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**Centre for  
Food Policy**

Shaping an effective food system

# Reducing Food Waste: the actions that work, and the limits to what we can do.

Reducing Food Waste:

Improving Business Practices, Reforming Supply Chains & Supporting Consumers

Thursday, January 11th, 2024 (09:30-13:00 GMT).

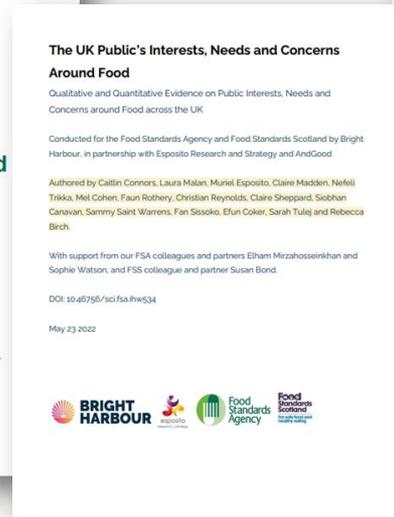
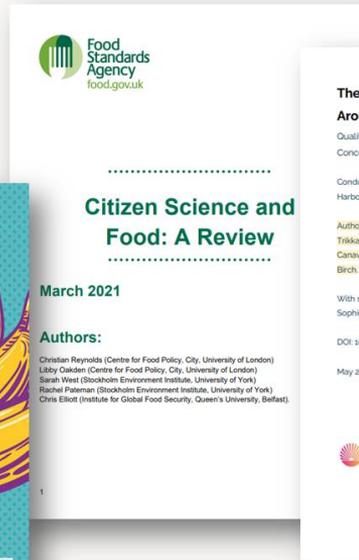
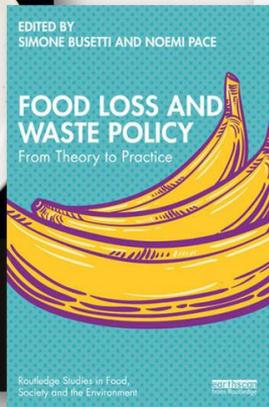
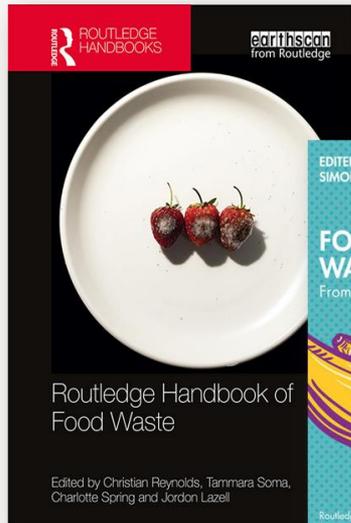
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Public Policy  
exchange

# Who am I?

## Reader at the Centre for Food Policy.

- Focus on sustainable food systems and food waste.
- Supporting the FSA/Defra through research projects. Scottish food systems research (ZWScotland). Household Simulation modelling (WRAP). Local food strategy development.
- Nutrition Society Food Systems theme lead. IFST Sustainability working group.
- Recent publications





Today is a work in progress and part of wider research on FLW policy solutions.

- All input warmly received.  
(Feedback, questions, your thoughts.)
- Who should I be talking to?

Dr Christian Reynolds  
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# In 2019 I presented this... and published this...



**N8 AgriFood**

What can local authorities do to reduce food waste?  
*What can we learn from ten years of food waste interventions.*

Public Policy Exchange, London, 13 February 2019

Dr Christian Reynolds  
Knowledge Exchange Research Fellow (N8 AgriFood project)  
Department of Geography, University of Sheffield  
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**N8**



HEALTHY EDUCATION FOR THE FUTURE



**SheFF**  
The University of Sheffield  
Sustainable Food Futures



Food Policy  
Volume 83, February 2019, Pages 7-27



Review

## Review: Consumption-stage food waste reduction interventions – What works and how to design better interventions

[Christian Reynolds](#)<sup>a, b</sup>, [Liam Goucher](#)<sup>c</sup>, [Tom Quested](#)<sup>b</sup>, [Sarah Bromley](#)<sup>b</sup>, [Sam Gillick](#)<sup>b</sup>, [Victoria K. Wells](#)<sup>d</sup>, [David Evans](#)<sup>e</sup>, [Lenny Koh](#)<sup>c</sup>, [Annika Carlsson Kanyama](#)<sup>f</sup>, [Cecilia Katzeff](#)<sup>g</sup>, [Åsa Svenfelt](#)<sup>h</sup>, [Peter Jackson](#)<sup>a</sup>

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<https://doi.org/10.1016/j.foodpol.2019.01.009> [Get rights and content](#) ▸

A Local Authority representative in the audience asked  
*"So what can we do to reduce food waste if we follow WRAP guidance already..."*  
For five years, I have been trying to answer!  
**So what do we know in 2024?**

# We know that FLW is a climate issue.

- Responses to FLW need to think about climate change

## 6% of global greenhouse gas emissions come from food losses and waste

Our World  
in Data

Emissions from food that is never eaten accounts for 6% of total emissions



Food production is responsible for 26% of global greenhouse gas emissions

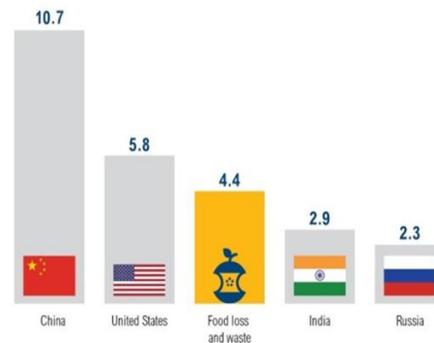
Note: One-quarter of food emissions comes from food that is never eaten: 15% of food emissions from food lost in supply chains; and 9% from consumer waste.

