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Plant food waste valorisation: Part of the wider food systems policy solution?

**Centre for
Food Policy**

Shaping an effective food system

Plant Food Waste Valorisation – Opportunities and Challenges
Hybrid Event hosted at the
Newlyn Building, University of Leeds, UK
11th-12th September 2023
13:35-14:00

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

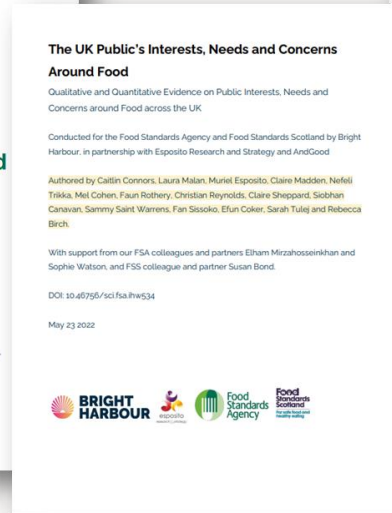
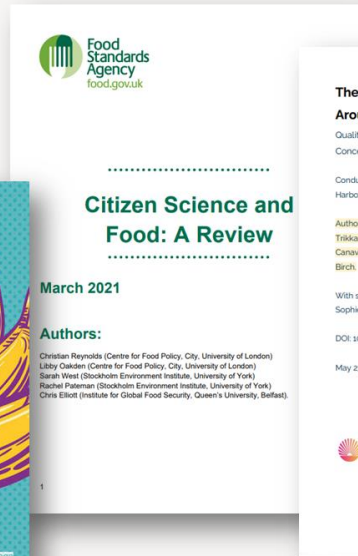
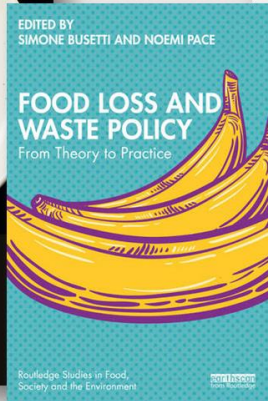
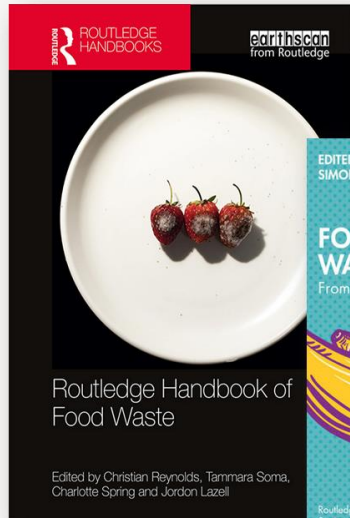
- All input warmly received. (Feedback, questions, your thoughts.)
- Who should I be talking to?

Dr Christian Reynolds
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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 (ZW Scotland). Household Simulation modelling (WRAP). Local food strategy development.
- Nutrition Society Food Systems theme lead. IFST Sustainability working group.
- Recent publications



To me, food loss and waste 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

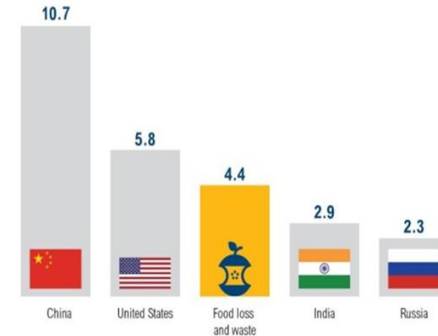
Note: One-quarter of food emissions comes from food that is never eaten: 15% of food emissions from food lost in supply chains; and 9% from consumer waste.

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 CO₂e (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.

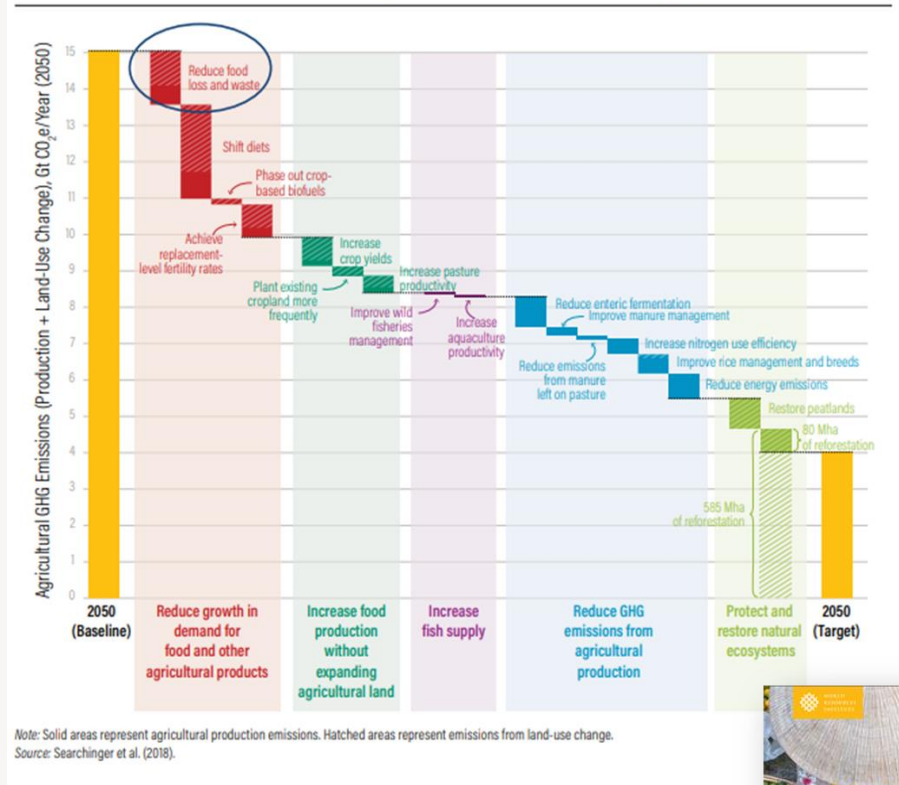
Source: CAIT, 2015; FAO, 2016. Food waste footprint & climate change. Rome: FAO.



