavior of food business employees is critical. In addition, campaigns to raise food waste awareness among consumers need to attract additional funding and support to expand to the scale of anti-littering and anti-smoking efforts.

FINANCING

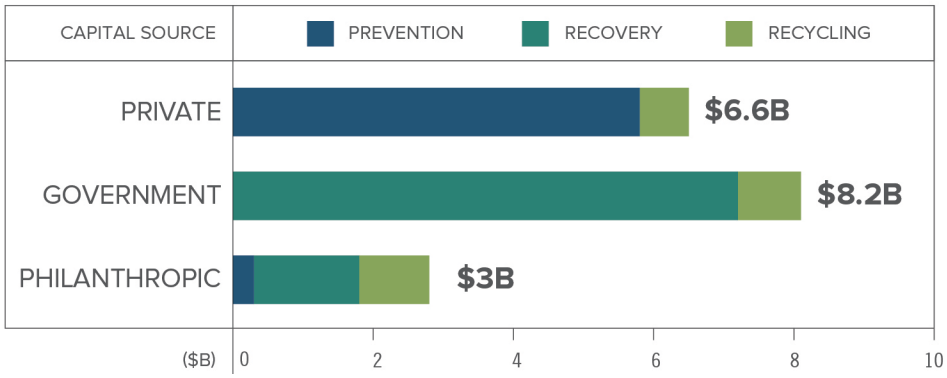
EVERY SOLUTION requires funding, whether a few hundred thousand dollars to fund a cold chain management pilot or hundreds of millions of dollars for new recycling infrastructure.

The *Roadmap* estimates that an aggregate $18 billion of new financing is needed to achieve a 20% waste reduction — or roughly $2 billion per year averaged over the next decade. While this may seem large, it amounts to only a tenth of a penny of investment for each pound of food waste reduced. This one-time investment will yield roughly $100 billion of economic benefits for society, including an estimated $20 billion of total business profit opportunity over the same period. ⊕

The financing needed to achieve the 20% reduction goal can be broken out into three broad categories: private, government, and philanthropic.

To overcome the bottlenecks to unlocking $18 billion in financing, $100-$200 million annually is needed in catalytic grants, innovation investments, and low-cost project finance.

FINANCING NEEDS FOR 20% REDUCTION IN FOOD WASTE OVER A DECADE



The financing sources were estimated using a three-step process. First, it was assumed that private finance would flow to solutions that offer market-rate returns: corporate purchases of products, services, or equipment; equity investments into growing businesses; and project finance for infrastructure. Next, the growth in government funding was estimated based on existing policies, including tax incentives and subsidized finance for recycling infrastructure. Finally, philanthropic grants and impact investments were calculated to fill the gap, providing the additional funding required to achieve scale.

Most financing needs can be met from a variety of sources. These estimates are not meant to be prescriptive; they are an approximation of the scale of resources needed to tackle the food waste challenge.

PRIVATE CAPITAL

Three types of private capital are required: internal corporate finance, private equity investment, and private project finance.

- **INTERNAL CORPORATE FINANCING: $5.2 BILLION** | When a company invests its own capital in a food waste solution, it must be mature enough to meet an internal return hurdle rate relative to other opportunities. Nearly 70% of corporate finance is needed for two capital-intensive prevention solutions: **Secondary Resellers** and **Packaging Adjustments**. Secondary Resellers require investment to build out new

⊕ *More detail on the methodology for estimating the financing gap can be found in the Technical Appendix available at refed.com.*

retail sales infrastructure, while making packaging adjustments requires upgrades to existing packaging production equipment and ongoing annual investment into more expensive packaging in some areas. Other major corporate investment areas include **Smaller Plates**, **Spoilage Prevention Packaging**, and distributed equipment for several recycling solutions.

- **PRIVATE EARLY-STAGE AND GROWTH EQUITY: $800 MILLION** | Private equity investments range from a $500,000 seed investment from an angel investor to a $20 million growth equity investment in a profitable but growing business. Priority sectors for this funding that are ready to scale include **Spoilage Prevention Packaging**, **Waste Tracking & Analytics**, **Centralized Composting, Centralized AD**, and **Commercial Greywater**. The dollar estimate is conservative as breakthrough innovations are not included in the 20% *Roadmap* analysis.
- **PRIVATE PROJECT FINANCE: $500 MILLION** | Project equity and debt fuels the development, construction, and operation of multi-million dollar infrastructure projects. Most of this funding is needed for large AD facilities, which typically finance 20% to 30% of the upfront costs through project equity, with the remainder funded through project debt after subtracting out subsidies. Smaller projects can also use project finance, including new packaging facilities, animal feed processing, and on-site pre-processing equipment. Lower cost financing will stimulate a larger number of projects to be built.

GOVERNMENT FUNDING

Government funding includes tax rebates or subsidies, as well as direct municipal, state, or federal project financing or grants to businesses to promote broader public goals.

- **TAX INCENTIVES: $7.2 BILLION** | The economic analysis found that **Donation Tax Incentives** for food businesses have an opportunity to stimulate an additional 380,000 tons annually of donated food. It is assumed that a maximum of $720 million per year of tax subsidies will be needed over the next decade to directly offset the additional time and labor costs incurred by businesses making food donations. These incentives are already supported by existing legislation passed into law in late 2015. Historically, a portion of businesses that qualify for tax incentives do not file for them, which likely reduces the actual tax burden by hundreds of millions of dollars per year below this estimate. Further research should explore a more detailed state-level assessment of donation tax incentives, as well as other tax incentives to support recycling projects or general corporate R&D that were not within the scope of this study.
- **PUBLIC PROJECT FINANCE: $1.1 MILLION** | The economic feasibility of recycling projects often depends on partial funding from public sources in the form of municipal bonds, debt, or utility public-private partnerships. Most of this funding will be directed to **WRRF with ADs**, which are publicly owned facilities managed by municipal wastewater authorities. **Community Composting** and some centralized recycling projects will also leverage public funding. Public finance typically is priced with a 3% to 5% interest rate, which is lower than most sources of private project finance.
- **GOVERNMENT SUBSIDIES:** Some government programs give direct grants to projects that promote the public good. These grants could cover a number of *Roadmap* solutions, including **Consumer Education Campaigns**, research and development, recovery programs, and recycling infrastructure pilots. For simplicity, all expected grant funding was allocated to the philanthropic sector.

