A ROADMAP TO REDUCE U.S. FOOD WASTE BY 20 PERCENT

Executive Summary

2016

ReFED | Rethink Food Waste *Through Economics and Data*

FOREWORD

The Journey Starts Now

By 2050, it is estimated that the Earth's population will top 9 billion. This growing population will undeniably stress our food systems, natural resources, and ecosystems. But consider this: Currently, we waste up to 40% of our food globally. In the United States, this equals roughly 400 pounds annually for every American. Meanwhile, one in seven Americans are food insecure.

These stunning facts — partnered with seeing waste occur firsthand through our work with our operating farm and the restaurants and grocery stores it services — really brought this issue home for us. This prompted us as philanthropists and a family concerned about healthy communities and ecological sustainability to ask our team to explore the topic of wasted food.

Through our family foundation, we have been focused on solving large-scale environmental issues with market-based solutions since 2001. We started by looking at how funding solutions to climate change, both through grants and impact investments, can play an important role in transitioning our society to a low-carbon economy.

Over the past 15 years, we've seen how climate change and resource utilization are closely linked, and food is one of the most important resources in that equation. This puts food waste squarely at the center of many global challenges. Reducing food waste would have a game-changing impact on natural resources depletion and degradation, food insecurity, national security, and climate change. As one of the largest economies and agricultural producers in the world, we believe the United States has a major role to play in setting an example and contributing to significant food waste reduction.

Last year, we approached like-minded philanthropists to join us in launching ReFED: "*Rethinking Food Waste through Economics and Data: A Roadmap to Reduce Food Waste*" to map a path for action and solutions. We knew from the start that a multi-stakeholder approach was needed so we invited leading food businesses, environmental and hunger organizations, investors, policymakers, and innovators to join the effort.

The economic analysis and research we undertook revealed exciting news: *Food waste is a solvable problem*. But four priority actions are needed to reach significant reductions. **First**, we must galvanize hundreds of millions of dollars of new catalytic funding. **Second**, policymakers must make pragmatic changes to tax incentives, safety regulations, and permitting procedures to support healthy market solutions. **Third**, America must unleash its spirit of innovation to develop new technology and business-model innovations. **Finally**, a sweeping education and awareness campaign is needed to change behavior both among consumers and employees of food businesses.

This *Roadmap* report is a guide and a call to action for us to work together to solve this problem. Businesses can save money for themselves and their customers. Policymakers can unleash a new wave of local job creation. Foundations can take a major step in addressing environmental issues and hunger. And innovators across all sectors can launch new products, services, and business models. There will be no losers, only winners, as food finds its way to its highest and best use.

The *Roadmap* is just the beginning. In order to succeed, we need to crowdsource even more information and solutions. ReFED has welcomed input at every stage and encourages input now. After reading the *Roadmap*, we encourage you to visit refed.com, dig deeper into our analysis, and send us your ideas and feedback.

This is a defining moment for us all. Let's start the journey now.

Thank you,

Betsy and Jesse Fink
Trustees
The Fink Family Foundation

We are grateful to everyone who contributed to the creation of ReFED and this *Roadmap*, especially our philanthropic co-funders and Advisory Council members. We would also like to strongly acknowledge the pioneers in food waste reduction who have dedicated time and great passion to this issue. Many have worked for years at the grassroots, national, and international levels to pave the way for this effort. And we'd like to thank you, the reader, for engaging in this issue. Together, with the steps laid out in this report, we can cut food waste by 20% with actions that are feasible today, which will set us on the path to meet the U.S. government's target of a 50% reduction in food waste by 2030.