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 (CO₂ equivalent)

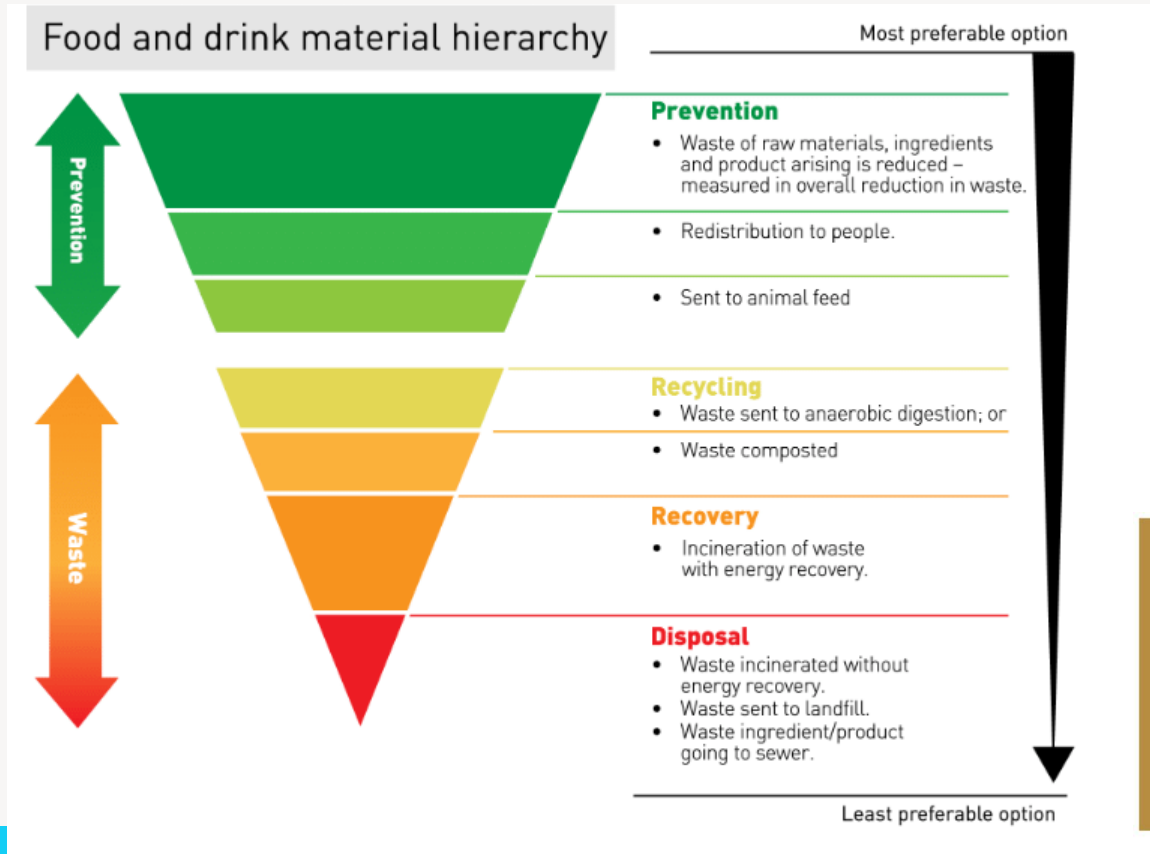


Is plant food waste valorisation part of this wider climate change narrative?

Today I want to ask

- How is valorisation currently regarded in UK FLW policy?
- How can valorisation become regarded as part of a wider food systems solution?

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

Valorisation has "competition" from other solutions

Table 1 Summary of food surplus, waste and related material arisings in the UK, and their respective treatment and disposal routes
(See notes on subsequent page for further detail)

	Household	HaFS*	Retail & Wholesale	Manufacturing	Farm	Total ¹
Total food waste	6.6 Mt	1.1 Mt	0.3 Mt⁸	1.5 Mt	[0.9 – 3.5 Mt]	>9.5 Mt
Food (excl. inedible parts)	4.5 Mt (£13.8 bn)	0.8 Mt (£3.2 bn)	0.3 Mt (£0.9 bn)	0.8 Mt (£1.1 bn)	nk	> 6.4 Mt (>£19 bn)
Preventing food becoming waste						
Redistribution & animal feed	0.3 Mt [n/a humans 0.3 Mt pets/ other animals]	>0.005 Mt [>4kt to people n/a to animals]	0.07 Mt [38kt to people] [27kt to animals]	0.67 Mt [35kt to people] [635kt to animals]	nk⁹ [7kt to people]	> 1.0 Mt
Waste management						
Recycling (AD/composting)	1.3 Mt²	0.04 Mt	0.15 Mt³	0.44 Mt⁴	nk	> 1.9 Mt
Recovery (thermal, landspreading)	3.0 Mt⁵	0.84 Mt⁶	0.15 Mt³	1.1 Mt⁴	nk	> 5.1 Mt
Disposal (sewer, landfill)	2.3 Mt⁵ [1.5 Mt sewer 0.8 Mt landfill]	0.21 Mt⁶ [nk sewer 0.20 Mt landfill]	nk^{3,10}	0.002 Mt⁴ [nk sewer 0.002 Mt landfill]	nk	> 2.5 Mt
In addition:						
Rendering of animal by-products				0.6 Mt	nk	0.6 Mt
Other food by-products⁷				2.2 Mt		2.2 Mt

* HaFS = hospitality and food service; nk = not known; n/a = not applicable

Other FLW solutions are embedded in the UK.

- Landfill (decline)
- Redistribution and AD (ascendent)

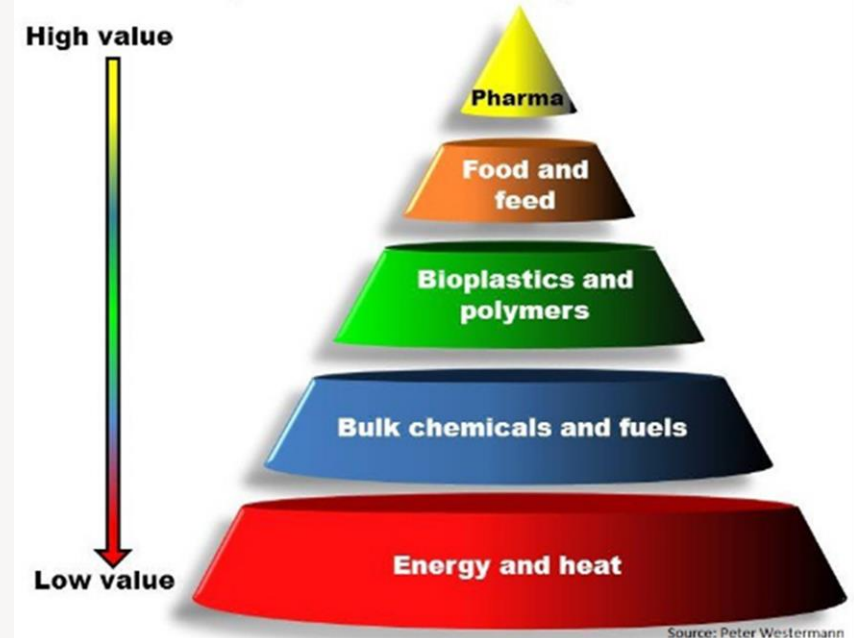


Valorisation has positive system impacts

- but is currently "too small" for the previous table. Why?