PHILANTHROPIC FUNDING

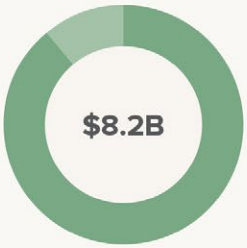
Philanthropic funding includes grants and impact investments to fund solutions that create public benefits or have costs and benefits that accrue to different organizations. Foundations are typically the main source of philanthropic capital, but funding can also come from private impact investment funds, high-net-worth individuals, and nonprofit industry associations. It is estimated that foundations currently allocate less than $10 million per year explicitly to food-waste-related solutions. To achieve the objectives in the *Roadmap*, funding levels will need to be dramatically scaled.

FINANCING NEEDS BY TYPE

PRIVATE

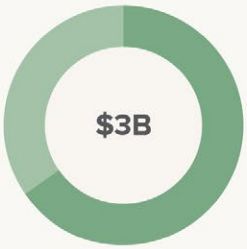
Corporate Finance - **$5.2B**
Private Equity - **$0.8B**
Project Finance - **$0.5B**

GOVERNMENT



Tax Subsidy - **$7.2B**
Project Finance - **$1.1B**

PHILANTHROPIC



Grants - **$2B**
Impact Investments - **$1.1B**

- **GRANTS: $2 BILLION** | Grants help support the scaling of solutions using six main methods: capacity building for local multi-stakeholder coalitions, direct education and training for consumers and businesses, policy advocacy and support, research and pilots, direct funding of critical infrastructure, and data tracking and monitoring.

  Philanthropic funders should prioritize their grant funding based on their mission. For those focused on hunger, there is ample opportunity to support the food recovery sector through storage, transportation, education, and advocacy efforts. Foundations focused on the environment or community development are recommended to back a multi-stakeholder national **Consumer Education Campaign**. Other priorities include stimulating **Centralized Compost** and **AD** projects in municipalities that face barriers, catalyzing innovation around compostable packaging and **Value-Added Processing** social enterprises, and fueling pilot projects around **Standardized Date Labeling** and **Produce Specifications**.

- **IMPACT INVESTMENTS**: **$1.1 BILLION** | In the *Roadmap*, impact investors are defined as those who seek a financial return but are willing to accept more risk or potentially lower returns in pursuit of measurable social or environmental impact. Recipients of these investments typically include social enterprises, infrastructure projects, early-stage innovators, and nonprofits.

  Impact investments mostly consist of low-interest loans and high-risk equity investments. The majority of capital is expected to come from foundations. Low- or no-interest loans and loan guarantees in the form of program-related investments are needed to fund food recovery and recycling infrastructure, particularly capital-intensive **Centralized AD** and **WRRF with AD** that support clean energy goals. **Centralized Compost** facilities may also be attractive due to high levels of job creation. Today, startups are seeking funding for solutions including **Donation Transportation** and **Donation Matching Software**. Finally, a small pool of high-risk, high-yield debt is needed to support sub-scale projects or pilots lacking a source of risk capital, including **Value-Added Processing** and **Community Composting**.

THE NEED FOR CATALYTIC CAPITAL

The majority of the financing required will flow naturally from existing government regulation and basic market forces. However, an estimated $100 to $200 million per year of catalytic capital is needed to unlock scale for solutions that face continual financing barriers.

Catalytic capital is defined as financing that has a multiplier effect in stimulating larger amounts of future financing and waste reduction by overcoming system-level barriers. Catalytic capital includes the majority of impact investments as well as smaller amounts of grants and other finance. There are five levers that generate this multiplier effect:

- *De-risking new innovations* – Startups need early-stage funding, subsidized pilots, or flexible debt to demonstrate they are effective in real-world settings to attract follow-on private investment.
- *De-risking novel projects* – Any project with a first-of-its-kind component faces an extra risk premium. Low-interest debt or credit enhancements can help get these projects deployed and de-risked to lower the cost of future financing.
- *Unlocking bottlenecks* – Some types of infrastructure projects struggle to attract funding due to marginal profit margins, but they are critical to lowering costs for the system as a whole. Trucks and storage facilities, for example, are bottlenecks within the recovery and recycling ecosystems.
- *Overcoming agency problems* – Some solutions fail to get funded because no one stakeholder benefits enough to justify the costs, such as various recycling projects or **Standardized Date Labeling**. Catalytic capital shifts the economics so other stakeholders are incentivized to invest.
- *Stimulating marginal projects* – Many projects with valuable social and environmental benefits are not financed due to marginal profitability. A slice of catalytic capital can shift the economics of these projects above the necessary hurdle rate to attract market-rate financing.

REGIONS RIPE FOR RECYCLING INVESTMENT

Investment potential is highest for recycling in regions with high landfill costs, high energy prices, and policies that provide clear market signals, including the Northeast, West Coast, and some Midwest regions. Refer to Recycling Solutions on page 52 for more information.

THE PATH TO A 50% REDUCTION

An estimated $18 billion of financing is needed over the next decade to achieve a 20% waste reduction target. The broader 2030 reduction target will be more challenging to finance because many of the most profitable and highest cost-benefit investments will have already been made. Two wide-scale efforts are needed to jumpstart financing and put the country on a path to reach the broader 50% goal:

THE OPPORTUNITY

Form new impact investment funds to galvanize investment in food waste reduction solutions, while better incorporating Non-Financial Impacts into government budgeting

1. AGGREGATE IMPACT INVESTMENTS USING A PURPOSE-BUILT FOOD WASTE SOLUTIONS FUND

A dynamic opportunity to accelerate the *Roadmap* implementation is to create new funding models that aggregate catalytic, impact-oriented capital. The opportunity exists to unlock market-rate capital that is available for promising investments by forming impact investment funds designed specifically to help de-risk new innovations and remove bottlenecks for projects not yet attracting capital.

Current investments in novel food waste solutions are often made with limited staff time and resources. Larger pooled impact investment funds — such as DBL Investors, a fund for environmental growth equity investments — have demonstrated the advantages of reaching $100 million or larger. Larger funds can invest in research staff to deepen their expertise on each sub-sector, widen their geographic coverage to source quality investments, develop a systemic methodology for due diligence, and leverage broader networks to help portfolio companies thrive.