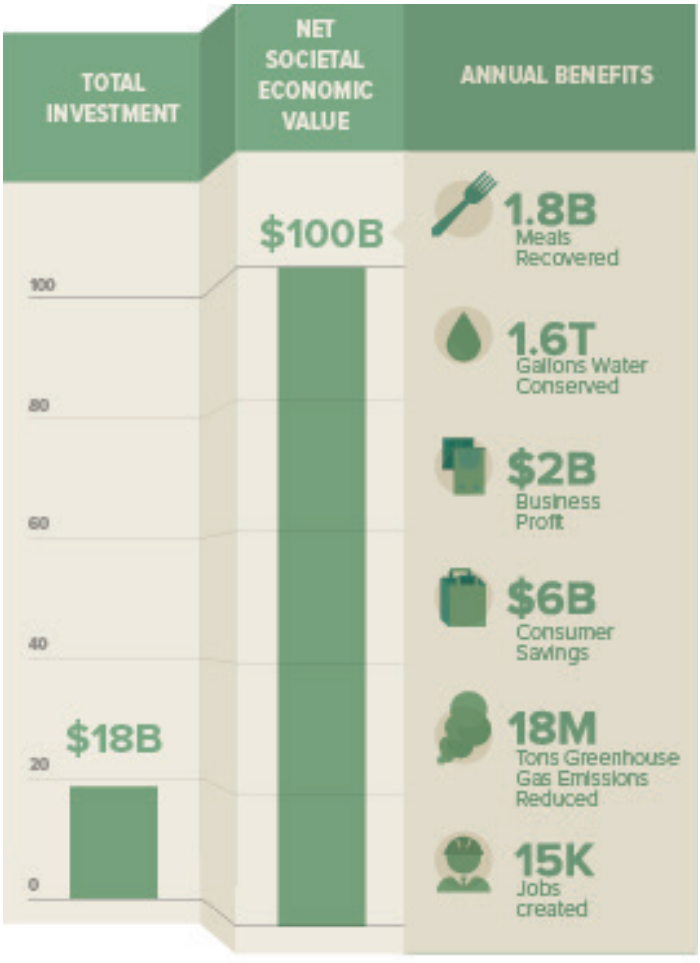
ABOUT THE ROADMAP

The magnitude of the food waste problem is difficult to comprehend. The U.S. spends $218 billion a year — 1.3% of GDP — growing, processing, transporting, and disposing of food that is never eaten. The causes of food waste are diverse, ranging from crops that never get harvested, to food left on overfilled plates, to near-expired milk and stale bread.

ReFED is a coalition of over 30 business, nonprofit, foundation, and government leaders committed to building a different future, where food waste prevention, recovery, and recycling are recognized as an untapped opportunity to create jobs, alleviate hunger, and protect the environment — all while stimulating a new multi-billion dollar market opportunity. ReFED developed *A Roadmap to Reduce U.S. Food Waste* as a data-driven guide to collectively take action to reduce food waste at scale nationwide.

KEY BENEFITS

The *Roadmap* outlines an actionable path to cutting U.S. food waste by over 20% — 13 million tons annually – while generating $100 billion of economic value over the next decade and creating 15,000 new jobs. The *Roadmap* is projected to generate the following benefits:



*Jobs and environmental benefits not included in $100B calculation.
Jobs created is a total number, not annual new jobs.
Investment and Economic Value were calculated over a decade.

CALL TO ACTION

These benefits are achievable, feasible, and realistic today, but they will not be achieved without a concerted effort. Stakeholders must commit to four levers of action: new *financing* to scale proven solutions, commonsense *policy* change, adoption of emerging *innovations*, and consumer and employee *education*.

Overall the *Roadmap* will require nearly $18 billion of new investment over a decade, amounting to less than a tenth of a penny for every pound of food waste diverted from landfill. To unlock this financing, $100 to $200 million of catalytic financing is needed annually to overcome bottlenecks through flexible grants, impact investments, and low-cost project finance.

The *Roadmap* shows how we can take steps today to cut food waste by 20%, putting the U.S. on a path to achieve the broader national target of a 50% reduction by 2030.

KEY STAKEHOLDER ACTIONS

Reaching the goals outlined in the *Roadmap* will require a collaborative effort from organizations throughout the food value chain.

FARMERS: Seek to reduce the 10 million tons of unharvested food lost each year by developing secondary markets for **Imperfect Produce** and further leveraging **Value-Added Processing**.

MANUFACTURERS: Reduce inefficiencies in manufacturing processes while collaborating with retailers on **Packaging Adjustments** and **Standardized Date Labeling**.

RESTAURANTS & FOODSERVICE: Save up to $1.6 billion in food purchasing costs by further adopting **Waste Tracking & Analytics** across all facilities, incorporating **Imperfect Produce** into menus, and integrating **Smaller Plates** and **Trayless Dining** in all-you-can-eat facilities.

GROCERY RETAILERS: Market discounted **Imperfect Produce**, continue to adopt **Improved Inventory Management** systems and **Spoilage Prevention Packaging**, and collaborate to **Standardize Date Labeling** to benefit consumers.