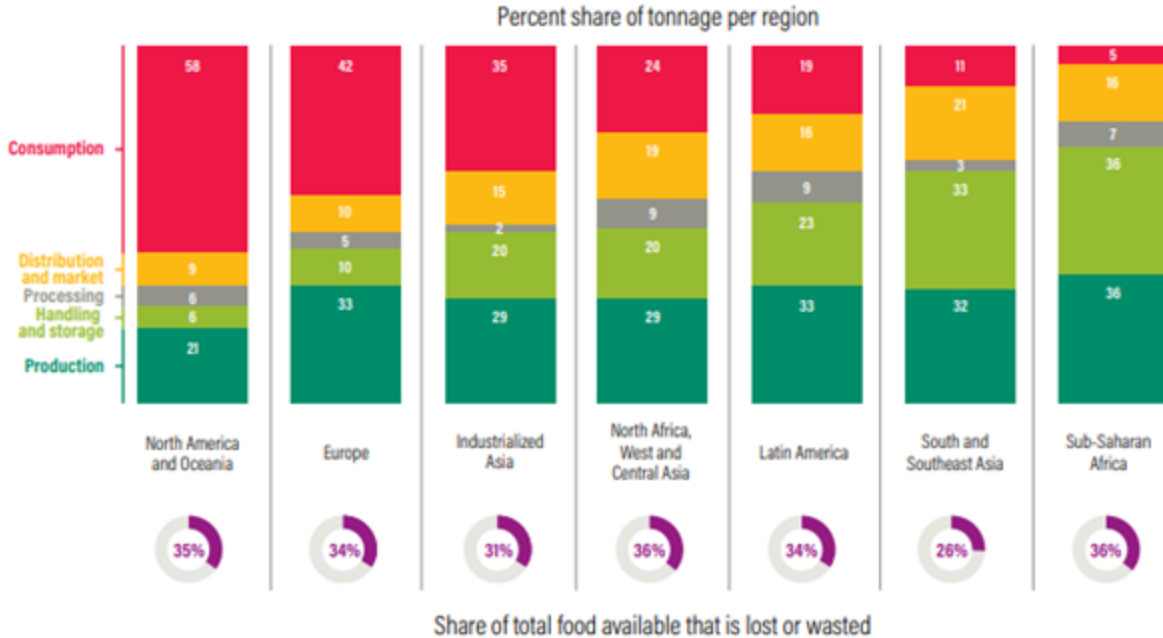
- Policy Focus is on **avoidable** waste - what we should be doing with the unavoidable 40% of food waste ?
- Policy focus is on **Energy** and **Heat**. Less focus on converting food waste materials into higher value products including:
 - Chemicals, materials, and fuels that could displace fossil derived products
 - Higher value food, pet food and animal feed products

Valorisation is many solutions and so has many places in the net-zero and FLW policy landscape.



FLW Spread across the globe and supply chain

Figure ES-1 | Distribution of Food Loss and Waste by Region and Stage in the Food Supply Chain, 2007



Notes: Values displayed are of food loss and waste as a percent of food supply, defined here as the sum of the "Food" and "Processing" columns of the FAO Food Balance Sheet. Numbers may not sum to 100 due to rounding.
Source: WRI analysis based on FAO (2011).

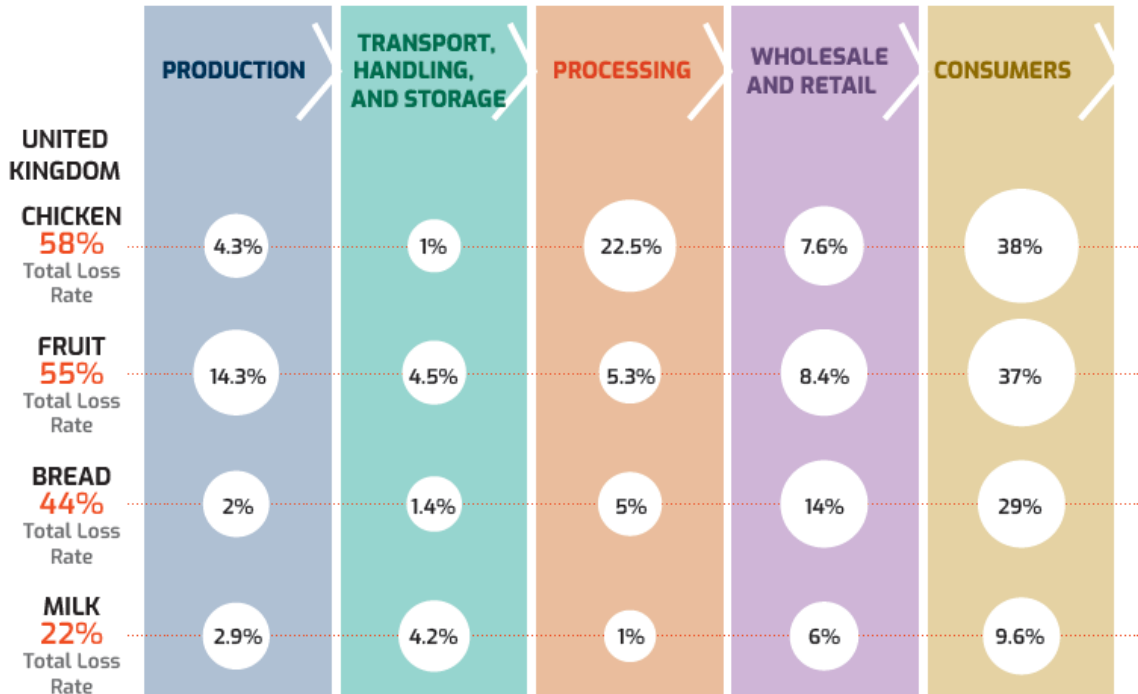
Only a certain % will ever be suitable for valorisation.

This is due to the challenges of mixed vs separate waste streams

But there are many types of valorisation...

