
UNEP Asia Pacific Food Waste Working Group 2023

Workshop 4: Green technology, business models and sustainable cold chain

14/11/2023

Clementine O'Connor

Youngran Hur

United Nations Environment Programme

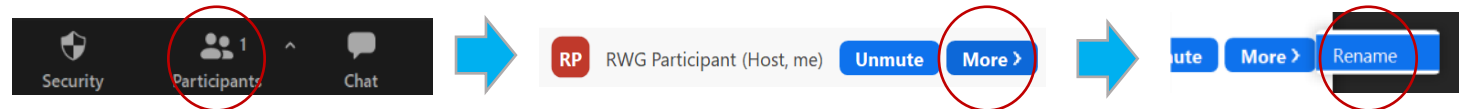
Hamish Forbes

Eloise Peacock

WRAP

HOUSEKEEPING

- Please mute microphone when somebody else is presenting or speaking. Please unmute your microphone for discussions and questions!
- Please change your name on Zoom to include your **country** (e.g. Joe Bloggs – United Kingdom)
- We are recording
- If you are having technical difficulties, please contact **[Project Admin]**



Agenda

Section
Introduction & housekeeping
Green technology for FLW reduction: what does technology try to achieve?
<i>Discussion of 7 mechanisms for food waste reduction through green technology, featuring guest speakers working on some of these solutions</i>
Business models and an enabling environment for green technology
National food waste reduction strategy
Workshop close



Green technology & business models

Seven key mechanisms for FLW reduction through green technology



Reduce excess production or purchase

Ensure as much sold /distributed as possible

Making the most of food which is bought/ produced

Measuring and monitoring

Reduce damage in handling

Increase stability of produce

Closing the loop of wastes generated



Reduce
excess
production
or
purchase

Reduce excess production or purchase

- **Forecasting**
 - Using AI – e.g. in retail environment [ShelfEngine](#)
 - Using machine learning – e.g. in Food Service [Tenzo](#)
- **Mechanism**
 - Data including weather, season, events and holidays is layered with historical data to assist with stock management to minimise stock not being used in time.
- **Inventory control**
 - **Mechanism:** ensure stock levels are accurately controlled with technology – e.g. [TotalCtrl](#)

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Reduce excess purchase/stabilise yields

- **Precision agriculture**

- Allows inputs to be targeted relative to the field conditions by utilising spatial, temporal and site-specific data
- Supports decision making, improves resource efficiency
- Utilises AI, Machine Learning, IoT, satellites etc.
- **Benefits:** Cost reduction, higher work and input efficiency, environmental benefits (lower GHGs, reduced run off etc.)

- **Mechanisms**

- Maximise/stabilise yields by reducing losses

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Reduce excess purchase/stabilise yields

- **Barriers: Internet access, cost (capital), knowledge and skills**
- **Low tech/collaborative action**
 - [WeFarm](#) a free peer-to-peer knowledge sharing service using SMS (no internet required)
 - Precision Development (PxD) a non-profit providing customised information to support smallholder farmers in developing countries
 - Free apps: Apps that provide crop and field data – e.g. [AgriXP](#)

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Reduce
damage
in
handling

Reduce damage in handling

- **Reduce damage during transport**
 - ‘Simple equipment in an innovative way’ – e.g. [moving from sacks to crates for tomatoes](#)
 - FAO’s [3D design library](#) includes open-source equipment design: crates for transport, handling, storage and retail display
 - Plastic stackable crates for lease/rental to reduce up-front costs e.g. [for mango transport](#)
- **Mechanism**
 - Produce items can easily be damaged during transport
 - Many opportunities by introducing simple, low-tech changes

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Reduce damage in handling

- **Logistics Technology**

- Direct-to-farm sales platforms – e.g. [Frubana](#), [Twiga Foods](#), [TaniHub](#)

- **Mechanism**

- Reduce number of intermediaries, and therefore potentially reduces damages in handling & aggregation
- Reducing middlemen can support farmers with better prices
- Direct sale can support with traceability of produce

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Image: TaniHub



Ensure as
much sold
/distributed
as possible

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service

Ensure as much sold/distributed as possible

- **Secondary marketplaces (B2B, B2C)**

- ‘Wonky’ fruit and veg marketplaces – e.g. [Mercado](#)
[Differente](#), [Oddbox](#)
- National directories – e.g. [Welsh Food and Drink directory](#)
- Buying/selling platforms – e.g. [Yume](#)
- Within a supply chain – e.g. [Tesco](#)