A purpose-built food waste solutions fund offers additional benefits to private, corporate, and philanthropic funders. For example, a grocery chain would benefit by catalyzing new recycling infrastructure where none existed before, lowering the costs of food waste disposal for stores in that region. By making it easier for all grocers to recycle their food scraps, the grocer could lower its own water and greenhouse gas footprints to help achieve corporate sustainability goals. Investments in prevention innovations would also have a direct impact on grocer profitability by reducing food purchasing costs, while recovery investments can increase employee morale and community relations.

2. QUANTIFY NON-FINANCIAL BENEFITS TO INCREASE GOVERNMENT SUPPORT

The largest expected financing category is government support in the form of tax incentives, project finance, and other subsidies. Although government funds are designed to support the public good, advocates have lacked data to include non-financial benefits into decision-making.

There are three main Non-Financial Impacts that could be better integrated. First, there is early evidence that food recovery may be an extremely cost-effective source for food assistance programs. Deeper research on this topic could help recovery efforts tap the tens of billions of federal dollars that support local food assistance. Second, the *Roadmap* has demonstrated the enormous potential water and GHG savings from prevention solutions. Food waste advocates should push for the inclusion of a social price on carbon and the economic benefits of agricultural water conservation in water-stressed regions into cost-benefit analysis frameworks.

Finally, since most food waste actions occur locally, there is an untapped opportunity to advocate for additional municipal funding. The benefits of job creation, reduced municipal spending on landfills, and energy security from local biogas supply all align with municipal goals. This could encourage municipalities to streamline permitting and offer better prices for electricity, including lower barriers for AD facility grid connections or utility quotas for distributed energy production.[73] Combined, adding Non-Financial Impacts into government planning could generate billions of dollars of additional funding by 2030 to cost-effectively support public goals.

CASE STUDY: THE CLOSED LOOP FUND

The Closed Loop Fund (CLF) was formed in 2013 after a convening led by Walmart resulted in a commitment of over $100 million from manufacturers, consumer goods companies, and retailers to help increase recycling rates in cities across North America. CLF began with a unique thesis that a lack of access to debt funding at affordable rates was hampering the growth of municipal recycling programs across the country. CLF provides municipalities zero-interest loans and gives private firms engaged in public-private partnerships access to capital at below-market rates. The corporate funders of CLF, as well as the entire consumer packaged goods industry, benefit financially by increasing the availability of recycled material to put back into their supply chains. Projects are screened based on clear metrics of financial viability, scalability (including the ability to solve key industry bottlenecks), and reporting metrics.

POLICY

CURRENT STATE OF U.S. FOOD WASTE POLICY

The *Roadmap* highlights a number of areas where policy can facilitate the adoption of food waste solutions. To achieve the 20% goal, the immediate priority is to spread best-practice policies at the local and state levels. Over the long-term, a 50% diversion goal will likely require a comprehensive federal food waste policy that sets national guidelines to significantly boost investment from national food businesses.

Policy treatment of food waste diversion differs dramatically throughout the country. Some states and even a few cities have implemented complete organics landfill bans to force businesses to invest in prevention, recovery, and recycling. While these bans incentivize waste reduction, they also create challenges for large businesses that operate across geographies. Similarly, the lack of standardized national regulation around date labeling and clear guidance on food safety for donations has hampered progress in building the business coalitions required to achieve major change.

NEAR-TERM POLICY PRIORITIES

The *Roadmap* was framed to focus on solutions that can scale under existing policy or with only minor adjustments. The near-term priorities focus on two solutions related to food recovery policy:

- Maintaining the recent expansion of permanent federal tax incentives for all farms and business sizes for food donations.
- Reforming food donation standards and standardizing safe handling practice regulations coupled with donation liability education.

In addition, a number of solutions call for straightforward policy adjustments to help overcome barriers. For example, many large compost and AD facilities are constrained by stringent regulations that vary by state and can lead to permitting processes that last three to five years. Often compost facilities that accept food waste must be permitted as solid waste facilities, which can cost over $10,000 per site. While it is important that facilities are safely sited and well designed, permitting agencies could put recycling projects on a fast track by giving them higher priority than landfill expansions and waste incinerators.

Commonsense policy adjustments that expand state and local incentives and reduce permitting barriers are needed to scale federal food donation tax incentives, standardize safe handling regulations, and boost recycling infrastructure.

Refer to **Donation Tax Incentives** (page 44), **Standardized Donation Regulation** (page 45), and **Donation Liability Education** (pages 48) for more information on stakeholder actions that can facilitate policy changes.

POLICY ACTIONS TO INCENTIVIZE FOOD WASTE CHANGE

SOLUTION	REGULATION TODAY		RECOMMENDED POLICY CHANGE
	FEDERAL	STATE/LOCAL	
Donation Tax Incentives	Yes (recently passed)	Yes (scattered))	Permanent federal tax incentives for all farms and business sizes
Standardized Date Labeling	No	No	Improved FDA guidance on: · standardized date labels · food donation safe handling rules · using plate waste for animal feed
Standardized Donation Regulation	No	Yes (scattered)	
Animal Feed	Yes	Yes (scattered)	
Centralized Anaerobic Digestion	Yes (temporary)	Yes	Organics bans for landfill or incineration Pay-as-you-throw pricing Streamlined permitting for large facilities Local incentives for distributed solutions
Centralized Composting	No	Yes (scattered)	
Commercial Greywater	No	Yes	
Home Composting	No	No	
Community Composting	No	Yes	
WRRF with AD	No	Yes (scattered)	

Multiple ReFED Advisory Board members have noted the importance of local recycling policy enforcement to ensure that waste streams have low levels of contamination. Only then do they offer enough Economic Value to fuel financially viable processing facilities.

THE PATH TO A 50% REDUCTION

Beyond these immediate priorities, 10 *Roadmap* solutions are in some way inhibited by the lack of national food waste legislation. The table on page 73 outlines solutions for which transformational policy would unlock significant additional opportunity.

Historically, national-level policy has not gained much ground due to a general lack of awareness of the issue and the complexity of engaging a large multi-stakeholder coalition. Many stakeholders do not realize that national food waste policy has the opportunity to generate jobs, cut the federal tax burden, and improve food and energy security, all of which could be drivers of bipartisan support.