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

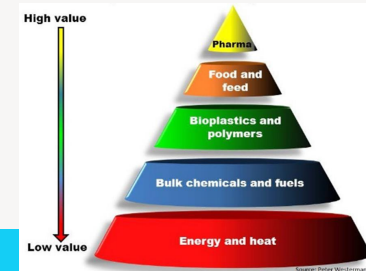
FIGURE 14: Rates of loss and waste at each stage of the supply chain – UK, Rwanda, Vietnam



Only a certain % will ever be suitable for valorisation.

This is due to the challenges of mixed vs separate waste streams

But there are many types of valorisation...



Many types of valorisation solution

	Waste reduction potential	Savings per tonne of waste reduced		
		Climate	Water	Costs
Products, processing and food waste solutions				
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	●	●	●	◆
Efficient business operations and supply chain solutions				
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
Education and behaviour change solutions				
Household behaviour change programs	■	■	■	■
Hospitality and food service solutions	◆	■	■	■
Waste audits at hospitality and institutions	◆	■	■	■
Food rescue, recovery and redistribution solutions				
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 solutions

ReFED (USA) 73 solutions

Australian food waste strategy 41 solutions

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

Some possible issues with valorisation as a "new" FLW solution

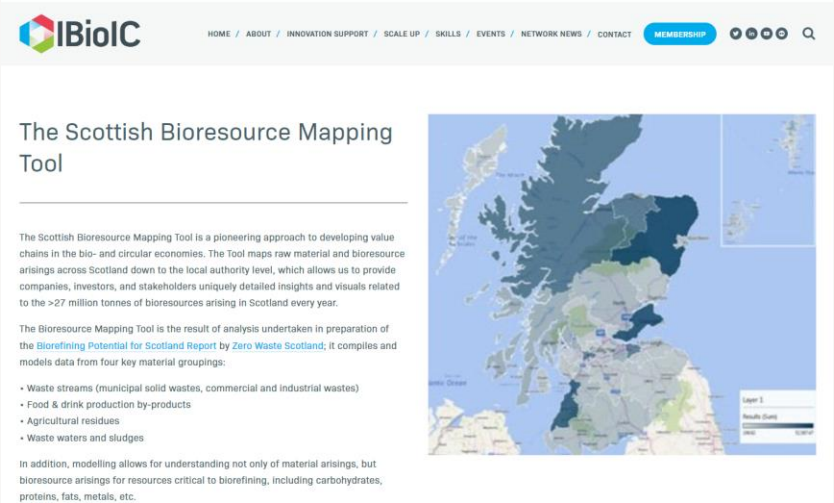
- Internal competition (Animal Feed and Biofuel vs other higher value valorisation types)
- Providers work in specific areas, and may lack the ability to scale.
- Valorised products may be more costly than conventional products, which can limit the customer base. (Until a market shock – Ukraine war?, Climate change?)
- End products vary greatly by the feedstocks used, so the economics and diversion potential vary depending on location (England vs Scotland vs Wales vs NI)
- Businesses selling their feedstock (waste) may not have the capacity to store product for extended periods of time.



Do we know the UK's current or maximum capacity?

■ Scotland

<https://www.ibioic.com/scottish-bioresource-mapping-tool>



The screenshot shows the IBioIC website with the title "The Scottish Bioresource Mapping Tool". The page includes a navigation menu, a search bar, and a map of Scotland. The map is titled "Layer 1 Results (km)" and shows various regions. Below the map, there is a list of waste streams and a description of the tool's purpose.

IBioIC HOME / ABOUT / INNOVATION SUPPORT / SCALE UP / SKILLS / EVENTS / NETWORK NEWS / CONTACT MEMBERSHIP

The Scottish Bioresource Mapping Tool

The Scottish Bioresource Mapping Tool is a pioneering approach to developing value chains in the bio- and circular economies. The Tool maps raw material and bioresource arisings across Scotland down to the local authority level, which allows us to provide companies, investors, and stakeholders uniquely detailed insights and visuals related to the >27 million tonnes of bioresources arising in Scotland every year.

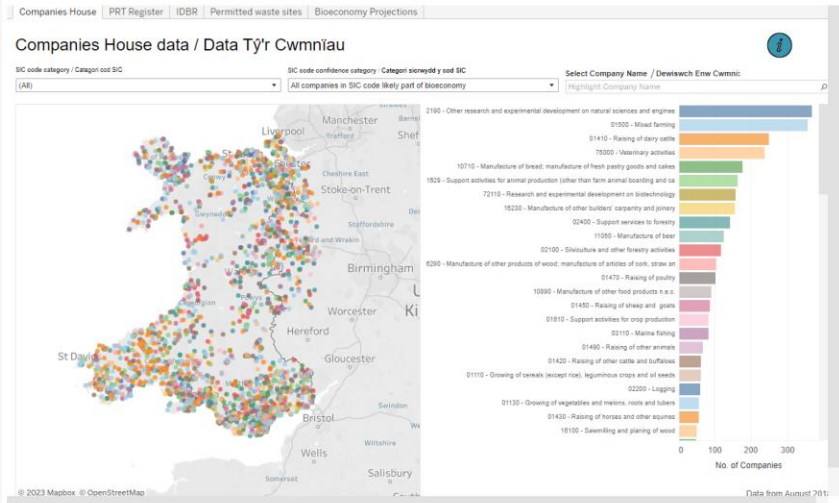
The Bioresource Mapping Tool is the result of analysis undertaken in preparation of the **Biorefining Potential for Scotland Report** by **Zero Waste Scotland**. It compiles and models data from four key material groupings:

- Waste streams (municipal solid wastes, commercial and industrial wastes)
- Food & drink production by-products
- Agricultural residues
- Waste waters and sludges

In addition, modelling allows for understanding not only of material arisings, but bioresource arisings for resources critical to biorefining, including carbohydrates, proteins, fats, metals, etc.

10 Wales

<https://w.rapcymru.org.uk/resources/tool/valorisation-tools>



The screenshot shows the "Companies House data / Data Tŷr Cwmniïau" tool. It features a map of Wales with colored dots representing companies, and a bar chart showing the number of companies for various SIC code categories. The bar chart is titled "No. of Companies" and ranges from 0 to 300. The SIC code categories are listed on the right side of the chart.