Mechanisms

- Reduce information barriers
- Form connections and communities of likeminded businesses
- Create new revenue streams & backup markets for farmers



Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service

Ensure as much sold/distributed as possible

- **Discounted sale**
 - Dynamic pricing
 - **High-tech:** Internet of Things sensors, electronic shelf labels. Studies have suggested [>21% reduction in waste](#), companies like [Wasteless](#) seen [c.33% reductions](#) in food waste
 - **Low-tech:** '[Yellow sticker](#)' approach
 - Apps for food service/retailers to advertise and sell discounted food
 - e.g [Too Good to Go](#) (EU/America); [GoodMeal](#) (Chile); [Surplus](#) (Indonesia); [Chomp](#) (Hong Kong); [B4 waste](#) (Brazil); [Food to Save](#) (Brazil)
- **! Need to ensure that waste isn't just 'moved' to consumers**



Ensure as much sold/distributed as possible

- **Redistribution**

- Digital services to connect businesses to redistribution charities – e.g. [FoodCloud](#), [Infineat](#)
- Digital platforms to support logistics of redistribution organisations – e.g. [Food Rescue Hero](#), [Goodr](#)
- Consumer-facing apps for food sharing and donations – e.g. [Olio](#)

- **Mechanisms**

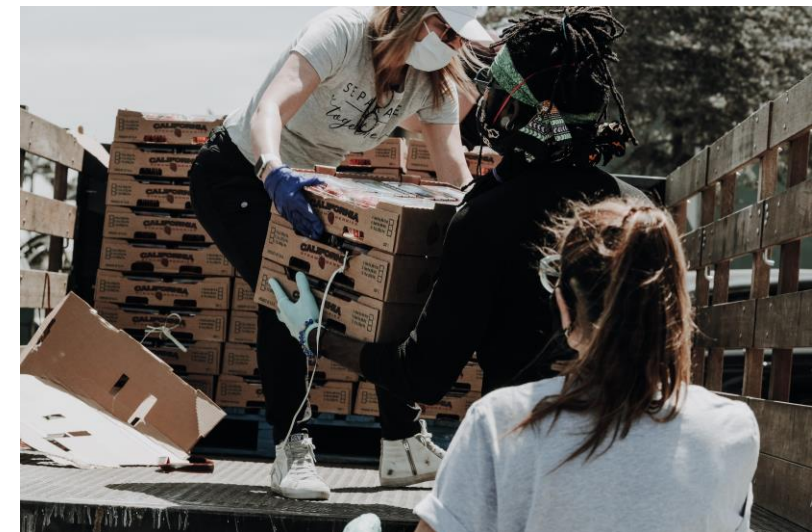
- Reducing information barriers & facilitating connections
- Supporting charities/social enterprises with limited resources
- Increasing efficiency of operations

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Guest speaker:
Alya Fatina Diandari -
Surplus

Measuring
and
monitoring

Measuring and monitoring

- **Monitoring condition of food across supply chain**
 - Quality assessment tools can help reduce movement of defective stocks and prioritise movement of goods which need to be moved – e.g. [ZoomAgri](#)
 - Storage conditions and product freshness can be monitored through IoT sensors or ‘Digital Twins’ – e.g. [TCS monitoring platform](#)
- **Mechanisms**
 - Live information to enable decision-making
 - Able to respond to natural variation & what is *actually* happening rather than what ‘normally’ happens

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Measuring and monitoring

- **Monitoring waste arisings in food service kitchens**

- Scales, monitors and imagery
- Some services offer AI-based food recognition or generating data reports
- Reported reductions of 30% edible food; 65% reduction in value of food waste; 30% reduction in waste
- e.g. Leanpath, Winnow, KITRO, Lightblue FIT

- **Mechanisms:**

- Data generation to identify hotspots & increase waste visibility
- Reducing burden for chefs
- Encouraging changes in behaviours & increasing profitability

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Making the
most of
food which
is bought/
produced