However, comprehensive federal legislation bundles multiple policies together making it easier to create legislation where every key stakeholder group wins. Consumer-facing businesses, farm groups, and landfill associations are critical stakeholder groups that need to see the economic benefits of legislation. In addition, comprehensive federal policy will generate minimum common standards, removing barriers to action for food businesses related to deciphering the panoply of local regulations for topics such as safe food donation handling and compost siting.

STEPS TO POLICY SUCCESS

In late 2015, Rep. Chellie Pingree of Maine introduced a comprehensive Food Recovery Act that pushes for many of the policy goals highlighted in this section. Based on the success of other similar campaigns, the following steps are needed to succeed in passing this or other comprehensive federal policy:

1. **BUILD A COALITION WITH A LEADER:** Considerable preparation is needed to ensure policymakers are aware of the issue and willing to invest political capital to support it. A strong nationwide, multi-stakeholder coalition should lead this effort by developing common goals, communicating unified messaging, and securing commitments from affected groups. This coalition can attract a wide range of stakeholders, including businesses, industry associations, and nonprofits, to educate policymakers on the issue.
2. **BRING THE FUNDING:** Considerable resources will be needed to coordinate a food waste advocacy effort. This financial support should come from the business and philanthropic communities, including advocates for the food insecure, farmers, and the environment. This is an issue with many winners and few losers — messaging should demonstrate how everyone's boat will rise by reducing waste.

When ReFED started the research on the *Roadmap*, comprehensive federal policy seemed like a distant aim. However, the recent passage of the FY2016 budget included a wide broadening of federal tax incentives for food donations. As this report goes to press, indications show that the potential for major policy wins is growing.

THE OPPORTUNITY:

Pass a federal-level comprehensive food waste bill that ties together policy opportunities and signals a market shift to food businesses

CASE STUDY:

CALIFORNIA FOOD WASTE POLICIES

In California, progressive policies have paved the way to create more food waste recycling projects in the pipeline than in any other state:

- AB 1826 banned organics from the landfill and requires food manufacturers, restaurants, supermarkets, and large foodservice providers to source separate and recycle food and yard waste.
- AB 1594 prevented organics from being used as alternative daily cover at landfill.
- AB 939 set a 50% disposal reduction mandate for cities and counties.
- AB 341 set a 75% collective recycling goal for the state for target year 2020 and requires that businesses and multi-family residences meet recycling requirements.
- AB 32 required California to reduce its GHG emissions to 1990 levels by 2020 by focusing on a series of major warming contributors including CO2 and methane. The California Air Resources Board, in direct response, implemented a Low Carbon Fuel (LCF) incentive to prompt the adoption of low-carbon transportation fuels, offering significant benefit to AD facilities that choose to convert biogas to CNG to power vehicles.

INNOVATION

AT A HIGH LEVEL, there are five priority categories of innovation that can drive the greatest impact on food waste reduction: packaging and labeling, IT-enabled transportation and storage, logistics software, value-added compost products, and distributed recycling.

The *Roadmap* solutions were analyzed "as is" with their current technological limitations, in existing markets, and using prevailing business models. Considerable innovation has already occurred to bring these solutions to market.

While disruptive innovation is not needed to achieve a 20% reduction, incremental innovation is expected to naturally improve performance and decrease costs over the next decade:

Key technology and business-model innovations are needed around these five areas:

- *packaging & labeling*
- *IT-enabled transportation and storage*
- *logistics software*
- *value-added compost products*
- *distributed recycling*

PREVENTION

- **Consumer Education Campaigns** will become more effective through new community-based social marketing tools, such as mobile phone apps that send text message reminders targeted to shoppers at grocery stores.
- Advancements in materials will make **Packaging Adjustments** and **Spoilage Prevention Packaging** more cost-effective over time.

RECOVERY

- **Value-Added Processing** will become affordable at smaller scales as new business models for food incubators and shared commercial kitchens become more widespread.
- **Donation Matching Software** will leverage advances in other sharing economy software to improve ease of use and location-based optimization.

RECYCLING

- **Centralized Composting** and **AD** facilities will benefit from innovations that squeeze higher yields out of equipment, reduce contamination through depackaging, increase throughput, or capture heat or energy more effectively.
- Compost profitability will rise as new value-added products mature in the market to mitigate stormwater runoff and enhance agricultural production.

CASE STUDY: WISERG HARVESTER USING SMART SENSORS TO TURN WASTE INTO FERTILIZER

One innovator is working to combine on-site recycling and waste analytics into a single package. In 2010, WISErg partnered with PCC Natural Markets in Seattle to pilot an on-site system called the Harvester, which converts up to 4,000 pounds of food scraps daily into a nutrient-rich liquid. A store employee enters an access code, food type, and reason for discard, and then deposits food scraps into the Harvester. A sensor gathers data on food weight, temperature, and time of day. WISErg applies cloud-based analytics to provide management insights to modify purchasing and handling behavior or to redirect edible batches to local food banks. Food scraps processed by the Harvester are then transported to a central facility to be mined for nutrients. The flagship byproduct, WISErganic, is a liquid fertilizer marketed to the agriculture industry. WISErganic has been shown to improve soil nutrient content and crop yields based on data from over 200 commercial growers actively using the product.

THE PATH TO A 50% REDUCTION

Over a third of *Roadmap* solutions can achieve major gains in market penetration through breakthroughs in technological and business innovations. In addition, several emerging innovations offer enormous potential if they become cost-effective over the next decade.

Because the food system is tightly interconnected, innovations often simultaneously benefit multiple parts of the value chain. For example, compostable packaging not only reduces recycling labor costs for waste generators who no longer need to separate food from packaging, but it improves the economics of **Centralized Composting** (and some **AD** facilities) due to reduced contamination rates.

In addition to technology innovation, business-model innovations that share risk across the supply chain in novel ways can be a large driver in waste reduction. For example, supply contracts between retailers and suppliers could be modified so farmers are not incented to over-produce to satisfy vendor contracts. Catering contracts could include clauses stipulating that clients are comfortable with running out of food at their events to relieve caterers of the need to over-prepare.

The table below highlights 15 high-priority technological innovation areas that can drive transformation in the food waste value chain. The greatest innovation opportunities occur within the prevention and recycling solutions.