Data source: Joseph Poore & Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*.

[OurWorldinData.org](https://ourworldindata.org) - Research and data to make progress against the world's largest problems.

Licensed under CC-BY by the author Hannah Ritchie.

If Food Loss and Waste Were its own Country,  
it Would Be the Third-Largest Greenhouse Gas Emitter



GT CO<sub>2</sub>e (2011/12)\*

\* Figures reflect all six anthropogenic greenhouse gas emissions, including those from land use, land-use change, and forestry (LULUCF). Country data is for 2012 while the food loss and waste data is for 2011 (the most recent data available). To avoid double counting, the food loss and waste emissions figure should not be added to the country figures.

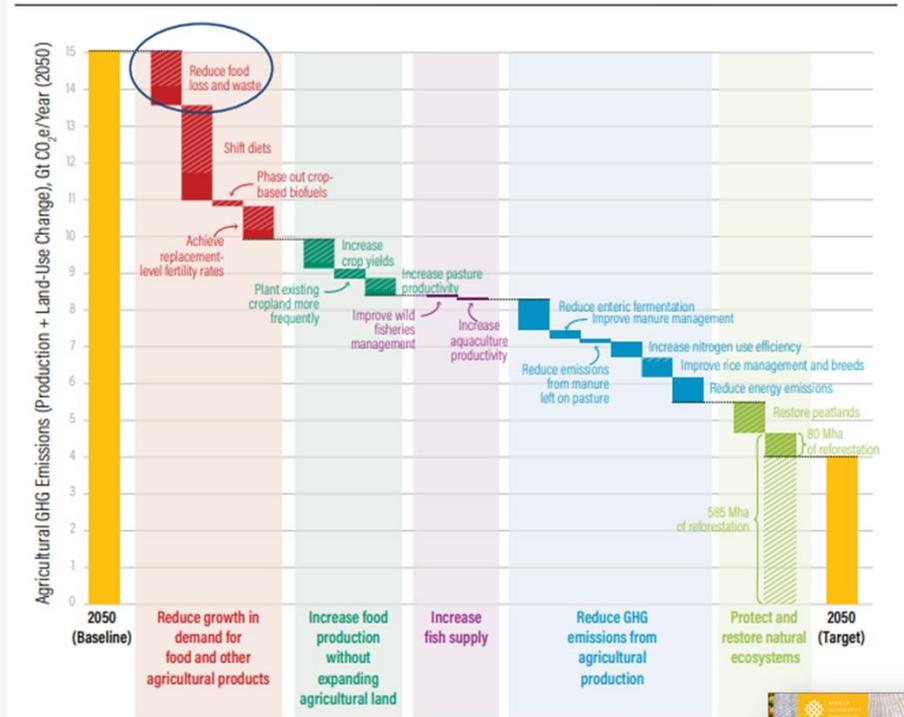
Source: CAIT, 2015; FAO, 2015. Food waste footprint & climate change. Rome: FAO.



# FLW reduction is one of the biggest actions we can take to reduce global GHGE

- The two biggest reductions we can make to agricultural GHGE to achieve a **2° C** warming target (4 Gt/year) or **1.5° C** warming target (0 Gt/year) are through:
  1. Shifting to sustainable diets
  2. Reducing Food Loss and Waste

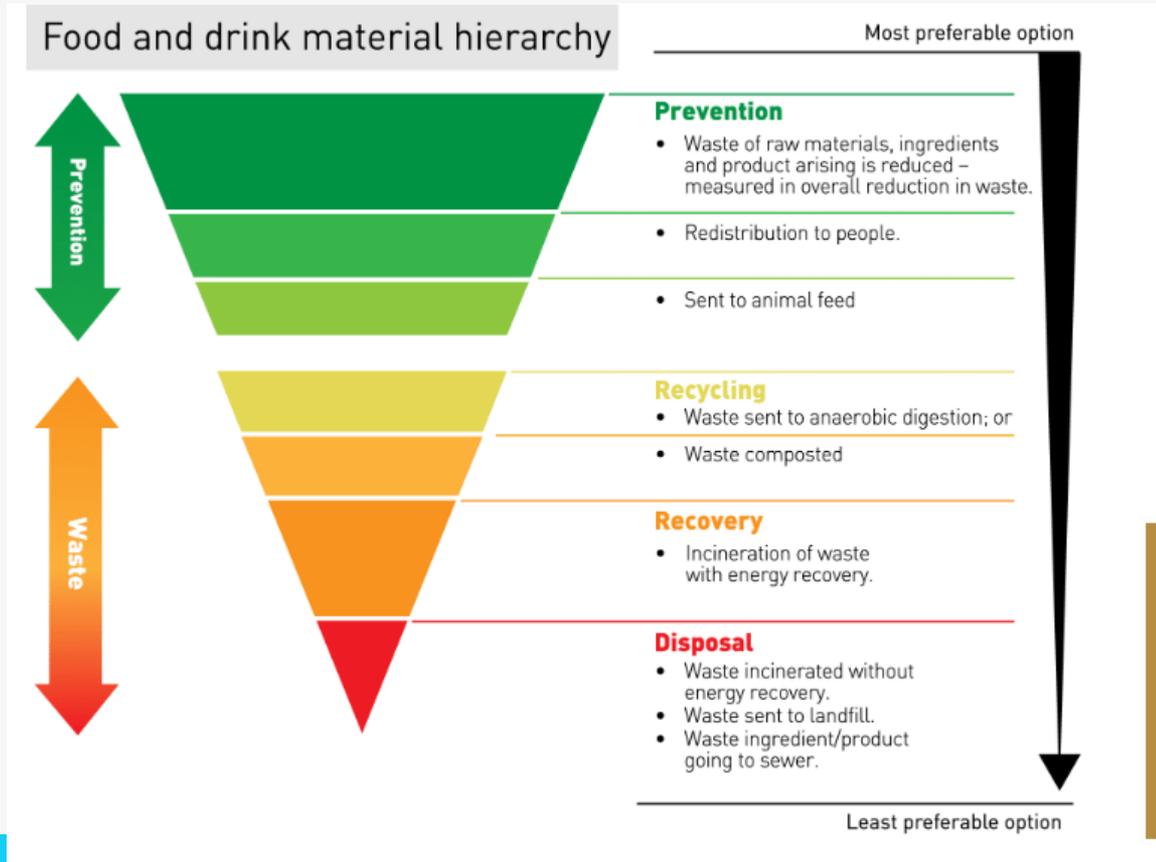
Figure I.2 | Reducing Food Loss and Waste Can Play an Important Role in Eliminating the Projected 15 Gt of Greenhouse Gas Emissions from Agriculture and Land-Use in 2050 (CO<sub>2</sub> equivalent)