Making the most of food which is bought/produced

- ‘Upcycling’ of surplus food and by-products: covered last session

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service

Minimal processing	Heat treatment/ chilling	Stabilisation	Size reduction	Advanced processing
Chopping, trimming	Cooking, blending, pureeing (soup, smoothie, juice)	Drying (freeze dry, airdry, spray dry), Freezing	Milling/grinding	Extraction
Second grade (surplus) produce chopped for use in kitchens 	Second/ third grade (surplus) produce prepared in cooked meals 	Freeze dried strawberry snacks from third grade (surplus) produce 	Spent grain flour from brewers grain (byproduct) 	Grapeseed extract from grape marc (byproduct) 



Making the most of food which is bought/produced

- ‘Upcycling’ of surplus food and by-products: covered last session

Advanced processing
Extraction
Grapeseed extract from grape marc (byproduct) 

- **Examples of extraction:**

- Distillation and solvent extraction, e.g. for [essential oils from citrus peels](#)
- Pervaporation, e.g. to [recover aroma compound from fruit juices](#)
- Supercritical fluid extraction, e.g. to [recover polyphenols from grape pomace](#)
- *And many more advanced industrial techniques*

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Making the most of food which is bought/produced

- **Helping households ‘buy what you need’ and ‘eat what you buy’**
 - Recipe finders based on the ingredients you have, e.g. [Supercook](#), [BigOven](#), [Gumbo](#)
 - ‘Smart fridges’ which take images or use AI to monitor inventory and support shopping lists – e.g. [Samsung Family Hub](#)
- **Mechanisms:**
 - Help consumers use existing ingredients
 - Reduce information barriers for those without cooking skills /creativity to do it themselves

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



Closing the
loop of
wastes
generated

Closing the loop

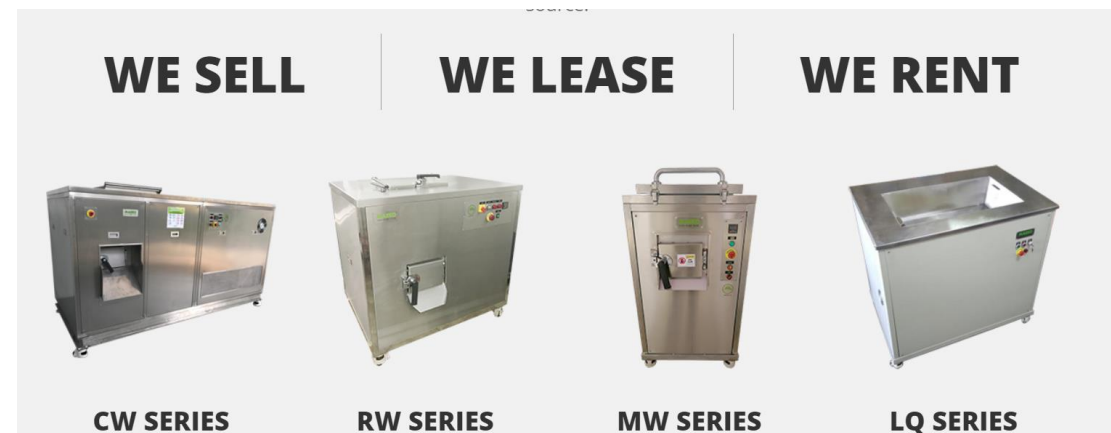
- **Bio-technology to ‘upcycle’ surplus and waste**
 - Insects (black soldier flies – see last session);
 - Fungi-based processing – e.g. [Mushlabs](#), [Mycorena](#)
- **Recycling services**
 - Small-scale composters and digesters for food service sites – e.g. [Maeko](#)
 - At-home processing for urban areas – e.g. [Mill make food grounds for chickens](#)

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service



[Image: Maeko](#)



Increase
stability of
produce

Increase stability of produce

- **Coatings to protect or chemicals to slow ripening**
 - Coating to protect produce [Apeel](#)
 - Reduce ethylene gas production – e.g. [Hazel Technologies](#)
 - Ethylene gas absorption to slow ripening – e.g. [Bluapple](#)