Companies House | PRT Register | IDBR | Permitted waste sites | Bioeconomy Projections

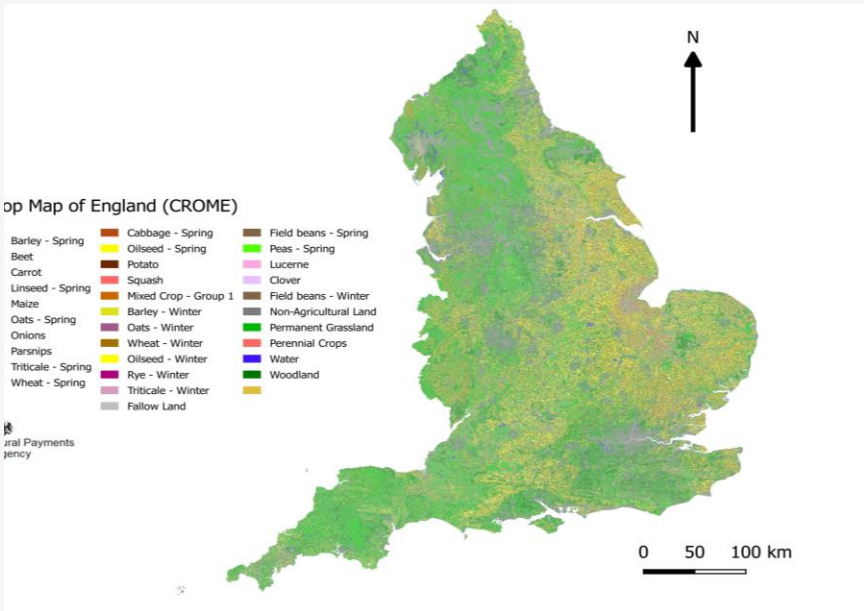
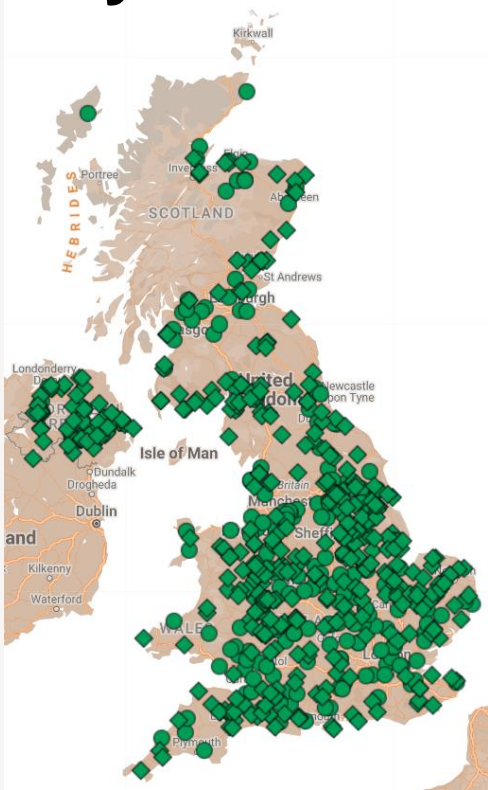
Companies House data / Data Tŷr Cwmniïau

SIC code category / Categori cod SIC (All) | SIC code confidence category / Categori sicrwydd y cod SIC (All companies in SIC code likely part of bioeconomy) | Select Company Name / Dewiswch Enw Cwmni: (Highlight Company Name)

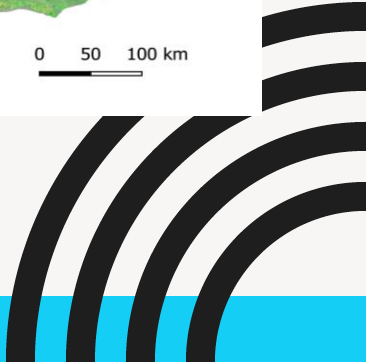
SIC code category / Categori cod SIC	No. of Companies
2190 - Other research and experimental development on natural sciences and engine	300
0100 - Mixed farming	250
01410 - Rearing of dairy cattle	200
75000 - Veterinary activities	180
10710 - Manufacture of bread; manufacture of fresh pastry goods and cakes	150
1829 - Support activities for animal production (other than farm animal boarding and ca	140
72110 - Research and experimental development on biotechnology	130
18235 - Manufacture of other builders' carpentry and joinery	120
02400 - Support services to forestry	110
19100 - Manufacture of beer	100
02100 - Silviculture and other forestry activities	90
8200 - Manufacture of other products of wood; manufacture of articles of cork, straw an	80
01470 - Rearing of poultry	70
18990 - Manufacture of other food products n.e.c.	60
01450 - Rearing of sheep and goats	50
01810 - Support activities for crop production	40
02110 - Saline fishing	30
01400 - Rearing of other animals	20
01420 - Rearing of other cattle and buffaloes	15
01110 - Growing of cereals (except rice), leguminous crops and oil seeds	10
02200 - Logging	5
01130 - Drying of vegetables and melons, roots and tubers	5
01430 - Rearing of horses and other equines	5
18100 - Sawmilling and planing of wood	5

Geographic tension: AD is where the feedstocks are. AD has already been invested in.

All operational anaerobic digestion plants in the UK (excluding water treatment facilities). April 2023



Crop Map of England (CROME) 2020



In 2017, valorisation was on the UK agenda

"A key area of focus for WRAP's Courtauld Commitment 2025 is to identify the best ways to recover products from food waste with the remaining wastes still being recycled in the most appropriate way." WRAP 2017

<https://www.wrap.org.uk/resources/case-study/getting-more-value-waste-and-surplus-food-drink>

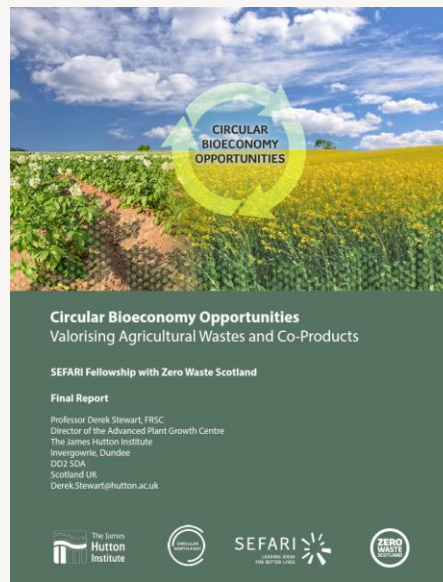
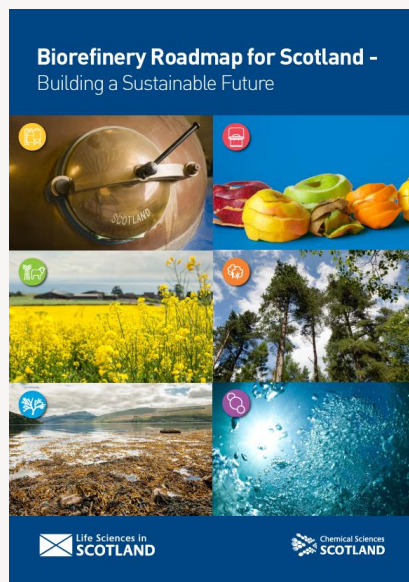
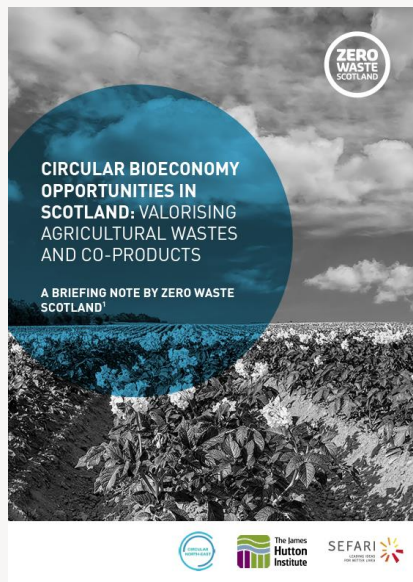
But in 2023 valorisation is somewhat absent from UK FLW documents (Courtauld) etc ...