FEDERAL GOVERNMENT: Create jobs and alleviate hunger by retaining and expanding food **Donation Tax Incentives**, and consider national **Standardized Date Labeling** legislation.

STATE AND LOCAL GOVERNMENT: Continue to support landfill or commercial food waste bans, reduce permitting barriers for **Centralized Compost** and **Anaerobic Digestion (AD)**, and implement consistent rules for **Standardized Donation Regulation** across states.

FOUNDATIONS & NONPROFITS: Support major **Consumer Education Campaigns**, build multi-stakeholder efforts for **Standardized Date Labeling** and employee education on best practices, and fund food donation and recycling infrastructure.

INVESTORS: Provide dedicated funds that offer flexible project finance for **Centralized Compost** and **AD** facilities, as well as early stage and growth equity to scale emerging innovations.

FOOD WASTE OVERVIEW

Food waste occurs throughout the supply chain. Upstream, waste begins at farms and food manufacturing businesses, where it is typically left in fields to be tilled over or converted into animal feed.

Yet over 80% of waste occurs downstream within consumer-facing businesses — grocery stores, restaurants, and institutional foodservice — and homes, where current recovery and recycling rates are estimated to be only 10%.

Of the $218 billion spent each year on food that is never eaten, roughly two-thirds is spent by consumers. This is due to high volumes of uneaten food, the high cost to purchase food at retail, and the high value of meat — a popular family purchase item. Almost four-fifths of food waste stems from perishables, primarily fruits and vegetables, because they are inexpensive and quickly go bad.

KEY DEFINITION

FOOD WASTE Any food that is grown and produced for human consumption but ultimately is not eaten

ECONOMIC ANALYSIS

The *Roadmap* analysis included a four-step process: Baseline Definition, Solutions Evaluation, Data Analysis, and Data Validation.

BASELINE DEFINITION:

Prior estimates of food waste in the U.S. have ranged from 35 million tons (EPA) to 103 million tons (FAO) per year, depending on scope and methodology. ReFED collected one of the broadest sets of data to date to establish a map of where food is wasted.

ReFED determined that the baseline amount of U.S. food waste today is approximately 62.5 million tons annually: 52.4 million tons disposed annually in landfills and incinerators and 10.1 million tons of on-farm waste from unharvested crops and packhouses.

SOLUTIONS EVALUATION:

A wide list of food waste solutions was gathered from stakeholders and narrowed to 27 priority solutions that met criteria around data availability, cost-effectiveness, feasibility, and scalability. ReFED's analysis follows the EPA Food Recovery Hierarchy, which prioritizes prevention, recovery, and then recycling solutions to maximize benefits.

- Prevention keeps waste from occurring in the first place.
- Recovery uses donations from food businesses to feed the hungry.
- Recycling transforms food scraps into value-added products instead of landfilling.

FOOD WASTE SOLUTIONS

Type	Category	Priority Food Waste Solutions
Prevention	1. Packaging, Product, and Portions	• Standardized Date Labeling • Produce Specifications (Imperfect Produce) • Packaging Adjustments • Spoilage Prevention Packaging • Smaller Plates • Trayless Dining
	2. Operational and Supply Chain Efficiency	• Waste Tracking & Analytics • Improved Inventory Management • Cold Chain Management • Manufacturing Line Optimization • Secondary Resellers
	3. Consumer Education	• Consumer Education Campaigns
Recovery	4. Donation Policy	• Donation Tax Incentives • Standardized Donation Regulation • Donation Liability Education
	5. Donation Infrastructure	• Donation Matching Software • Donation Storage & Handling • Donation Transportation • Value-Added Processing
Recycling	6. Agricultural Products	• Centralized Composting • Home Composting • Community Composting • Animal Feed
	7. On-site Business Processing	• In-Vessel Composting • Commercial Greywater
	8. Energy & Digestate	• Centralized Anaerobic Digestion (AD) • WRRF with AD

DATA ANALYSIS

The *Roadmap* includes three analyses of the 27 solutions: Marginal Food Waste Abatement Cost Curve, Business Profit Potential, and Non-Financial Impacts.