Primary
Production

Processing
and
manufacture

Retail &
Distribution

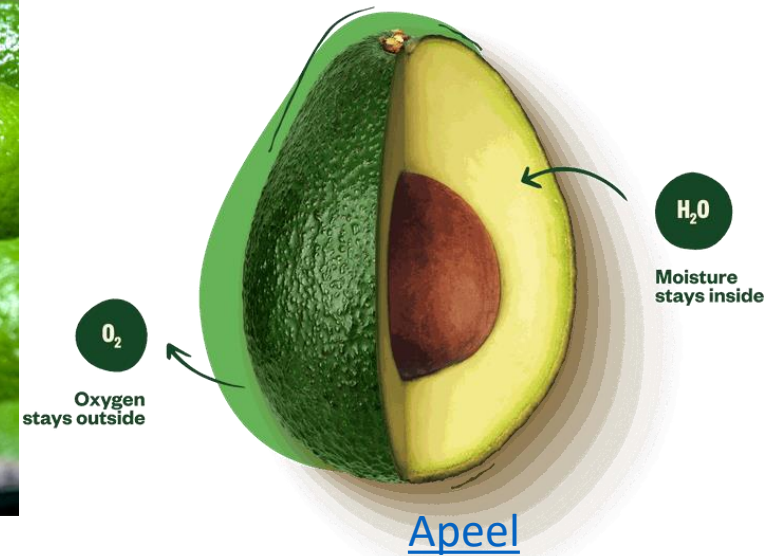
Consumer at
home and
food service



[Bluapple](#)



[Hazel Technologies](#)



Increase stability of produce

- Adequate post-harvest storage

- Low-tech:

- E.g. [mud silos for maize](#) in Northern Ghana
 - [Hermetic storage](#)

- Cold chain:

- Off-grid cooling services, e.g. [brick/charcoal cooler for mango storage](#)
 - Off-grid 'Cooling as a service' – e.g. [ColdHubs](#), [Solar Freeze](#), [Kivu Cold](#)