# Many reasons / drivers for FLW

Primary Production	Processing and Manufacturing	Distribution and Wholesale	Retail	Food Service/ Institutions	Household
Spillage	Spillage	Cosmetic or physical damage	Product recall	Product recall	Product recall
Cosmetic or physical damage	Trimming during processing	Spoilage	Food prepared improperly	Food prepared improperly	Food prepared improperly
Damage from pests or animals	Rejected from market	Past sell-by date	Food cooked but not eaten	Food cooked but not eaten	Food cooked but not eaten
Not harvested		Rejected from market	Cosmetic damage	Cosmetic damage	Cosmetic Damage
Unable to sell due to quantity or size		Unable to reach market	Spoilage	Spoilage	Spoilage
Unable to reach market			Past sell-by date		Past sell-by or use-by date

# Food loss and waste solutions are within a hierarchy



All interventions and policy solutions prevent, divert (recover or recycle), or reduce food loss and waste.

**We need a combination of solutions** to achieve Sustainable Development Goal 12.3.

TARGET 12-3

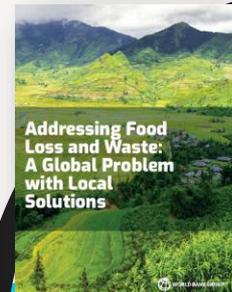
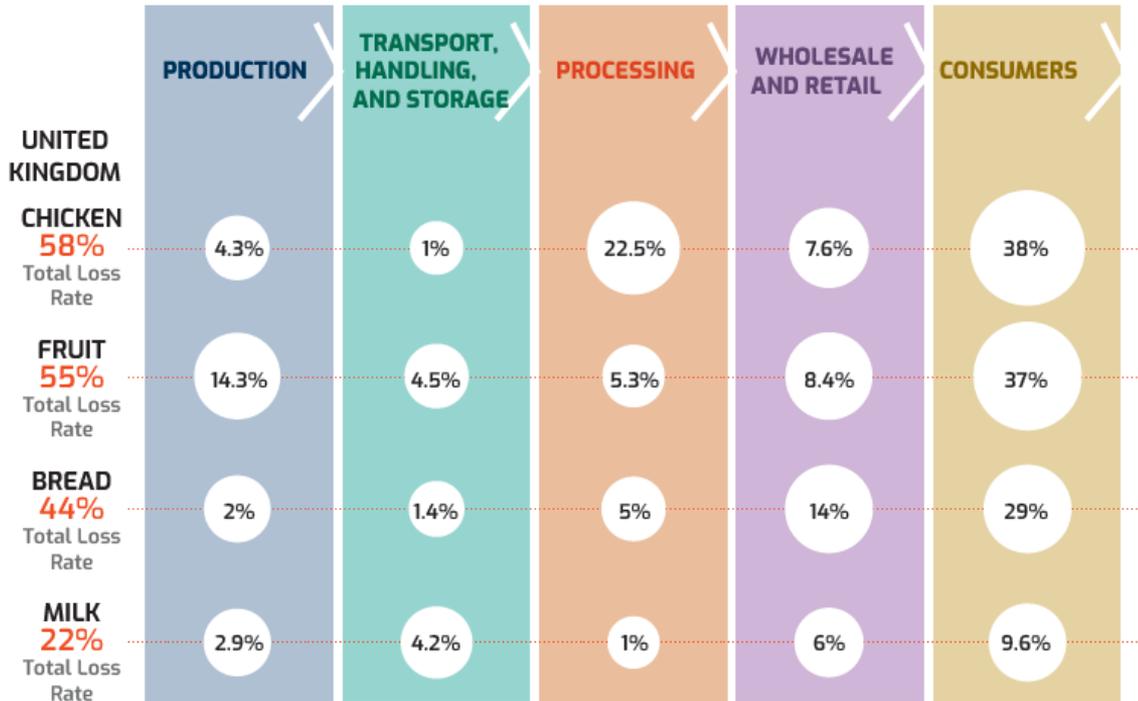
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

50%

HALVE GLOBAL PER CAPITA FOOD WASTE

# Action needed at different points in the supply chain, for diff. products/countries...

FIGURE 14: Rates of loss and waste at each stage of the supply chain – UK, Rwanda, Vietnam



# Many Actors needed to reduce FLW

Figure 4.2 | Key Actors for Reducing Food Loss and Waste (Not Exhaustive)



# 2019 - Review: Consumption-stage food waste reduction interventions

- 17 applied interventions that claim to have achieved food waste reductions.
- 13 quantified food waste reductions.
  - Plate size interventions resulted in up to **57%** food waste reduction.
  - Changing nutritional guidelines in schools reduced vegetable waste by up to **28%**.
  - Information campaigns had up to **28%** food waste reduction.
- Lots of gaps and missing data.