THE OPPORTUNITY:

Build a network of food waste innovation incubators across the U.S. with dedicated funding, mentorship, and facilities to achieve technology and business-model breakthroughs across five priority innovation areas

HIGH-PRIORITY INNOVATION AREAS: PREVENTION SOLUTIONS

SOLUTION	MARKET CHALLENGE	INNOVATION OPPORTUNITY
BREAKTHROUGHS IN EXISTING SOLUTIONS		
Cold Chain Management	Real-time monitoring of trucks, warehouses, and shipping containers could reduce waiting times and errors through RFID/sensors.	Lower sensor costs to less than $10 per pallet and improve effectiveness to meet needs of logistics providers.
Inventory Management	Half of the market does not utilize advanced inventory management systems today.	Target small- and medium-size customers through development of low-cost, flexible solutions.
Packaging Adjustments	Consumers haven't demanded adjustments, and modifications raise concerns about unintended consequences such as breakage.	Conduct consumer behavior research to identify core needs. Fund product R&D to pilot disruptive packaging such as edible films or nonstick bottles.
Spoilage Prevention Packaging	Applicability is limited to certain food types and types of storage.	Improve performance across a wider variety of food types and storage settings.
Waste Tracking & Analytics	Market penetration of solutions is small to date.	Minimize manual measurement through low-cost cameras and sensors and integration with inventory data.
EMERGING TECHNOLOGIES		
Dynamic Store Merchandising	System costs are tremendous, relying on real-time price screens, strong inventory management systems, smart carts, and handheld devices.	Verify NPV through a retail pilot, and identify path to reduce costs. Experiment with location-based mobile phone discounting to reduce total solution cost.
Smart Labeling	The NPV of this solution has not been proven through the limited pilots to date.	Achieve labels that are cheap enough to drive a food-safety or waste-reduction value proposition when placed on the majority of perishables.

HIGH-PRIORITY INNOVATION AREAS: RECOVERY SOLUTIONS

SOLUTION	MARKET CHALLENGE	INNOVATION OPPORTUNITY
BREAKTHROUGHS IN EXISTING SOLUTIONS		
Value-Added Processing	Facilities are expensive and require large scale, reducing applicability for smaller recovery opportunities.	Develop distributed and mobile technologies, combined with new preservation technologies, to cost-effectively link processing on farms to businesses and recovery organizations.
Donation Transportation, Donation Storage & Handling	New infrastructure can be costly and limited in the amount of time it is actually in use.	Identify novel tools to allow for effortless sharing of existing, under-utilized infrastructure not currently linked to recovery networks.

HIGH-PRIORITY INNOVATION AREAS: RECYCLING SOLUTIONS

SOLUTION	MARKET CHALLENGE	INNOVATION OPPORTUNITY
BREAKTHROUGHS IN EXISTING SOLUTIONS		
Centralized AD	Additional labor cost is needed to depackage food, reducing the quantity and quality for recycling.	Scale down large depackaging technology to enable systems at every retailer and manufacturer location.
Home Composting	Current adoption is low due to poor designs, lack of space, and odors.	Achieve odor-free, beginner-level home composting systems for under $50 per unit.
Centralized Composting	Compostable packaging underperforms vs. industry standards and can decrease shelf life of perishables while costing 25% to 100% more.	Conduct R&D in compostable packaging to achieve products on par with conventional price and performance.
Animal Feed	Facilities currently rely on individual relationships.	Leverage sharing economy to create a network of waste generators and farms.
EMERGING TECHNOLOGIES		
Small-Scale AD	Biogas cleaning and electricity conversion is not economical at small business scale, utilization for heat is seasonal,[74] and on-site handling of digestate is challenging for small businesses.[75]	Achieve transformational cost reductions to be commercially viable, which would drive massive collection cost reductions in low-density municipalities and rapid scale similar to distributed energy systems.
Collection	Collection costs can make up 50% to 75% of the overall cost for collecting and processing food waste.	Develop new route optimization technology and new tools to reduce water weight of food scraps before or during transit.

STEPS TO INNOVATION SUCCESS

A network of *Food Waste Innovation Incubators* across the country with dedicated funding, mentorship, and facilities would be one of the biggest enablers of bringing these 15 innovations to market. Incubators could sponsor dedicated cohorts focused on each of the five major innovation challenges: packaging and labeling, IT-enabled transportation and storage, logistics software, value-added compost products, and distributed recycling. Development of this incubator network will require the following:

1. **ADDITIONAL SERVICE OFFERINGS:** Many startups come to an incubator looking for funding. But equally as valuable is access to a variety of non-financial support, such as business mentors, lab equipment, and connections with consumer-facing businesses and recycling facilities for testing. Foundations can partner with food businesses and universities to fund the use of existing but underutilized equipment and facilities, including commercial kitchens.
2. **PLEDGE TO PILOT:** Food waste innovations need to be tested in the market to ensure that they meet industry expectations. The incubator network should partner with food businesses that commit to pilot new technologies and to reduce the costs and measurement burdens of pilots.

A number of existing food-related incubators, accelerators, and networks could provide a fertile starting point for this effort. For-profit and nonprofit organizations include:

- California: Food System 6, Farm2050, and the Mixing Bowl
- New York City: Food-X, Food Future, Inc. (Food Next) and Accel Foods
- Illinois: Good Food, Now We're Cooking
- Boston: Branchfood, Greentown Labs

A number of larger food companies, including Chobani, Diageo, Mars, and Coca Cola, have also recently launched food innovation accelerators and incubators, demonstrating the benefits to business of joining this effort. These entities could be guided by a more formal industry association or by a loose coalition to reduce redundancy and share best practices.

EDUCATION

THE LARGE number of *Roadmap* barriers that are behavioral in nature highlights the need for education, training, and capacity-building for consumers and food business staff to enable change at scale. The path to a 20% reduction in waste includes **Consumer Education Campaigns** as a standalone solution given its ability to be implemented nationwide. Employee training is embedded as part of the cost of implementation of most solutions.

In addition to campaigns that raise food waste awareness among consumers, it is critical to launch a widespread training effort to change behaviors of food business employees.

CONSUMER EDUCATION

Consumer education is one of the most cost-effective and scalable *Roadmap* solutions, as it will directly influence food purchasing and eating behaviors. Examples of behavior changes include reducing over-purchasing, gauging when to use or freeze near-expired food, and incorporating leftovers into soups or other flexible recipes.