but not from Wales and Scotland, or other countries...

Scotland

27 Mt. of bioarisings, 16.7Mt. agricultural-related bioarisings .

Several common valorisation technologies identified.



<https://www.zerowastescotland.org.uk/resources/maximising-value-agricultural-waste>

<https://www.sdi.co.uk/media/tw/ejlm2/biorefinery-roadmap-for-scotland-2019.pdf>

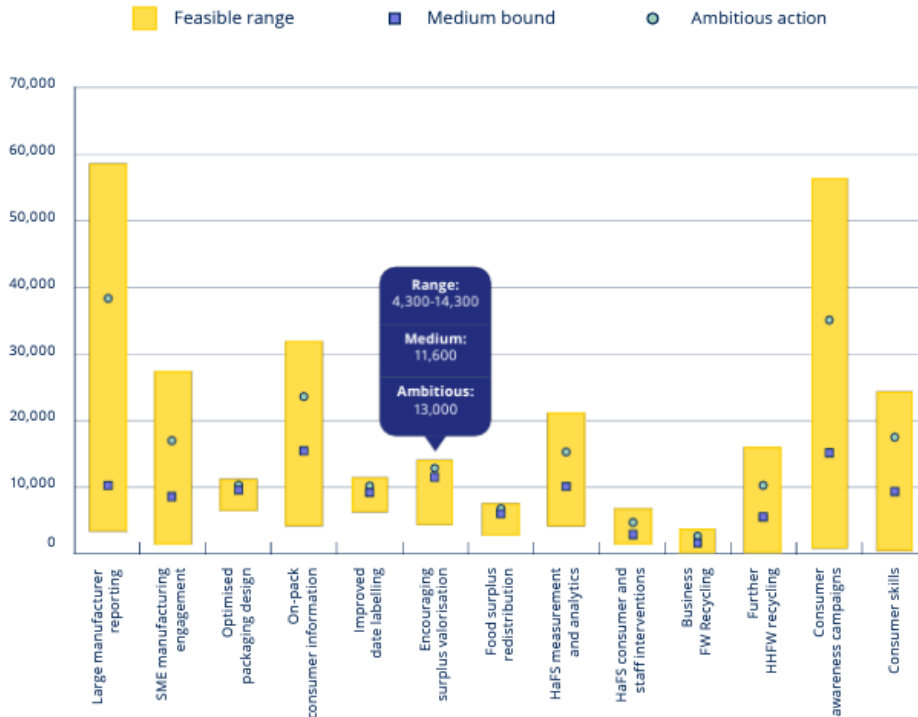
https://sefari.scot/sites/default/files/documents/SEFARI%20Gateway_Fellowship_%20Agbyproduct_FINAL.pdf

<https://www.zerowastescotland.org.uk/resources/report-biorefining-potential-scotland>

Welsh FW Routemap: 3rd largest reduction solution

"Unless action taken very quickly, <valorisation> is unlikely to have most impact until after 2030"

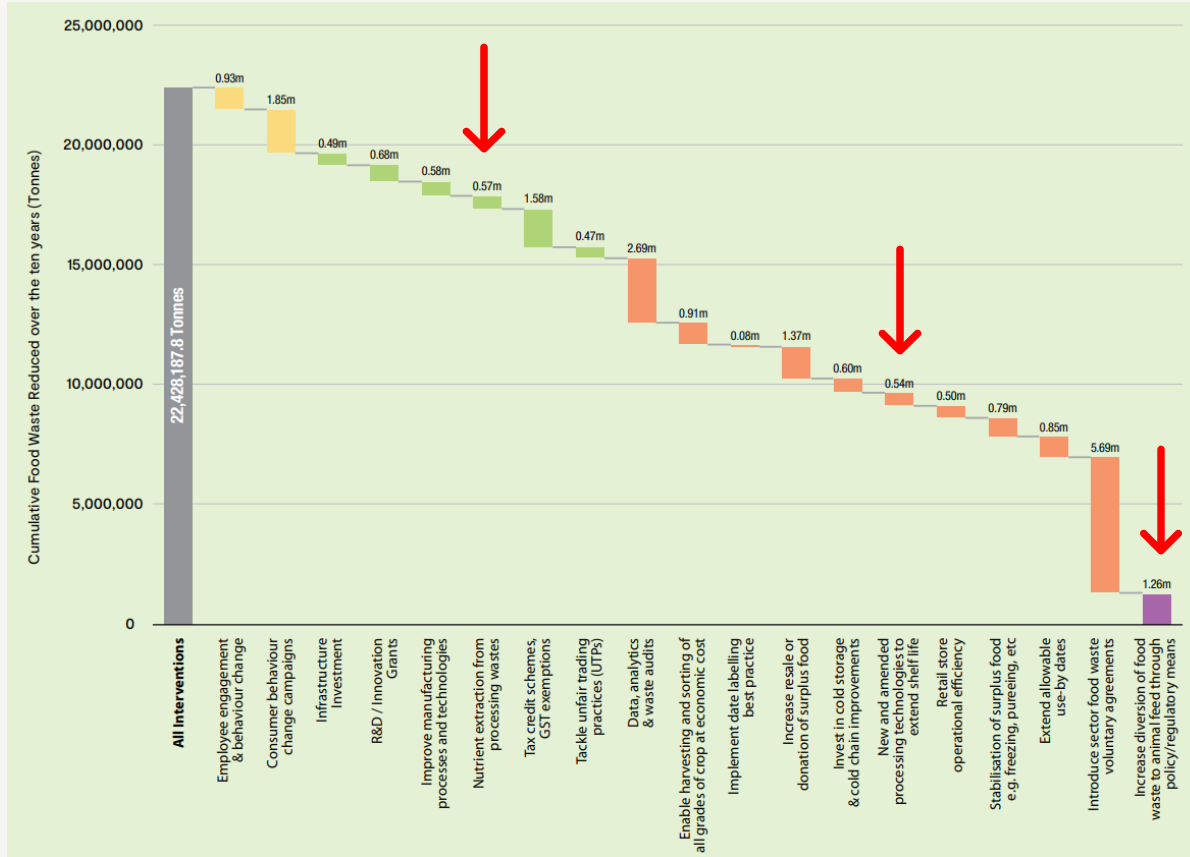
Figure 4: Estimated savings in 2030 by intervention