# A growing reviewed evidence base.

- Zhang et al 2023 <https://doi.org/10.1016/j.foodpol.2023.102480>
  - Overall effect of nudges on food waste reduction is a 0.38 SD
  - Effectiveness of nudges can be reinforced when applied in public (vs. private) settings
- Casonato et al 2023 <https://doi.org/10.1016/j.spc.2023.08.002> ,
  - Nudges rated as ++ effective,
  - School education programmes ++ effective
  - Food management skills ++ effective
  - Training + effective
  - Site based posters and awareness campaigns + effective
  - National food waste campaigns +/- effective
- Tian et al 2022 <https://doi.org/10.1088/1748-9326/ac72b6>
  - Behavioural interventions have a moderate effect ( $\beta = 0.22$ ) on food waste reduction,
  - Education programs having the most significant impact
  - Informational feedback having the least.
- Stöckli et al. 2018 <https://doi.org/10.1016/j.resconrec.2018.03.029>
  - Informational interventions: the most commonly used intervention type BUT evidence indicates that this intervention type is relatively ineffective,
  - A lack of evidence of the effectiveness of anti-consumer-food-waste interventions.



# Many types of FLW Action

	Waste reduction potential	Savings per tonne of waste reduced		
		Climate	Water	Costs
<b>Products, processing and food waste solutions</b>				
Animal feed from insects	■	●	●	●
Processed food waste to chicken feed	■	●	●	●
Dairy waste to animal feed	■	●	●	●
Processing technology to improve shelf life	■	◆	■	◆
Standardised date labelling	◆	■	■	■
Better information for longer shelf life	◆	■	■	■
Fibre products from food waste	◆	●	◆	●
New food products from processing waste	●	●	●	●
Nutrient extraction from processing waste	●	●	●	●
Packaging size and design adjustments	●	■	■	■
Relax produce specifications at retail	●	●	●	◆
<b>Efficient business operations and supply chain solutions</b>				
Waste tracking and analytics	■	◆	■	■
Improved cold chain management	■	◆	◆	■
Whole crop purchase contracts	◆	●	●	●
Centralised and 'dark' commercial kitchens	◆	◆	■	■
Manufacturing line optimisation	●	●	●	●

	Waste reduction potential	Savings per tonne of waste reduced		
		Climate	Water	Costs
<b>Education and behaviour change solutions</b>				
Household behaviour change programs	■	■	■	■
Hospitality and food service solutions	◆	■	■	■
Waste audits at hospitality and institutions	◆	■	■	■
<b>Food rescue, recovery and redistribution solutions</b>				
Business-to-consumer platforms	■	◆	■	■
Increase food rescue across supply chain	■	◆	■	◆
Secondary resellers	◆	◆	●	◆
Legislating food rescue at retail	◆	■	●	■
Sustainable catering guidelines and procurement	●	■	■	■
Online platform for surplus products	●	◆	●	◆