Consumer education is also critical to the success of other *Roadmap* solutions. **Standardized Date Labeling** and **Packaging Adjustment** solutions will be much more effective if consumers are aware of them. When food is ready for disposal, education also impacts whether consumers decide to put it down the drain, separate it for composting, or combine it with regular trash. Previous home recycling programs have demonstrated the need for clear, frequent and consistent communications about proper separation of materials and pickup schedules. Finally, consumer education drives increased demand for business products and services that reduce waste, including imperfect produce and trayless all-you-can-eat facilities.

Lessons can be gleaned from similar education campaigns, specifically around residential energy efficiency and other recycling programs:

- *Say Hi Neighbor:* In the energy efficiency sector, the biggest motivator of action is often comparison to one's neighbors. Campaign planners should seek a neighborhood waste benchmarking for food.
- *Goal-setting:* Consumers can be encouraged to set and track waste-reduction goals, as goal-setting has been proven to be a powerful motivator for action.
- *Make It Fun:* Consumers have a greater emotional connection to food than many other resources they use, so waste reduction can be rebranded as a way to cherish farmers, love our bodies, and build healthy families.
- *Make It Easy:* Even small hassles, like walking outside in the cold to compost food scraps, can be a barrier to action. **Home Composting** and **Spoilage Prevention Packaging** solutions must be nearly painless to gain widespread adoption.

Refer to **Consumer Education Campaigns** (page 31) for more information on stakeholder actions that can support consumer education.

EMPLOYEE TRAINING

Half of ReFED's solutions require hands-on employee involvement in day-to-day execution. These roles include:

- Knowing how to avoid removing product from shelves when it is still safe and edible
- Identifying and preparing food that can be donated
- Depackaging and properly source-separating food waste to remove contaminants before transport for recycling, which is critical to the viability of recycling processors

The *Roadmap* assumes that employee training is part of the cost of implementation modeled for each solution. However, given the sector fragmentation, one key short-term need is the dissemination of best-practice training materials. This could take the format of online training videos, printed signage and labeling for kitchen and retail environments or at points of disposal, or low-cost training and consulting services. Similar to food safety information, guidance on how to reduce food waste should be visible throughout food businesses to keep the issue top of mind and easily actionable for employees.

Recycling employee training is more complex due to the diversity of waste feedstocks that are acceptable at each facility. Many programs continue to see higher-than-targeted contamination rates, which hurt their cost-effectiveness. In these environments, messaging and implementation need to be kept simple. For example, many cities have seen municipal solid waste recycling rates double or triple after they switched to combined bins that did not require employees or homeowners to separate out paper, plastic, and metals.

THE PATH TO A 50% REDUCTION

To create a systemic transformation in consumer and employee awareness to reach a 50% reduction, a coordinated campaign is needed to increase the average American's ability to articulate what actions are most effective at home and in the workplace. An audacious program to expand national education on the issue would have two components: a national consumer education campaign and employee certification program.

NATIONAL CONSUMER CAMPAIGN

In 2016, NRDC and the Ad Council will launch the first widespread public service campaign promoting food waste awareness, similar to a program launched in the U.K. by WRAP in recent years. This program will likely begin by targeting behavior around a few key decision-making points, such as standing in grocery store aisles or storing food in the refrigerator.

A 50% reduction will require a campaign that is deep, broad, and long, approaching the awareness penetration of other major campaigns that have promoted increased seat belt use, smoking prevention, litter reduction, or forest fire prevention. Significant additional funding is a starting point. This can help fund research to identify the best messaging, recruit key influencers, experiment with viral messaging approaches, and iterate. To be effective, a multi-stakeholder coalition will likely be required to coordinate messaging and priorities among constituents.

THE OPPORTUNITY

Expand emerging efforts to achieve a national social-based marketing campaign that achieves awareness and behavior change, comparable to Smokey the Bear or other successful education efforts, in coordination with a national employee food waste certification effort.

EMPLOYEE CERTIFICATION PROGRAM

With the high turnover rates in food businesses, employee training is a key barrier to achieving waste reduction at scale. Beyond basic training and awareness, a rigorous certification program would raise the stakes for measuring, verifying, and promoting best practices throughout the country.

The quickest path would be to link food waste certification to existing food safety certification programs, as they are already mandatory in many food businesses and are a top priority for management teams. The first step in this process would be for businesses to work with certifying bodies to begin collecting best practices and training materials on a voluntary basis.

ReFED RECOMMENDS INTEGRATING FOOD WASTE CERTIFICATION INTO EXISTING FOOD SAFETY PROGRAMS.

STEPS TO EDUCATION SUCCESS

Specific strategies to roll out national consumer and employee certification campaigns would include similar steps:

1. **FOCUS ON SOCIAL DYNAMICS AND SELF-INTEREST:** Experience has shown that while some people are interested in social or environmental impacts, most behavior is influenced by interpersonal dynamics or personal financial benefits. Messaging should focus on family, budgets, and freeing up money for aspirational purchases.

   Similarly, businesses will have to make food waste matter to individual store and kitchen employees through a certification program. As one ReFED Advisory Council member explained, “It didn’t really click with our kitchen staff until they saw how much time they could save by not prepping extra food — which meant they could take a longer break, or go home early.”[76]

   With support from industry associations and nonprofits to collect case studies, businesses can communicate metrics that will resonate with employees. These could include time saved during food prep, extra hours available to prep food for donation and recycling, or increased ease in knowing what product to move off store shelves. Similar to how businesses nominate energy efficiency champions, a program to unleash “Food Waste Champions” could empower an army of influencers.

2. **MEASURE AND ADJUST:** Both consumer and employee campaigns need to track impact to inform further targeting or messaging needs. While studies have been conducted in the U.K. and elsewhere to measure the impact of consumer awareness, there has been minimal tracking on what works in U.S. culture. Nonprofits can partner with businesses to track impact in specific markets or campaigns. Waste characterization studies, similar to energy audits, are a powerful tool for businesses or municipalities to set a baseline of waste, a standard monitoring process, and collective goals.

While the *Roadmap’s* initial **Consumer Education Campaign** solution is expected to cost roughly $25 million per year, a comprehensive and aggressive national education and employee certification campaign would require five to 10 times more funding. For example, the recycling industry spends on average $1 per household and $5 per business annually to keep people aware and engaged in programs. Yet the return on investment in terms of dollars saved and strengthened communities is likely to be many times greater.