MARGINAL FOOD WASTE ABATEMENT COST CURVE ("COST CURVE")

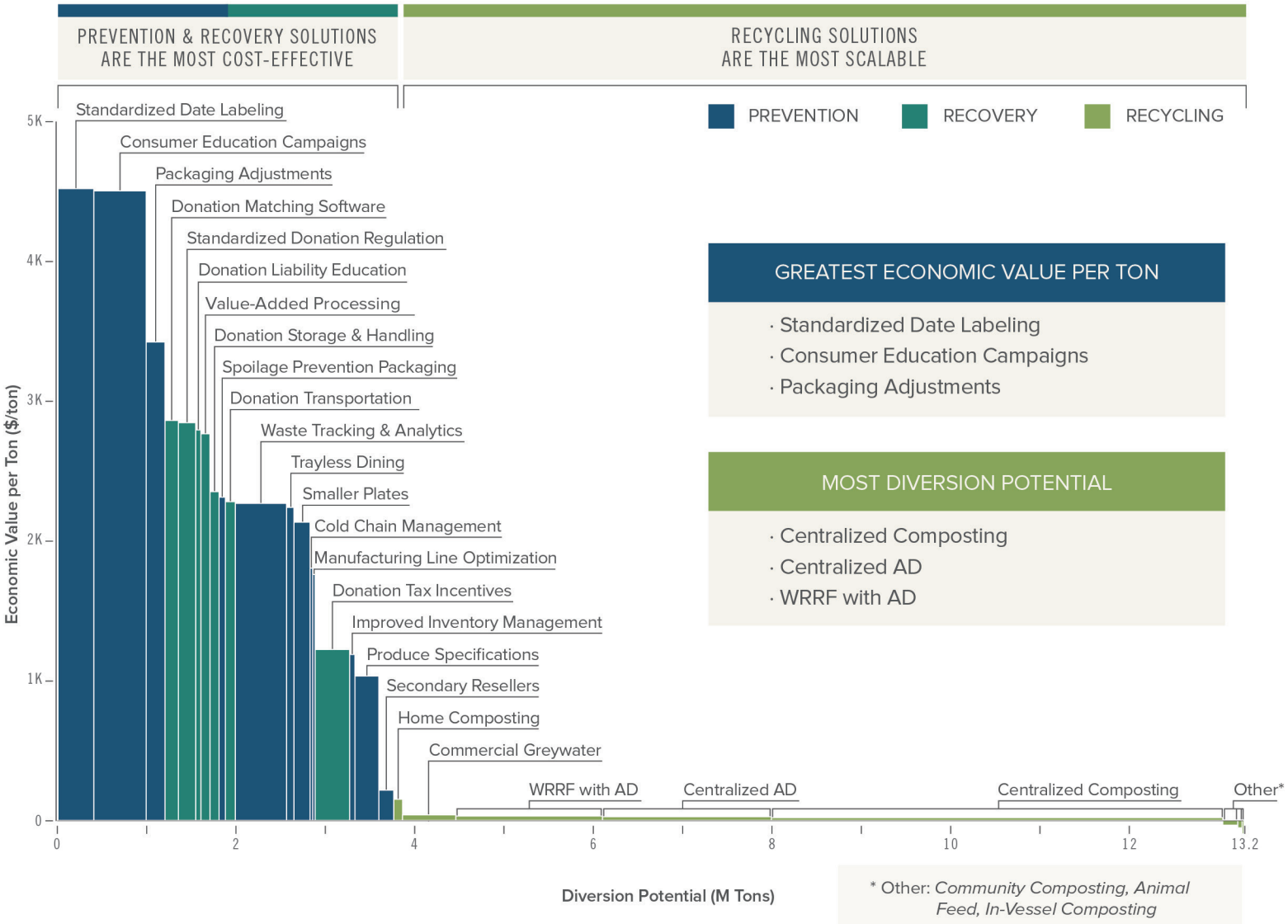
The Cost Curve illustrates an at-a-glance comparison of solutions based on the cost-effectiveness per ton of waste reduced and the scalability of the diversion potential. Cost-effectiveness is based on Economic Value — the annual aggregate financial benefit to society minus all investment and costs.

Implementing the 27 solutions would deliver $10 billion of annual Economic Value to society. Prevention and recovery are generally magnitudes more cost-effective than recycling, while recycling offers significantly larger diversion potential.

Why is this?

- Prevention and recovery typically require low upfront investment for software upgrades or packaging tweaks, while recycling requires higher upfront investment for large processing and logistics infrastructure.
- Prevention and recovery capture the high value of edible food, while recycling captures inedible food scraps, which are 10 to 50 times less valuable.
- Centralized recycling projects achieve scale through large municipal programs that coordinate policy, collection infrastructure, and processing facilities.
- Prevention and recovery solutions are harder to scale because they require more customization and collaboration for each type of food business facility.