■ High impact ◆ Medium impact ● Low impact



**The Path to Half** (Victoria, Au) 25 Actions

**ReFED** (USA) 73 Actions

**Australian food waste strategy** 41 Actions

**Recommendations for Action in Food Waste Prevention** (EU Platform on Food Losses and Food Waste) 47 Actions

# Welsh FW Route map 13 actions

Figure 4: Estimated savings in 2030 by intervention

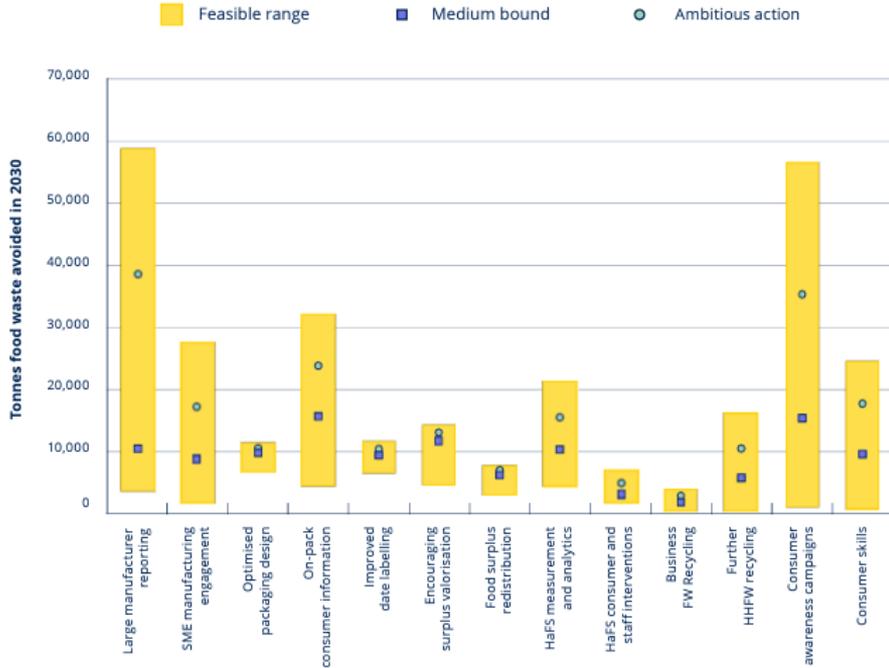
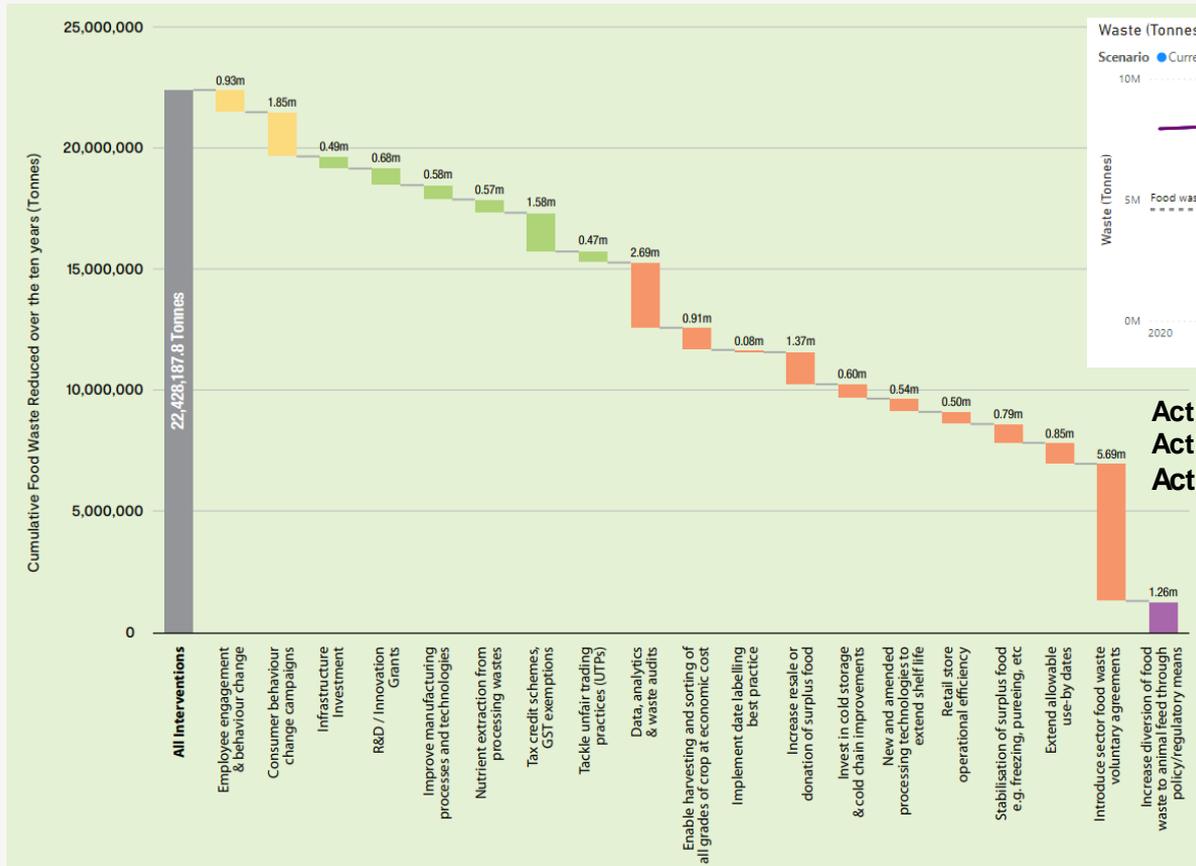


Figure 1: Progress to food waste target

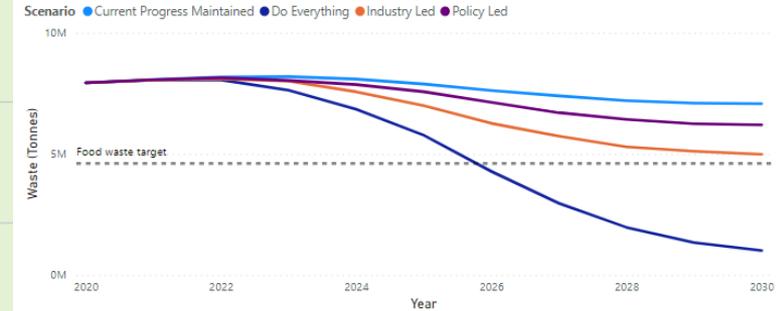


Actions impact on different parts of the food system  
 Actions reduce different amounts of waste  
 Actions happen over different periods of time