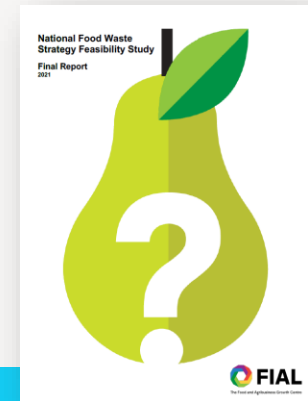
- "Most achievable is to divert **manufacturing and retail waste** up the waste hierarchy, from disposal/recycling to **valorisation into feed**, expected to be substantial
- If able to address **contamination risks** associated with household/HaFS food surplus, opportunity becomes significantly larger"
- ~9% of total (medium) FLW reduction



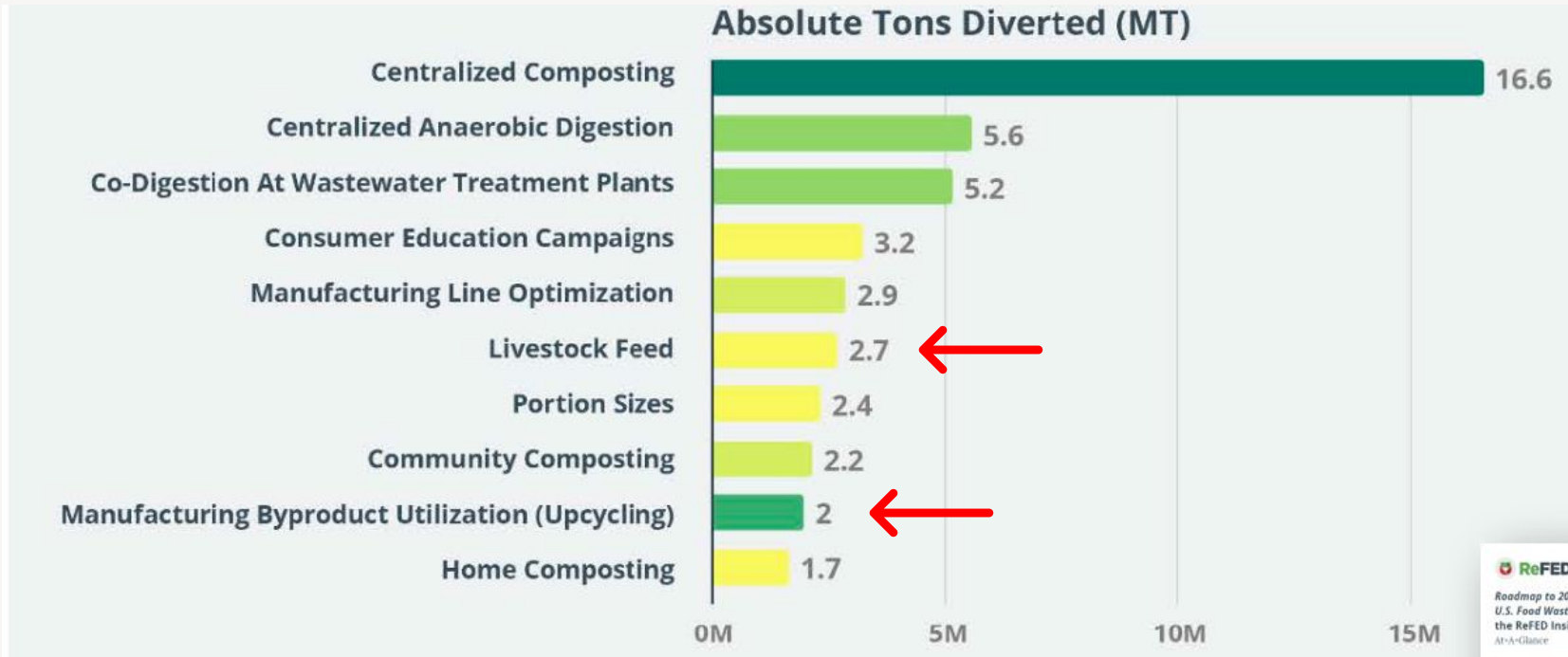
Australian FLW strategy



- Nutrient extraction from processing wastes (3%)
- New and amended processing technologies to extend shelf life (2%) ?
- Increase diversion of food waste to animal feed through policy/regulatory means (6%) ?
- Combined are **11% 3rd largest reduction**



USA – 6th and 9th largest reduction solution



ReFED
Roadmap to 2030: Reducing U.S. Food Waste by 50% and the ReFED Insights Engine At-A-Glance





Currently Valorisation is not framed by UK policy
as scalable before 2030.

But it *is* one of the largest FLW solution categories.

We need to reframe to highlight systems benefits.



We need to reduce barriers to scale/access through policy.

We need better policy coherence.

Multiple solutions need policy coherence

Food policy coherence

The alignment of policies that affect the food system with the aim of achieving health, environmental, social and economic goals, to ensure that policies designed to improve one food system outcome do not undermine others.
Food policy incoherence creates problems and misses opportunities.