MARGINAL FOOD WASTE ABATEMENT COST CURVE



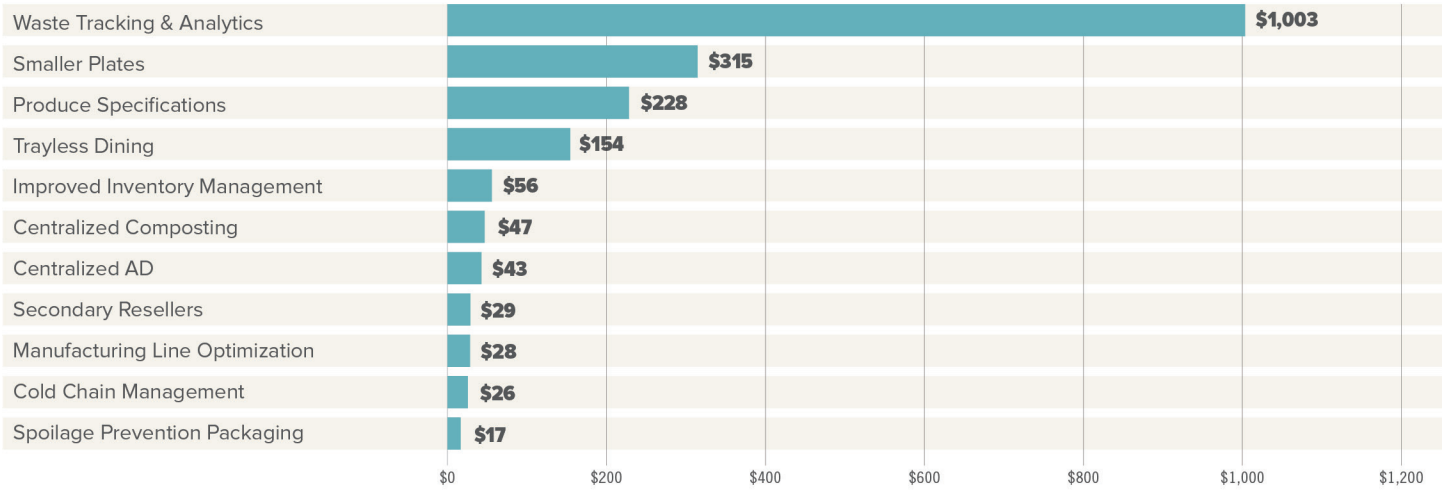
BUSINESS PROFIT POTENTIAL

The Roadmap estimates that $1.9 billion of annual Business Profit Potential will come from the revenue and cost savings of implementing 11 of the analyzed solutions.

Restaurants and foodservice facilities can achieve the largest profit opportunity, $1.6 billion annually. The majority of this profit comes from improved **Waste Tracking & Analytics**, reflecting the operational inefficiencies in food purchasing and kitchen prep. Retailers and recycling developers can capture additional profit by finding new markets for **Imperfect Produce**, integrating **Spoilage Prevention Packaging** into more products, and building out dozens of new **Centralized Composting** and **AD** facilities.

RESTAURANTS AND FOODSERVICE FACILITIES HAVE THE LARGEST PROFIT OPPORTUNITY— $1.6 BILLION ANNUALLY.

ANNUAL BUSINESS PROFIT POTENTIAL ($M)



NON-FINANCIAL IMPACTS

The *Roadmap* focused on four of the many additional benefits of food waste reduction: meals recovered, jobs created, greenhouse gas reductions, and water conservation.

MEALS: ***1.8 billion meals*** can be recovered annually, doubling current donation levels of food at risk of being wasted, primarily through improved tax donation incentives and standardized safe handling regulation for donated food.

JOBS: ***15,000 jobs*** can be created primarily through processing and applying compost. Other job creation drivers include AD facilities as well as food donation transportation, storage, and handling.

GHGS: Nearly ***18 million tons of GHG emissions*** may be reduced annually by avoiding agricultural and livestock impacts and reducing methane emissions from scraps disposed in landfills. Solutions that prevent emissions associated with meat production have the largest impact per ton.