FUTURE RESEARCH OPPORTUNITIES

Throughout the development of the *Roadmap*, several areas were identified that would strongly benefit from additional research. Given the diversity of research that needs to be undertaken, ReFED recommends that a coordinating entity ensure that research continually builds upon itself and is not duplicative. In Europe, FUSIONS (Food Use for Social Innovation by Optimising Waste Prevention Strategies) was developed to help coordinate the research agenda. It includes 21 project partners from 13 countries, bringing together universities, consumer organizations, and businesses.[77]

QUANTIFYING FOOD WASTE ALONG THE VALUE CHAIN
The *Roadmap* relied on the best available data for developing a baseline of where food is wasted. However, in some cases, the quantity of food waste is extrapolated from only one or two studies. It is recommended that future research focus on developing additional data, leveraging the Global Food Loss and Waste Protocol as a framework. This research should focus on the following areas:

- On-farm losses, including variations by different types of products, sizes of farms, geography, reasons for losses, and final destination
- Differences among small and large businesses
- Regional differences
- Seafood waste on ships
- Specialty Institutions, including corporate cafeterias and prisons
- Food waste disposed down the drain in homes and businesses

QUANTIFYING CURRENT LEVELS OF FOOD WASTE INVESTMENT
To more efficiently direct philanthropic, government, and investor resources toward food waste solutions, better data tracking is needed to quantify current investment levels and types of investments.

DRIVERS OF CONSUMER AND EMPLOYEE BEHAVIOR
Effective messaging strategies require a better understanding of the drivers of behavior. Currently, the best available data on consumer response to a food waste social marketing campaign comes from WRAP in the U.K. There is a need for U.S.-based research on responsiveness to various marketing strategies. This research can benefit from an emerging body of work that seeks to apply behavioral economics to environmental and social issues.

ADDITIONAL SOLUTIONS
While the *Roadmap* includes opportunities across the entire supply chain, the primary focus was on actions that can be taken by consumer-facing businesses. Future research could this research to focus on solutions for farmers, manufacturers, and consumers. High-priority areas that currently have a lot of interest include gleaning, farm forecasting, online grocers, local farming, and subscription meal services.⊕

SYSTEM COMPLEXITIES AND INTERDEPENDENCIES
As discussed earlier, there is a lack of research available to assess the macro level changes that may occur in our food system from a large reduction in waste. A high priority area for research is to better understand the macro-level economic and environmental impacts of waste prevention.

⊕ *A comprehensive list of additional solutions can be found in the Technical Appendix on refed.com.*

MOVING TO ACTION

Food waste represents a unique opportunity to protect the American economy, conserve natural resources, create jobs, reduce the tax burden, and feed the nearly 50 million Americans who experience food insecurity. The *Roadmap* has demonstrated that it is feasible using existing solutions that have positive or breakeven Economic Value to reduce food waste by 20% over the next decade. The primary barrier is galvanizing new sources of philanthropic, public, and private financing to scale up these known solutions. ReFED has also identified the transformational changes that need to be made in the areas of policy, innovation, and consumer and employee education to achieve the national goal of reducing food waste by 50% by 2030.

Many of the solutions analyzed are ready to be implemented today. There is a compelling business advantage for companies to act quickly to market imperfect produce, develop new packaging solutions, and nudge consumers with redesigned all-you-can-eat facilities. These solutions offer a chance for businesses to improve their profitability while creating stronger brands and customer engagement.

Additional solutions will require stakeholders to collaborate across the value chain. **Standardized Date Labeling**, improved **Donation Transportation**, and upgraded **WRRF with AD** facilities will require new and potentially challenging industry partnerships between the public, private, and social sectors. Even so, the expected payoffs from these efforts will be enormous, delivering multiple times more economic value than can be created by acting as individual entities.

Finally, the *Roadmap* represents a snapshot in time. As food waste issues continue to evolve, future research opportunities abound to expand upon the analysis and insights presented within this report. Key research priorities include gathering better data around where food is wasted along the value chain, researching drivers of consumer and employee behavior, and expanding to new solutions outside the scope of the *Roadmap*. The most valuable area for future research is likely in understanding the opportunities behind systemic transformations. A national organics landfill ban, for example, though seemingly improbable, would send a huge economic signal overnight that would catalyze innovation and create new markets.

ReFED has developed ***refed.com*** as a hub to help all stakeholders collaborate and take action. The *Roadmap* Cost Curve is available in a dynamic format to allow adjustment of the data and timeframe represented. The website will be updated to integrate new research, data, and partnerships.

The *Roadmap* is meant to not just be a research report for academic use, but a data-driven playbook for the whole food sector to take action. We invite you to join us in making the next decade known as the time in history when the United States finally dedicated the resources and willpower to make significant strides in solving the food waste challenge.

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GLOSSARY

TERM	DEFINITION
Anaerobic digestion (AD)	A series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen resulting in two end products: biogas and digestate
Biogas	A mixture of methane and carbon dioxide gases produced during the anaerobic digestion process; can be used for heat and electricity or converted into vehicle fuel
Biosolids	Properly treated and processed sewage sludge; often used as a fertilizer for soils
Business Profit Potential	The expected annual profits that the private sector can earn by investing in solutions after adjusting for initial investment required, differentiated costs of capital, and benefits that accrue to non-business stakeholders
Catalytic funding	Grants or other impact investments that are meant to unlock larger pools of capital by de-risking or improving the return profile of investments
Consumer-facing businesses	Retail grocers, restaurants, foodservice providers, and institutions. Distributors are also added to this category for this report.
Cosmetic imperfection (Imperfect Produce)	Produce that is undersized, blemished, misshapen, or otherwise unmarketable for sale
Digestate	Produced after anaerobic digestion is completed and can be processed into compost
Diversion	The process of diverting food waste from landfills or farmland tillage for a higher value and more productive purpose, like prevention, recovery, animal feed, or composting
Economic Value	The annual aggregate financial benefits to society (consumers, businesses, governments, and other stakeholders) of a solution minus the costs
Food loss	Generally refers to unintended loss of food during harvesting, post-harvest handling, processing, and distribution; included as part of “food waste” as defined in this report
Food recovery organization	An organization that seeks to alleviate hunger through the distribution of recovered food
Food scraps	Generally used to refer to food that is no longer fit for human consumption
Food waste	Food grown and produced for human consumption but not eaten. This includes food still safe to eat — surplus, damaged, or expired — as well as unavoidable waste, such as bones or rinds
Gleaning	Harvesting leftover crops, typically by volunteers
Impact investors	Those investors who seek a financial return but are willing to accept more risk or potentially lower returns in pursuit of measurable social or environmental impact, often through low-interest loans and high-risk equity investments
Institutions	Hospitals, schools, prisons, government buildings, and military bases
Landfill	A place to dispose of refuse and other waste material by burying it and covering it with soil; as used in this report, also includes incineration
Meals recovered	Wasted food recovered for human consumption, using a conversion of one meal equal to 1.2 pounds
Metropolitan Statistical Area (MSA)	A statistical area representing a number of towns and cities around an urban core of at least 50,000
Net present value	Represents the sum of all costs and benefits for each solution over 10 years discounted to the current year using a standard social discount rate of 4%
Non-Financial Impacts	The social and environmental benefits and costs from reducing food waste
On-farm loss	Food loss that occurs on farms and in packinghouses; distinguished from food waste in landfills because the majority of this loss is tilled into soils as nutrients
Tipping fee	The fee paid by haulers for waste disposal at landfills or recycling facilities
Transfer station	A place where local waste collection vehicles deposit their waste cargo prior to loading into larger vehicles for transportation to a different MSA
Water resource recovery facility (WRRF)	A municipal facility that treats water and runoff from disposal pipes, including material from sink disposals; sometimes referred to as a wastewater treatment plant