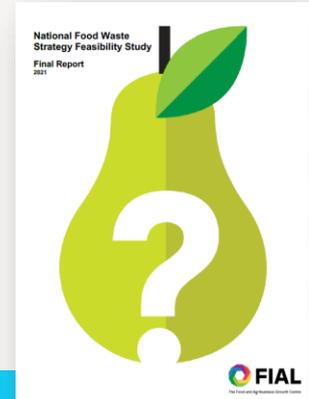
# Australian FLW strategy 41 actions



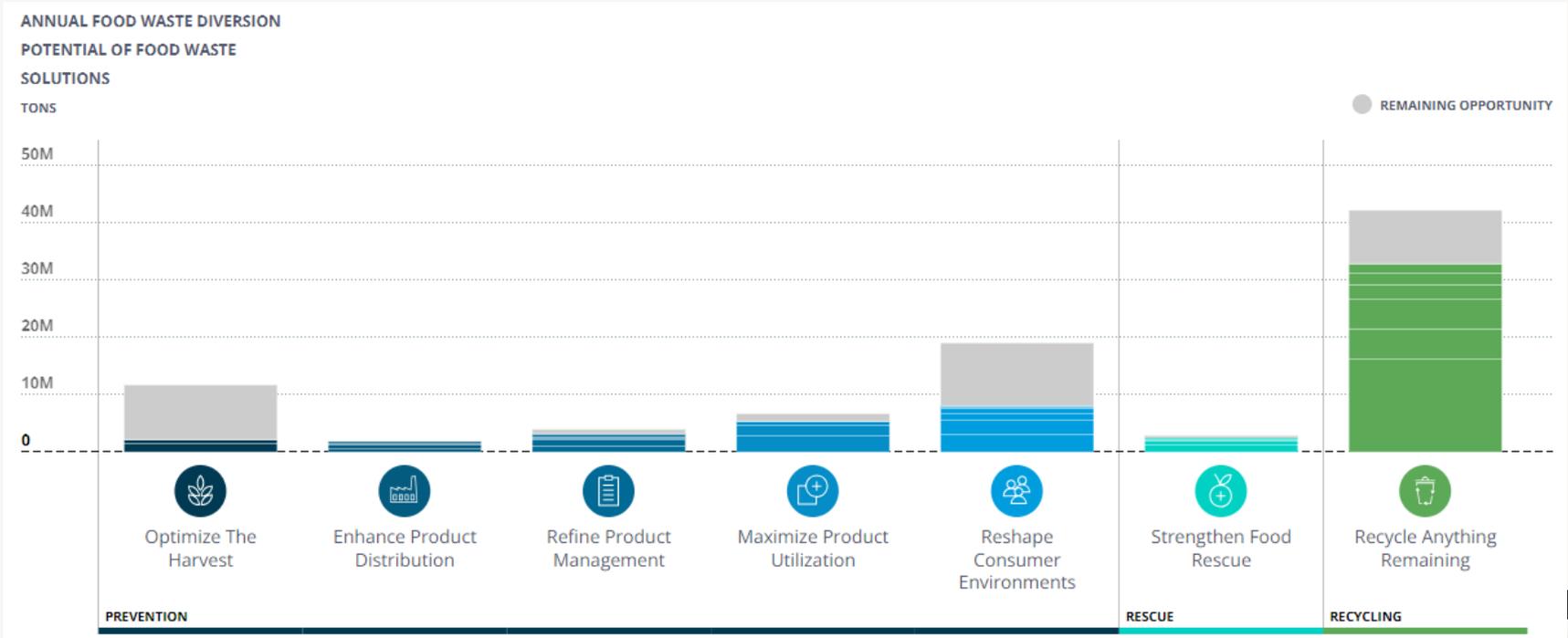
Waste (Tonnes) by Year and Scenario



**Actions impact on different parts of the food system**  
**Actions reduce different amounts of waste**  
**Actions happen over different periods of time**

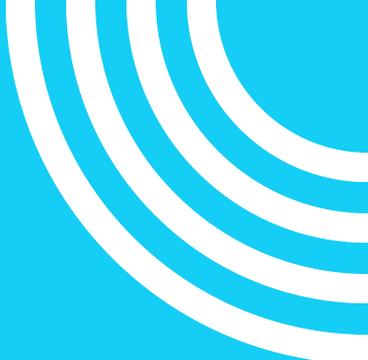


# ReFed Solutions Database USA 73 actions



**Actions impact on different parts of the food system**  
**Actions reduce different amounts of waste**  
**Actions happen over different periods of time**





We have a growing number of  
lists of actions across multiple  
countries...



**But we don't have a review of  
effectiveness of these actions!**

# Objective: Create an evidence base for Actions

- "Imperfect" review of the literature, using 25 Academic articles, NGO reports and policy documents.
- Looking for the suggested actions to reduce and divert FLW
- Recording tonnages and % of diversion
- Mapping these actions to
  - 1) 89 Keywords
  - 2) 11 categories from the Food Systems Transformation Solution-Bank



# 25 sources (8 quantified documents) –109 quantified actions, 713 actions total

Source	Quantified Actions	Total Actions
A meta-analysis on the effectiveness of food-waste reducing nudges (2023)		25
A National Strategy to Reduce Food Waste at the Consumer Level (2020, National Academy of Sciences)		12
<b>Assessment of food waste prevention actions - European Commission (2019)</b>	<b>29</b>	<b>43</b>
Call for Testing Interventions to Prevent Consumer Food Waste (University of Bern)		4
<b>Case studies on household food waste reduction interventions Fight Food Waste Cooperative Research Centre (2023)</b>	<b>4</b>	<b>6</b>
Changing the rules of the game: Impact and feasibility of policy and regulatory measures on the prevention and reduction of food waste (2020)		32
European Citizens' Panel on Food Waste Final recommendations		23
<b>FIAL (2021). Appendix 2: National food loss and waste reduction: Review of international best practice and interventions,</b>	<b>1</b>	<b>40</b>
Food Loss and Waste Sector Guidelines (Greece)		4
<b>Food Loss and Waste Sector Guidelines (Turkey)</b>	<b>1</b>	<b>5</b>
HALVING FOOD LOSS AND WASTE IN THE EU BY 2030:THE MAJOR STEPS NEEDED TO ACCELERATE PROGRESS		6
Mitigating climate change via food consumption and food waste: A systematic map of behavioral interventions (Reisch 2021)		19
New paradigms on how to achieve zero food waste in future cities – Optimizing food use by waste prevention and valorization (2015)		65
No time to waste: assessing the performance of food waste prevention actions (Laurentiis 2020)		1
Recommendations for Action in Food Waste Prevention ( EU Platform on Food Losses and Food Waste)		47
REDUCING CONSUMER FOOD WASTE USING GREEN AND DIGITAL TECHNOLOGIES (UNEP DTU partnership)		53
Reducing food loss and waste (World Resources Institute)		107
Reducing Food Loss and Waste along the Food Value Chain in APEC during and postCOVID-19 Pandemic (March 2022)		16
<b>ReFED: A Roadmap to reduce US Food Waste by 20% (March 2016)</b>	<b>28</b>	<b>28</b>
<b>Review: Consumption-stage food waste reduction interventions – What works and how to design better interventions (Reynolds 2019)</b>	<b>8</b>	<b>17</b>
Setting the scene for an EU initiative on food waste reduction targets (European Commission 2023)		25
Sustainable Materials Management of Food in the APEC Region: A Review of Public Policies That Support Reducing Food Loss and Waste (2022)		82
<b>The Path to half: Solutions to halve Victoria's Food Waste by 2030 (2020)</b>	<b>25</b>	<b>25</b>
<b>Welsh Food Waste Routemap (WRAP 2023)</b>	<b>13</b>	<b>21</b>
What a waste! Evidence of consumer food waste prevention and its effectiveness Cecilia Casonato (2023)		7
<b>Grand Total</b>	<b>109</b>	<b>713</b>

## Different rates of effectiveness for different actions. Different levels of quantified evidence base.

Category (primary)	Average of Average diversion or reduction potential %	Total mentions	Number of quantified studies
Certification and standards	5%	8	3
Direct food provision		43	13*
Economic/financial	7%	36	1
Framework policies	10%	47	3
Governance/organisation	17%	50	5
Information/communication	13%	206	29
Market intervention		11	0
Not sure	7%	17	2
Regulatory	13%	125	28
Technology/innovation	26%	167	25

\* Not all data provided as a % so these could not be included.