Health (social) policy
goal = to prevent disease and treat and manage ill-health in the population

Environmental policy
goal = less deforestation, water pollution, greenhouse gases

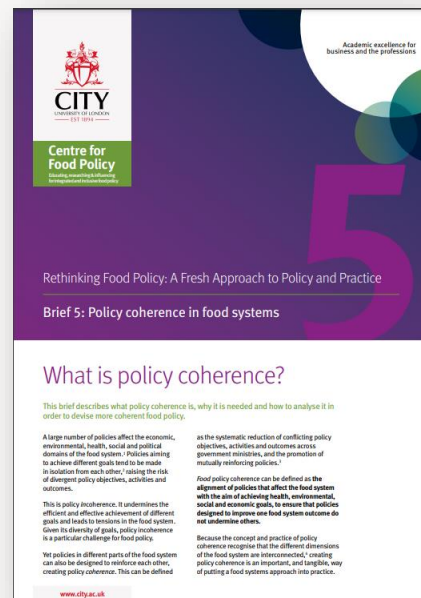
Economic policy
Goal = growth and competitiveness for income generations and jobs

Policy incoherence



Economic policy or economic policy instruments not fit for purpose in reinforcing environmental and health policy goals

Policy made in different spaces

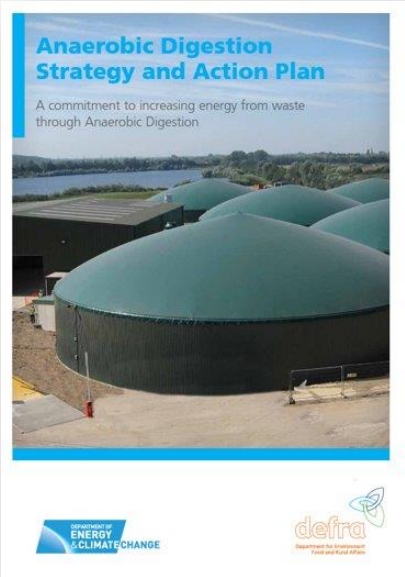


Multiple government departments linked to Valorisation... (but not enough?)



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

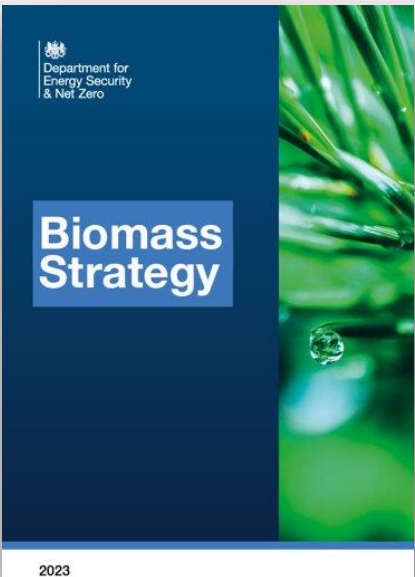
So where is valorisation discussed in the UK?



2011



2018



2023

- Wider circular economy framing.
- Focus on feedstock capacity.
- Energy generation focus
- FSA report provides a systems view.

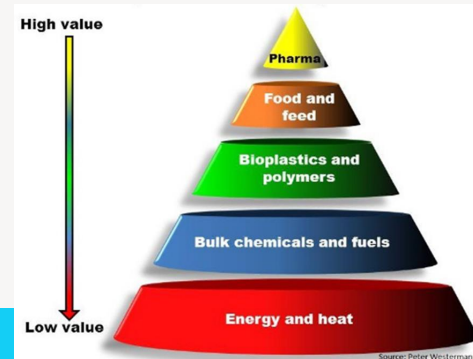
Food Standards Agency

The Future of Animal Feed

Area of research interest: [Emerging challenges and opportunities](#)
Planned completion: 2 February 2023
Project status: Completed
Project code: FS900202
Authors: Dr. Georgios Poxas; Prof. Illias Kyriazakis; Prof. Bob Doherty
Date published: 28 April 2023
DOI: <https://doi.org/10.46756/sci.fsa.gz1586>

Why is valorisation incoherent in the UK?

- Until the FSA report there has been little discussion of the **health, social, net zero** benefits of valorisation in a UK level policy document.
- This lack of wider systems framing may mean that for other govt departments it is not high priority .
- The valorisation community is also not the best at co-ordinating messages and policy work. (food vs feed vs fule)



Do we have the policy environment and scalability yet for valorisation, bio-economy hubs and spokes etc. ?

- Do we have consistent feedstocks?
- Technical solutions: Solving mixed vs separate waste streams (contamination risks etc.)
- **What policy framing do we need to get there?**
 - Engagement of primary producers and feed stock producers.
 - Multiple support mechanisms for different types of valorisation
 - Farmer and industry diversification into "Net Zero enterprises"
 - Protein/crop valorisation as part of wider food system change

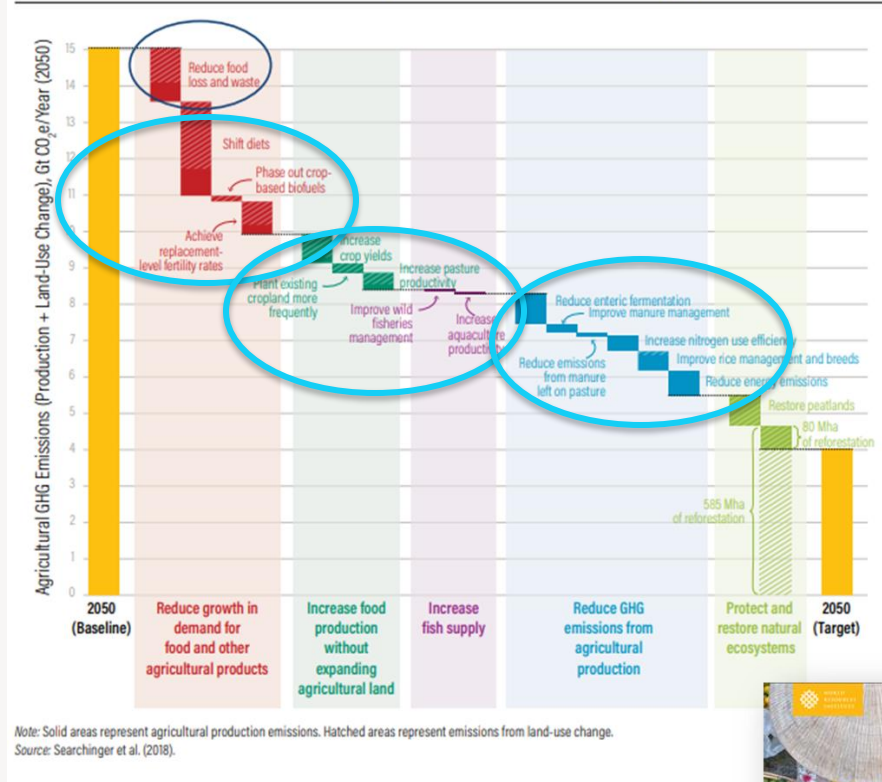


End objective:

Can we link valorisation to these wider food systems actions?

Making it a wider food systems solution?

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 (CO₂ equivalent)



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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
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Undergraduate degree

Food Policy MSc/PGDip/PGCert/MSc

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PhD/MPhil Food Policy

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