WATER: ***1.6 trillion gallons of water*** annually may be able to be conserved — 1.5% of annual U.S. freshwater withdrawals — primarily through the prevention of large amounts of water needed for agriculture.

The *Roadmap* would also increase the amount of compost available to enrich our soils, with potential benefits ranging from enhanced water retention to carbon sequestration.

DATA VALIDATION

Over 80 experts were interviewed, and all assumptions and methodology were refined by a multi-stakeholder Advisory Council of industry leaders. Future research that integrates system interdependencies can enhance and refine this economic analysis going forward.

KEY DEFINITION

BUSINESS PROFIT POTENTIAL is defined as 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 nonbusiness stakeholders.

PREVENTION

Just as it is more cost-effective to prevent a disease than to treat it later, prevention is the most cost-effective strategy to reducing food waste. Prevention solutions have the highest cost-effectiveness and net environmental benefit and hold the potential to divert 2.6 million tons of annual waste.

Common barriers to prevention include misalignment of costs and benefits between stakeholders, lack of consumer demand for waste-saving activities, information gaps, and organizational silos within large food businesses.

KEY FINDINGS

- Prevention generally requires low levels of investment for behavior drivers such as packaging changes, software, and marketing.
- At retail, food is worth roughly $2.50 per pound, magnitudes higher than the value of food as crops on farms or scraps for disposal.
- Prevention, by avoiding unnecessary fertilizer and fuel use on farms, has twice the lifecycle greenhouse gas benefit per ton of food waste diverted compared to recycling.

The three most scalable prevention solutions are:

- **Standardized Date Labeling**, which will help reduce the estimated 20% of consumer food waste caused by confusing "sell by," "best by," and "use by" labels that do little to indicate actual food safety risks.
- **Consumer Education Campaigns**, which will raise awareness and educate consumers about ways to save money and prevent waste.
- **Waste Tracking & Analytics** within more restaurants and commercial kitchens, which can track data on wasteful practices to inform behavioral and operational changes.

RECOVERY

Most people have seen perfectly good food thrown away at a restaurant or dinner party and wished there was a way to get it to people in need. Food recovery captures food donations from businesses and transports it to organizations that feed the hungry, such as food banks and soup kitchens. The *Roadmap* demonstrates that food recovery can double nationwide, increasing by roughly 1.8 billion meals (1.1 million tons).

Common barriers to food recovery include liability concerns among food businesses, fragmented food safety regulations, a lack of transportation and storage infrastructure capacity, and the extra financial burden associated with food donations. Food recovery networks differ widely by region and geography. Rural communities often face higher transportation costs to reach people in need, while urban communities may lack food sourcing and procurement channels from farms and food manufacturers. California is more likely to have surpluses of fruits and vegetables, while Iowa and Texas are likely to have more grains and meat available.

KEY FINDINGS

- The food recovery ecosystem requires three pillars to scale: 1) enabling policy that financially incentivizes donations from businesses while providing standardized food safety regulations, 2) education for businesses on donor liability protections and safe food handling practices, and 3) logistics and infrastructure to transport, process, and distribute excess food.
- Over half of the recovery opportunity requires tweaks to legislation regarding tax incentives for business donations and safety regulations for donated food handling.
- Nearly half of new recovery potential comes from produce surpluses on farms and at packinghouses, a sector with lower levels of donations today than food retailers.

The three most scalable recovery solutions are:

- **Donation Tax Incentives** that are sustained and expanded to cover all types of food businesses
- **Standardized Donation Regulation** that standardizes enforcement among local and state health departments to provide a common set of rules for large businesses.
- **Donation Matching Software** that connects individual food donors with recipient organizations to reach smaller-scale and perishable food donations.

RECYCLING

Recycling offers the most scalable path to reducing food waste nationally, enabling 9.5 million tons of annual waste diversion — nearly three-quarters of the total *Roadmap* potential. Recycling food waste through distributed or centralized processing diverts food scraps from landfills and transforms it into beneficial soil amendments, clean biogas, or animal feed.

Municipalities have increased interest in food waste recycling due to shrinking landfill capacity, improving economics, and greater awareness of positive environmental impacts. Many programs are driven by state and local policies, including landfill bans, renewable energy incentives, and direct economic incentives. Food waste is typically combined with other organics recycling programs such as lawn clippings and manure.

A municipal recycling program depends on three elements to remain healthy: homes and businesses that consistently put food scraps into separate bins, haulers that have enough economic incentive to pick up separate loads of food scraps and deliver them to recycling facilities, and processing facilities that remain profitable through sufficient access to feedstock material, financing, and end markets.