APPENDIX

ReFED FOOD WASTE SOLUTIONS DATA SET

TYPE	SOLUTION	DIVERSION POTENTIAL (K TONS / YEAR)	ECONOMIC VALUE PER TON DIVERTED	ECONOMIC VALUE ($M / YEAR)	BENEFIT ($M / YEAR)	COST ($M / YEAR)	BUSINESS PROFIT POTENTIAL ($M / YEAR)
Prevent	Consumer Education Campaigns	584	$4,531	$2,648	$2,669	($22)	
Prevent	Waste Tracking & Analytics	571	$2,282	$1,303	$1,378	($75)	$1,003
Prevent	Standardized Date Labeling	398	$4,547	$1,812	$1,820	($8)	
Prevent	Produce Specifications	266	$1,039	$277	$389	($112)	$228
Prevent	Packaging Adjustments	208	$3,443	$715	$949	($234)	
Prevent	Smaller Plates	178	$2,147	$382	$407	($25)	$315
Prevent	Secondary Resellers	167	$218	$37	$1,265	($1,229)	$29
Prevent	Trayless Dining	83	$2,253	$187	$190	($3)	$154
Prevent	Spoilage Prevention Packaging	72	$2,326	$167	$312	($145)	$17
Prevent	Improved Inventory Management	59	$1,194	$71	$114	($44)	$56
Prevent	Manufacturing Line Optimization	20	$1,770	$35	$39	($3)	$28
Prevent	Cold Chain Management	18	$1,816	$32	$35	($4)	$26
Recover	Donation Tax Incentives	383	$1,230	$470	$1,103	($633)	
Recover	Standardized Donation Regulation	193	$2,863	$553	$557	($4)	
Recover	Donation Matching Software	150	$2,879	$432	$433	($1)	
Recover	Donation Transportation	110	$2,294	$252	$317	($65)	
Recover	Donation Storage & Handling	103	$2,366	$244	$297	($53)	
Recover	Value-Added Processing	102	$2,783	$285	$295	($10)	
Recover	Donation Liability Education	57	$2,810	$159	$164	($4)	
Recycle	Centralized Composting	5,037	$4	$18	$520	($502)	$47
Recycle	Centralized AD	1,884	$21	$40	$348	($308)	$43
Recycle	Water Resource Recovery Facility (WRRF) with AD	1,637	$23	$38	$189	($151)	
Recycle	Commercial Greywater	595	$33	$19	$57	($38)	
Recycle	Community Composting	167	($34)	($6)	$13	($19)	
Recycle	Home Composting	97	$149	$14	$18	($3)	
Recycle	Animal Feed	49	($52)	($3)	$2	($4)	
Recycle	In-Vessel Composting	12	($95)	($1)	$1	($2)	
TOTALS		**13,201**	**771 (AVG)**	**10,181**	**13,883**	**(3,702)**	**1,945**

APPENDIX

ReFED FOOD WASTE SOLUTIONS DATA SET

TYPE	SOLUTION	FINANCING COST OVER 10 YEARS ($M)	GHGS (K TONS / YEAR)	MEALS RECOVERED (M MEALS / YR)	WATER CONSERVATION (B GALS / YR)	JOBS CREATED (PARTIAL LIST)
Prevent	Consumer Education Campaigns	$247	2,336		281	
Prevent	Waste Tracking & Analytics	$89	2,306		317	
Prevent	Standardized Date Labeling	$82	1,593		192	
Prevent	Produce Specifications	$133	422		39	
Prevent	Packaging Adjustments	$1,872	830		100	
Prevent	Smaller Plates	$246	711		86	
Prevent	Secondary Resellers	$2,250	510		58	
Prevent	Trayless Dining	$27	332		40	
Prevent	Spoilage Prevention Packaging	$1,095	329		44	
Prevent	Improved Inventory Management	$140	181		20	
Prevent	Manufacturing Line Optimization	$4	61		7	
Prevent	Cold Chain Management	$4	62		6	
Recover	Donation Tax Incentives	$7,179	874	638	110	
Recover	Standardized Donation Regulation	$48	714	322	93	
Recover	Donation Matching Software	$10	555	250	72	
Recover	Donation Transportation	$729	407	183	53	1,604
Recover	Donation Storage & Handling	$580	381	172	50	2,145
Recover	Value-Added Processing	$108	299	171	38	153
Recover	Donation Liability Education	$48	210	95	27	
Recycle	Centralized Composting	$981	2,605			9,000
Recycle	Centralized AD	$957	1,179			1,933
Recycle	Water Resource Recovery Facility (WRRF) with AD	$823	728			100
Recycle	Commercial Greywater	$88	0			
Recycle	Community Composting	$72	163			230
Recycle	Home Composting	$4	53			
Recycle	Animal Feed	$7	34			
Recycle	In-Vessel Composting	$8	11			
TOTALS		**17,830**	**17,885**	**1,829**	**1,632**	**15,165**

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