Primary
Production

Processing
and
manufacture

Retail &
Distribution

Consumer at
home and
food service

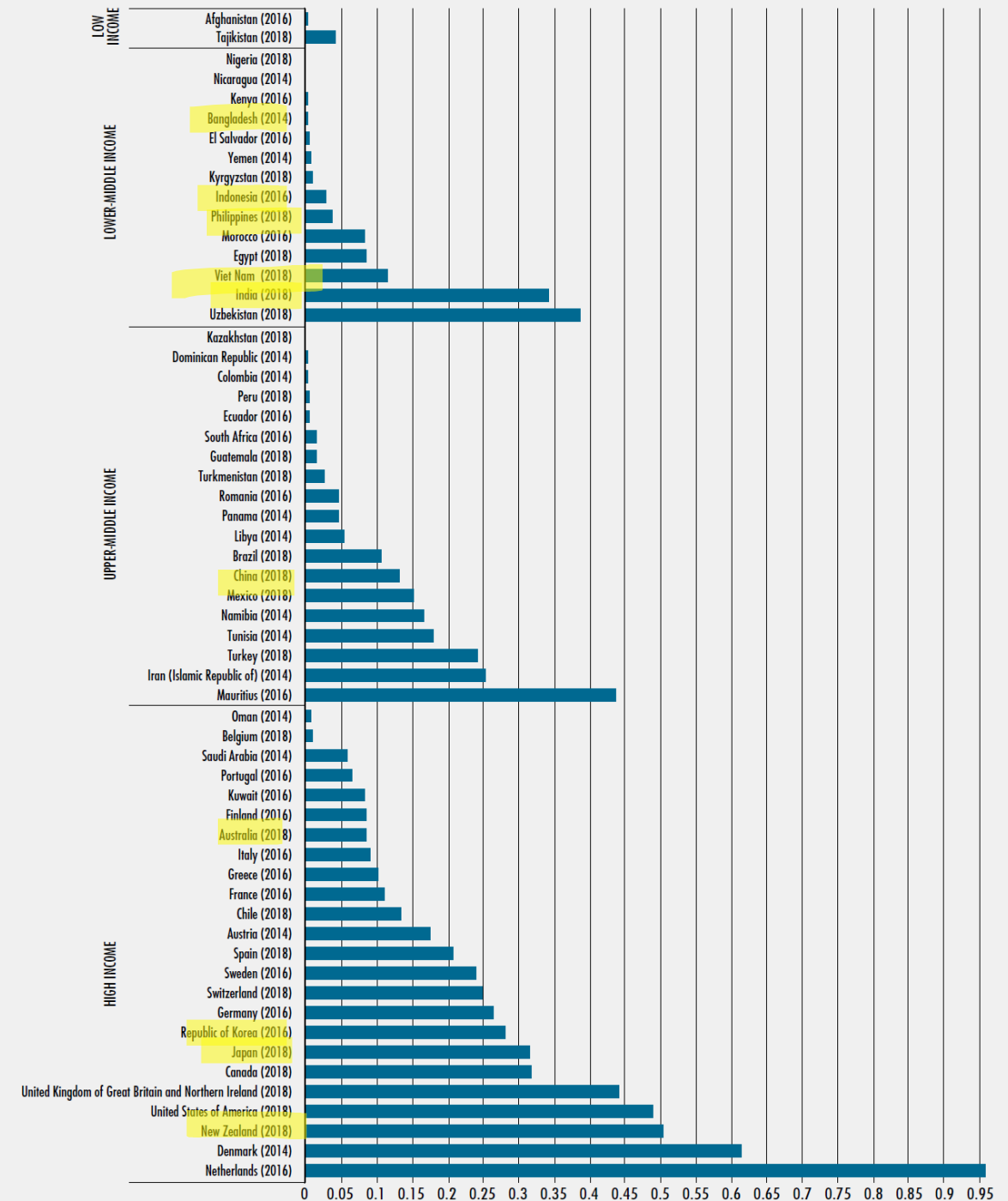


Image: IRRI.org



Cold chain (Asia Pacific)

- Market development index, developed by Global Cold Chain Alliance, measures refrigerated warehouse capacity (in cubic metres) per capita in urban areas



Angshuman Siddantha – UNEP

Benjamas Chotthong – Thailand Environment Institute

Business models

- **Digital platforms & startups**

- No creation of new infrastructure – use existing materials (e.g. smartphones)
- Value proposition is saving money for consumers or businesses
- Need to establish financial opportunity – e.g. businesses pay to be a part? Gov't funding?

- **Rental / services**

- Reduce upfront costs for users
- Provider has control over infrastructure/tools and can update them
- Consistent stream of money for provider

- **Social enterprise / not for profit**

- Aiming for social good rather than monetary returns
- Does still have costs which need covering: private, public funding?



Enabling environment for technology

- **Green tech does not solve food waste, but may be an enabler and accelerator**
 - Need for comprehensive, integrated approach linking technology, policy, regulation, incentives, infrastructure, information and behavioural science
- **Governments, businesses and civil society all have a role to play**
 - Partnerships across public, private and civil-society to make targeted interventions
 - Legal/regulatory approaches can create incentives
- **Some pre-requisites for leveraging green and digital technologies**
 - Adequate internet access – or providing an alternative
 - Access to the tech without prohibitive upfront costs
 - Adequate skills amongst consumers and businesses



National Food Waste Reduction Strategy

Baseline

Context and background

- What is known about food waste in your country?
- What **political objectives or targets** exist around food waste?
- How does FLW prevention and waste management **contribute** to other social, economic and environmental objectives?

What has been done so far? See [Germany's Food Waste strategy](#) 'Ongoing work' (page 9)



Measurement

- In what sectors do we have reliable data?
- Where are the data gaps?
- How do we plan on filling those data gaps?
- What is the approach to monitoring going forward?