KEY FINDINGS

- The Northeast, Northwest, and Midwest generally show the most potential for Economic Value from recycling due to high disposal fees and high compost and energy market prices.
- Including the non-financial job and environmental benefits of large compost and AD projects into municipal cost-benefit analyses will help more projects to be built.
- The top three levers to scale recycling are an increase in landfill disposal costs, efficiencies in hauling and collection through closer siting to urban centers, and denser routes.
- Other key bottlenecks to overcome are high upfront project costs (particularly for AD facilities), low pricing for biogas and compost, assurance of material supply, packaging that contaminates the waste supply, and permitting and siting of processing facilities.

The three most scalable recycling solutions are:

- **Centralized Composting**, which can divert the most waste of any solution but will require an increase in compost demand for agricultural and environmental remediation to match the boost in supply.
- **Centralized Anaerobic Digestion (AD)** that harnesses the energy in food scraps for electricity or transportation and provides a digestate that can enhance soils.
- **Water Resource Recovery Facilities (WRRF) with AD** that utilize existing wastewater infrastructure to accept additional waste delivered by truck or through existing sink disposal pipes.

THE PATH AHEAD

The *Roadmap* demonstrates that achieving a 20% reduction in food waste will generate a positive financial, social, and environmental return on investment. But it will not happen without a concerted effort to galvanize action across four areas: **financing**, **policy**, **innovation**, and **education**. This section outlines the resources needed to enable a 20% reduction, as well as the biggest opportunities to reach a broader 50% goal.

FINANCING

The *Roadmap* will require $18 billion of investment to implement within a decade, or roughly $2 billion per year, which costs less than a tenth of a penny per pound of food waste reduced. This one-time investment is projected to yield roughly $100 billion in societal economic value over the same period. Key financial benefits include a reduction in consumer food bills, increased business profit, and a reduced tax burden for municipalities from lower landfill disposal fees.

Most of this funding will flow naturally from market forces or the extension of existing government programs. The $18 billion can be broken out into private, philanthropic, and government sources.

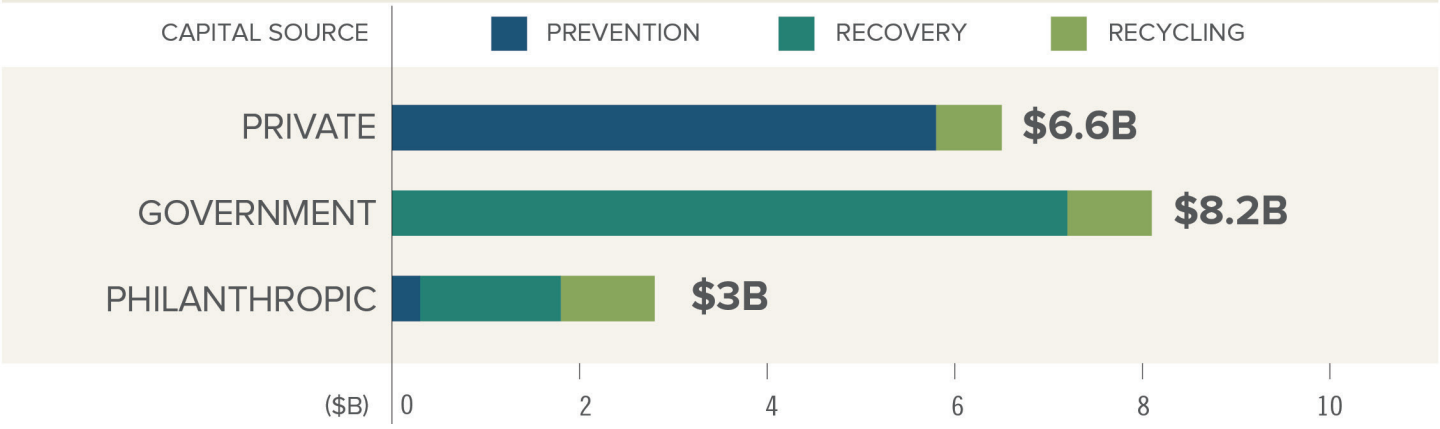
Private investment of $6.6 billion is expected to flow to opportunities that offer a compelling risk-adjusted return. The largest portion is expected from internal corporate capital expenditures on solutions such as **Secondary Resellers**, **Packaging Adjustments**, or **Smaller Plates** in dining facilities. Additional private capital is needed for private venture and growth equity to fund and scale businesses that provide emerging solutions. Private project equity and debt will be needed mainly for large recycling facilities.