# Different rates of effectiveness throughout the supply chain

Average diversion or reduction potential %

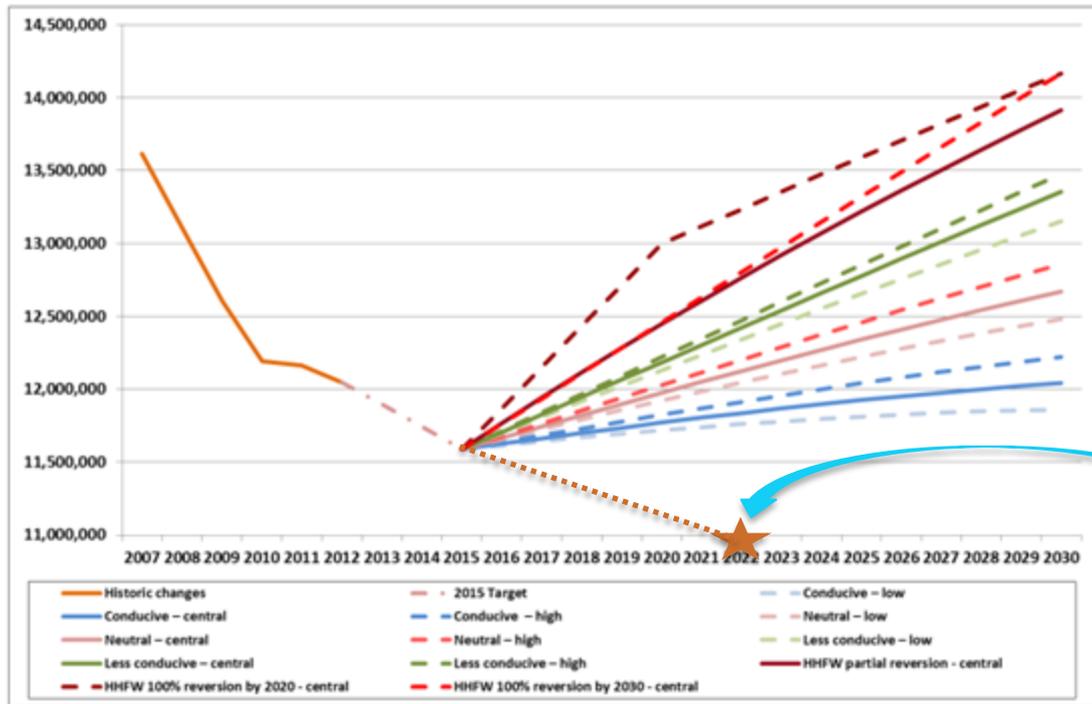
	On farm/Primary Production	Supply chains Wholesale Manufacturing	Grocery/Retail	Out-of-home	Institutional	Informal	Local government	Consumers & Citizens
Certification and standards	5%							
Direct food provision								
Economic financial	7%			7%				
Framework policies	10%	10%	10%	10%	10%			
Governance organisation		25%	25%	17%	17%	25%		
Information communication				5%	10%			14%
Market intervention								
Regulatory	18%	12%	14%	20%	17%	23%	33%	18%
Technology innovation	17%	28%	31%	27%	24%	24%		32%
<b>Average % per supply chain stage</b>	15%	20%	22%	21%	19%	23%	33%	19%

# So what works?

		Average diversion or reduction potential %	Min diversion or reduction potential %	Max diversion or reduction potential %	# of quantified studies
Regulatory	Advisory Guidelines	3%	3%	3%	1
	Food-Related Laws	16%	3%	28%	2
	Food-Related Rules	33%	12%	54%	2
	Industry Voluntary Agreements	20%	20%	20%	1
	Labelling	5%	5%	5%	1
	Self-Regulation	11%	1%	30%	12
Technology & innovation	Distribution of Food Surplus	21%	1%	50%	7
	Financing of Innovation	58%	25%	90%	2
	Research Activities on Food System	33%	25%	50%	3
Information & communication	Consumer Information Campaigns	10%	2%	18%	3
	Digital content	7%	6%	8%	2
	Labelling	5%	5%	5%	1
	Skills, Knowledge Training	16%	15%	16%	2
Governance & organisation	Mapping, Measuring and Monitoring	17%	9%	25%	3
Certification and standards	Standards – Food Safety, Quality, Composition	5%	1%	8%	3