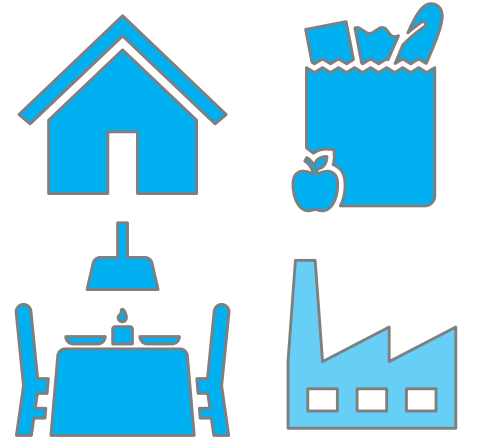
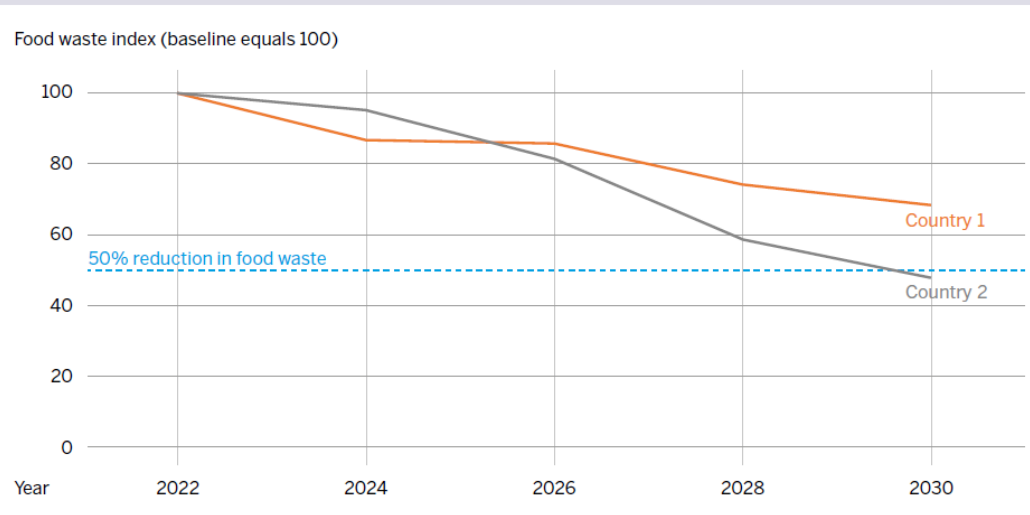


Figure 5: Food Waste Indices for two hypothetical countries



Remember:

- Accuracy sufficient for tracking over time
- Prioritising sectors & subsectors where we expect the most waste to occur
- Samples representative of the country (region, income, type of business, season)



Identifying focus areas

- **Clarify your objectives**
 - *Is aim economic efficiency? Is it food security? Is it environmental objectives?*
 - Your priority may determine where in the supply chain action is prioritised ([FAO 2019](#))
- **Prioritising subsectors**
 - *Where are most meals eaten? Through which channels are most food sold? Are waste rates likely to be substantially different?*
 - Priority areas likely determined by where the biggest opportunity is, where change is realistic, and where there are the most co-benefits.
- **Cities and rural areas**
 - Food Waste Index 2023: data is suggesting there may be more waste per capita in cities than rural areas, so focus on cities may be appropriate



Public Private Partnerships



Brings together businesses in a pre-competitive forum to tackle common issues.

Connects businesses with government and policy makers to drive change in a holistic way.

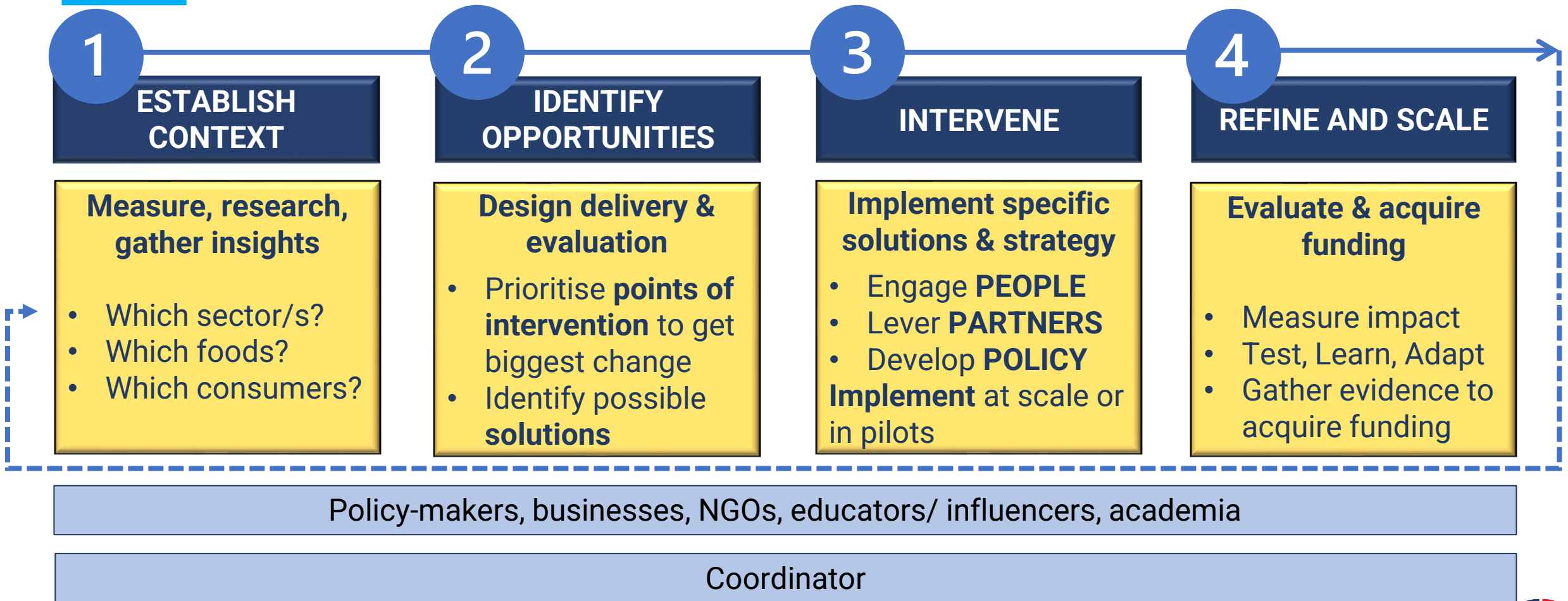
Drives innovation across the sector to create long term change.