Government support of $8.2 billion is expected mainly via existing legislation. Most of this funding consists of tax incentives over the next decades to incentivize food businesses to increase their rate of food donations. In addition, nearly a billion dollars of public project finance is needed to stimulate projects that have a strong social benefit, such as **WRRF with AD** and **Community Composting**.

Finally, philanthropic funding of roughly $3 billion is needed to fund solutions that create public benefits or have costs and benefits that accrue to different organizations. Of this funding, nearly a billion dollars of impact investments, a major source of catalytic financing, is needed in the form of low-interest loans and high-risk equity investments. Catalytic financing will serve a critical role to overcoming system-level bottlenecks, de-risking new innovations or novel projects, overcoming agency problems, and stimulating projects with marginal economics.

Big Financing Opportunity — Form new impact investment funds to galvanize investment in food waste reduction solutions while better incorporating social and environmental benefits into government budgeting.

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



POLICY

The *Roadmap* was framed to focus on solutions that can scale under existing policy or with only minor adjustments. The near-term priority should focus on three policies:

- Donation Tax Incentives — Maintain and build upon the recent expansion of permanent federal food donation tax incentives for all farms and food businesses.
- Food Donation Regulation — Create a common standard of safe handling practice regulations among state and local health departments.
- Recycling Best Practices — Spread best practices to encourage recycling, such as streamlined permitting of processing facilities, improved enforcement of waste bans, and expanded incentives to encourage diversion of food waste from landfills.

Ten *Roadmap* solutions could be further enhanced through standardized policies at the federal level.

Big Policy Opportunity – Pass comprehensive federal food waste legislation that ties together nearly a dozen individual policies and signals a market shift to food businesses.

INNOVATION

At a high level, there are five priority categories of technology 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
- Distributed recycling solutions

In addition to technology innovations, business-model innovations are needed to develop new ways to share risk across the supply chain in novel ways.

Incremental innovation will lower the cost and improve the performance of many *Roadmap* solutions. Advancements in materials will drive innovation around packaging, while new mobile apps will improve the effectiveness of **Consumer Education Campaigns** and **Donation Matching Software**. Numerous plant-level innovations around **Centralized Composting** and **AD** will drive down processing costs and improve the quality of outputs.

Over a third of *Roadmap* solutions have the potential for disruptive innovations that can further expand their potential beyond the projections in this report. The food technology innovation sector is growing rapidly, with new food incubators and investment funds emerging each month. By focusing this entrepreneurial energy to solve the biggest barriers inhibiting food waste reductions, top priority innovations can be accelerated into the market.

Big Innovation 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.

EDUCATION

The large number of *Roadmap* barriers that are behavioral in nature highlights the need for education, training, and capacity-building to enable change at scale. Behavior change is needed for two core groups: consumers and employees.

Consumer Education Campaigns is one of the most cost-effective and scalable *Roadmap* solutions because it directly influences food purchasing and eating behaviors. Consumer education is also critical to spurring consumer demand for smarter offerings at grocery retailers and restaurants, including **Standardized Date Labeling**, **Spoilage Prevention Packaging**, **Imperfect Produce**, and **Trayless Dining**.

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 UK in recent years. This campaign must be expanded, measured, and improved over time.

For food businesses, half of ReFED's solutions require hands-on employee involvement in day-to-day execution, which is challenging given high turnover rates in the sector. Training is needed to avoid the removal of product from shelves when it is still safe and edible, identify food that can be donated, and properly source-separate scraps to remove contaminants for recycling. The quickest path to widespread employee training would be to link a new 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.

Big Education Opportunity – Expand emerging efforts to achieve a national social-based marketing campaign that achieves widespread consumer awareness and behavior change in coordination with a national food waste employee certification effort.

HOW TO TAKE ACTION

With this report, ReFED calls upon American businesses, nonprofits, government leaders, and investors to rise to the challenge and lead the way in transforming the management of food waste from a burden to a critical resource in solving society's biggest challenges.

Ready to join the coalition?

Visit ReFED.com to download the full report and find more information about top priority opportunities to take action today.