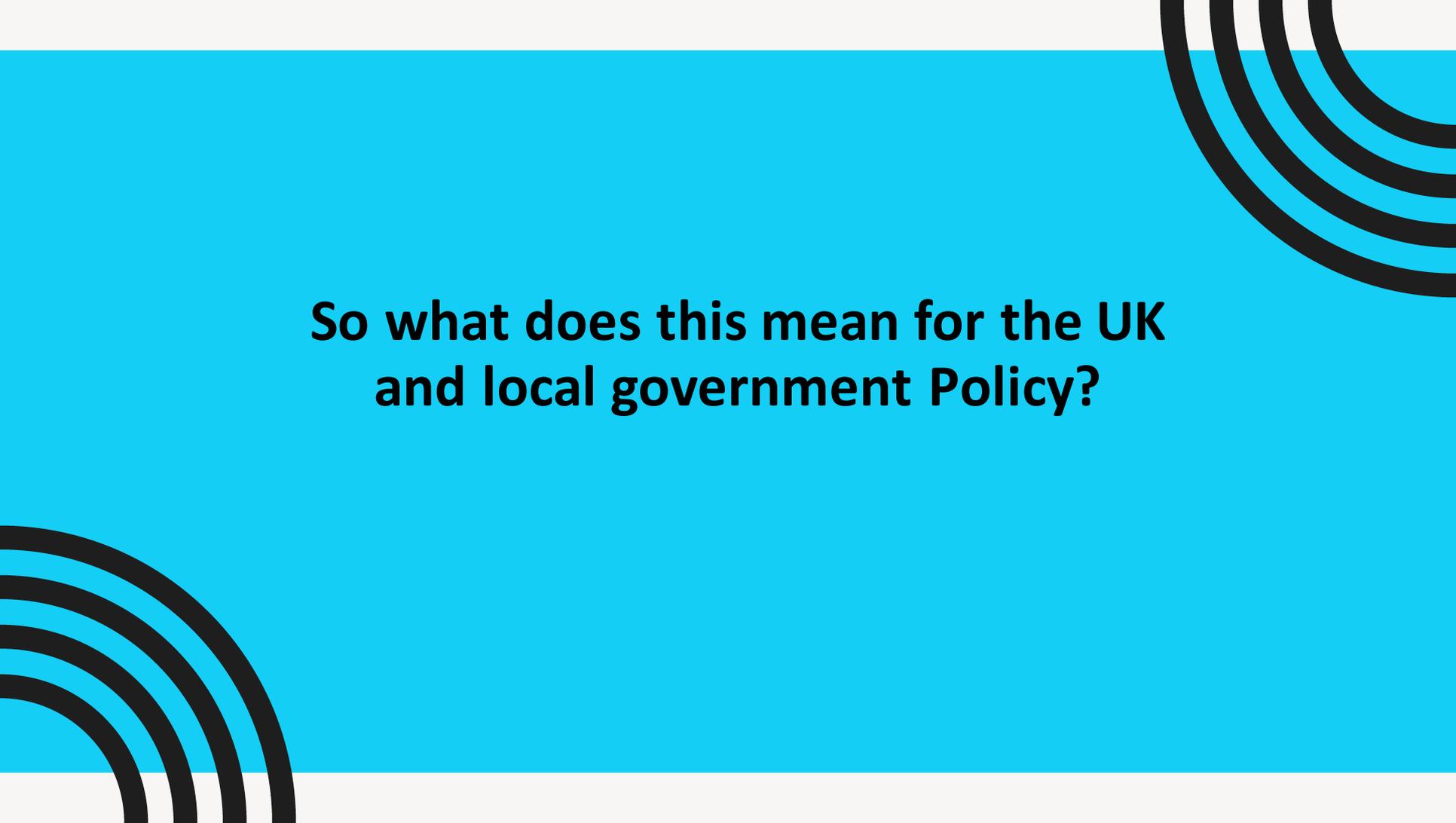
# A reminder: Reduction is not enough

**Figure 4** – Estimates of UK food waste (tonnes), incorporating different scenarios for total food waste (three different economic scenarios – 'conductive', 'neutral' and 'less conducive'), under different rates of population growth (low, central and high). Note for the 'reversion' scenario, and the household fraction of the total, 'low' = partial reversion, 'medium' = 100% reversion by 2030 and 'high' = 100% reversion by 2020).



**We need a combination of solutions that prevent, divert (recover or recycle), or reduce food loss and waste to achieve Sustainable Development Goal 12.3.**

*Where we are in 2022/23*



**So what does this mean for the UK  
and local government Policy?**

# Multiple government departments linked to FLW reduction... (but not enough?)



- Defra
- BEIS (2021) => Department for Business and Trade (DBT), the Department for Energy Security and Net Zero (DESNZ)
- FCDO (overseas funding)
- Are they all talking?
- Who is leading?

# Complexity! 34 Local Govt. policy areas linked to food.

Access to safe drinking water  
Accessible healthy food retail  
Affordable housing  
Agrobiodiversity and wild foods  
Animal husbandry  
Breastfeeding  
Dedicated food system policy/strategy  
Dietary guidelines for external settings  
Education on/enforce food safety regulations  
Education/events on food system issues  
Encourage existing retailers/caterers to sell healthy, sustainable and affordable food  
Encourage opening of new fresh food outlets; discourage unhealthy outlets

## Food losses and food waste

Food production on LG land  
Food related job creation  
Food supply and food system resilience  
Healthy eating by LG staff  
Healthy/sustainable LG food procurement policies

Home and community gardening  
Local food initiatives for economic development  
Local food producers  
Local, sustainable food processing  
Modify housing/property designs to ensure adequate food storage/preparation areas  
Nutrition in vulnerable populations  
Partner with sport clubs to provide healthy choices  
Pregnancy dietary advice  
Public food markets and distributors  
Restrict unhealthy food advertising; increase healthy food promotion  
Restrict unhealthy food in vending machines under LG control  
Strengthen food chain connections/distribution  
Sustainable local food production  
Sustainable water management in food production  
Traditional food cultures  
Use economic measures to encourage affordability/consumption of healthier foods; discourage less healthy foods



Today is a work in progress and part of wider research on FLW policy solutions.

- All input warmly received. (Feedback, questions, your thoughts.)
- Who should I be talking to?
- Do you have evidence of impact in public documents?

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# End of presentation

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<https://www.city.ac.uk/about/schools/health-sciences/research/centre-for-food-policy>

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University of London offers the following  
courses

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Undergraduate degree

### **Food Policy MSc/PGDip/PGCert/MSc**

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