Enables the sharing of best practice so the whole of the industry can contribute to changing the food system to prevent food waste

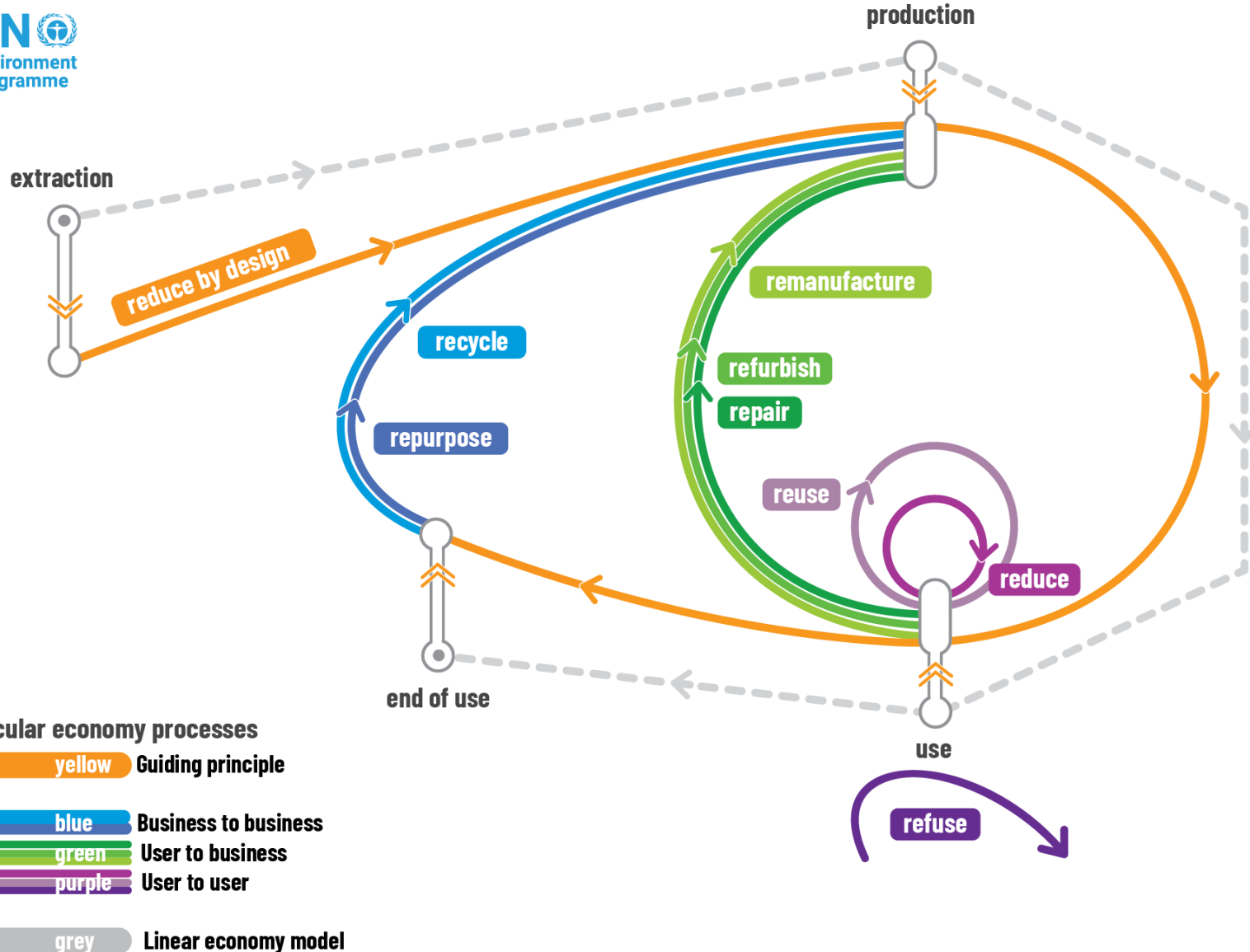
Requires measurement & reporting which enables the monitoring of progress against agreed targets



Consumer Behaviour Change



Circular Food Economy



Framework to approach upcycling

Key initial questions:

- **What** resources do we have available? In what quantities?
- **What** can be achieved with those resources?
- **Where/when** are those resources available?
- **How accessible?** Competing use for resources?
- Do end markets exist? Do they need creation? What role for policy in supporting them?



Green Technology

Reduce
excess
production
or purchase

Ensure as
much sold
/distributed
as possible

Making the
most of
food which
is bought/
produced

Measuring
and
monitoring

Reduce
damage in
handling

Increase
stability of
produce

Closing the
loop of
wastes
generated



National Food Waste Strategy

	Retail and supply chain waste	Food service waste	Consumer / household waste	Waste management
Public private partnerships	Is a PPP a suitable solution to retail waste in your country? Which organisations could be involved in a PPP?			
Behaviour change	Behaviour change campaigns in the retail environment could reduce household waste. E.g. buying more loose, increasing knowledge (different date labels etc.).	Behaviour change likely relevant in many settings, e.g. restaurants, schools, hotels. What's the right solution for each place?	What skills/knowledge could help consumers minimise their waste? What media could be utilised to deliver campaigns?	Could a campaign be used to increase participation in food waste recycling?
Circular economy	How can organisations repurpose wastes that cannot be prevented?	How can organisations repurpose wastes that cannot be prevented?	How can household wastes be most effectively recycled?	
Green tech	Can technology be implemented to support forecasting. Is dynamic pricing viable?	Can tech support redistribution, e.g. via apps?	How can green tech help consumers to buy what they need/use everything they need?	

Your strategy

National Food Waste Reduction Strategy Template

Following on from the first series of Regional Working Groups that aimed to support nations to create actionable plans to for food waste measurement to report against SDG 12.3.1, the present series focuses on delivering food waste reductions.

To fully benefit from participating in the workshop series, participants are invited to complete the following document, with the aim to guide participants in developing a National Food Waste Strategy.

Please follow the template below. The questions presented show key information you want to capture. If you do not have data which could inform this in your country, expert judgement between Regional Working Group participants will be sufficient to start, though you should think about how evidence gaps can be filled. For additional guidance, including prompts for each section relevant to the workshop series, please see 'National Food Waste Reduction Strategy Outline Guidance Document'.

Context and background

- **What is known** about food waste in your country?
- **What political objectives or targets** exist around food waste?
- How does FLW prevention and waste management **contribute to other social, economic and environmental objectives**?
- **What has been done so far?** See [Germany's Food Waste strategy](#) 'Ongoing work' (page 9)

Reducing retail and supply chain waste

- **What are your retail supply chains like?** For example, how much food goes through supermarkets when compared to traditional shops or farmers' markets? Do retailers control their supply chains or do wholesalers and 'middlemen' play a large role? How does this impact your approach to food waste reduction? Evidence of market analysis is demonstrated in [Canada's Food Loss and Waste Strategy](#) (pages 6-11).

Key questions:

- 1) Does your country have a food waste baseline figure?
- 2) Thinking about funding for food waste measurement and reduction strategies, who, in your country, could be responsible? Consider private organisations and public bodies.
- 3) Can you list the key stakeholders that you feel would need to be engaged in an effective PPP in your country?
- 4) Thinking about food service and household food waste, how could circular economy principles or behaviour change campaigns target waste generating activities that are specific to your country. Consider what by products are produced in your country, consider dining out culture. Also think about any research that has been conducted or could be carried out to understand these sectors.

Workshop close

Thank you!