

Household measurement methods

Food in households

- **Food and associated inedible parts** removed from the human food supply chain in Households



Guidance for countries to measure food waste

Sector	Methods of measurement							
Manufacturing (if included)	Weighing Direct measurement (for food-only waste streams)			Waste composition analysis (for waste streams in which food is mixed with non-food)	Volumetric assessment	Mass balance	Counting/ scanning	Not for collected, solid waste
Retail								
Diaries (for material going down sewer, home composted or fed to animals)								



Potential measurement methods

Food waste diaries

Questionnaires to households

Mass balance

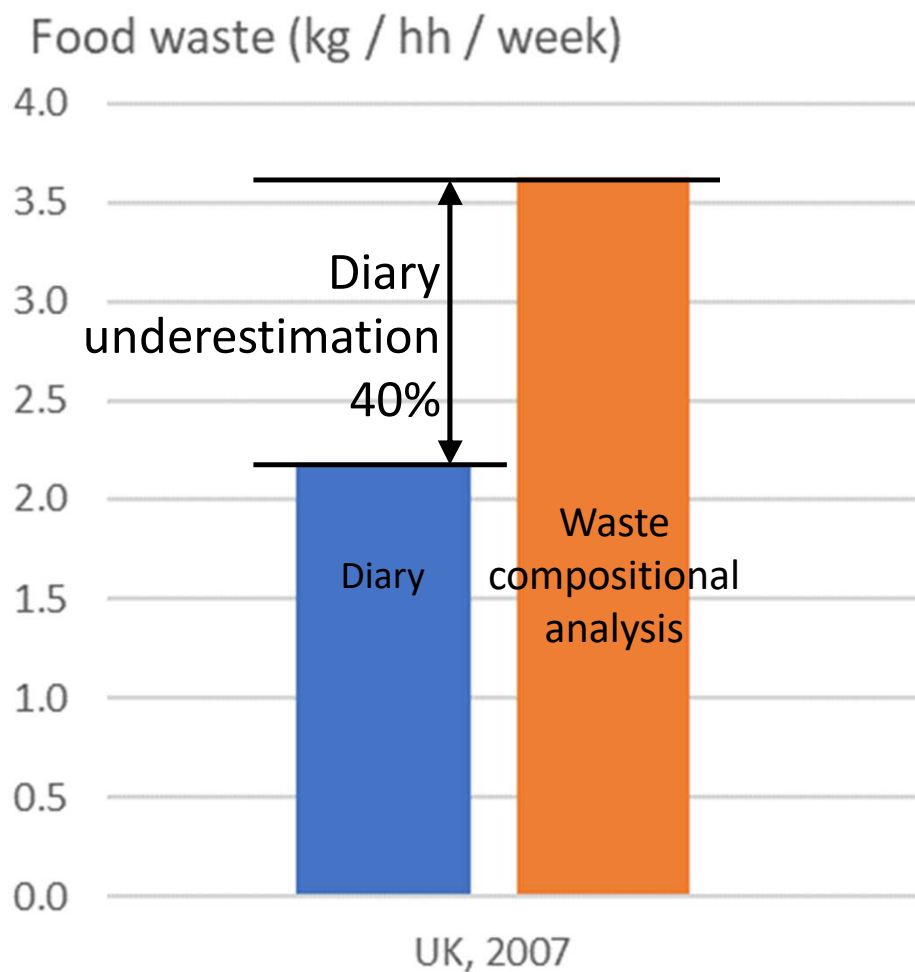
Weighing

Sorting and weighing (waste compositional analysis)



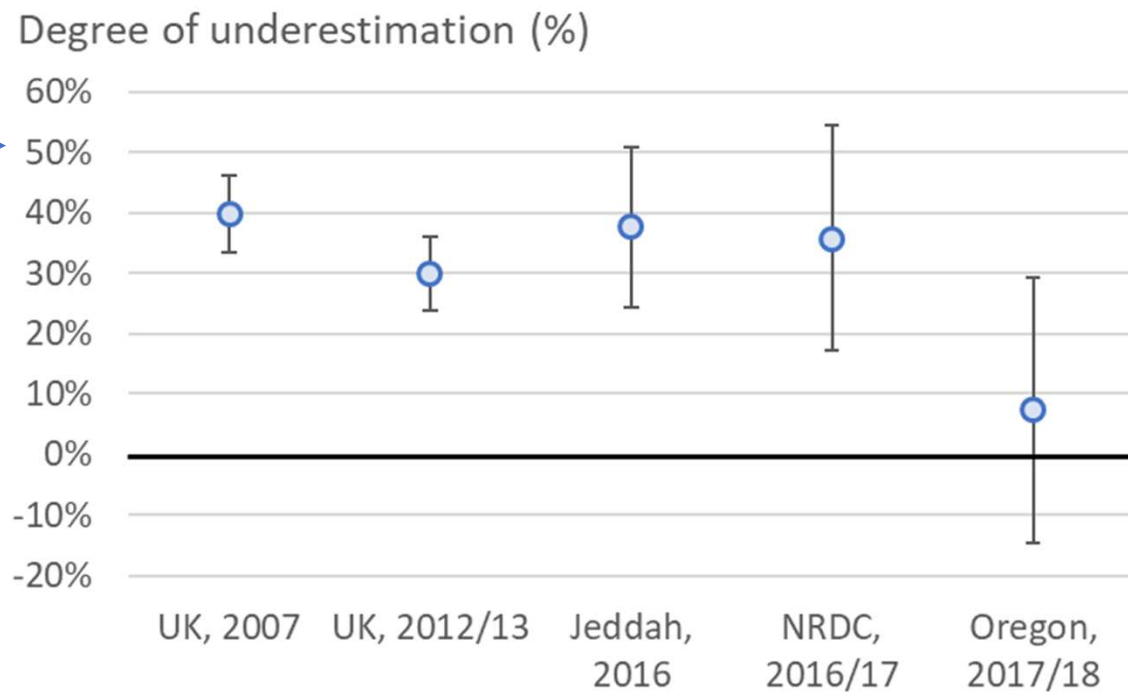
Diaries

Comparing food waste in waste streams collected by the municipalities from households →



Different diaries: different levels of underestimation

Five different comparisons



From: Comparing diaries and waste compositional analysis for measuring food waste in the home, <https://doi.org/10.1016/j.jclepro.2020.121263>



Potential reasons diaries underestimate

- Households change behaviour during diary period
- Households don't report all food waste
- Households measure food waste incorrectly
- People completing diaries not representative of whole population



Potential measurement methods

~~Food waste diaries~~

Questionnaires to households

Mass balance

Weighing

Sorting and weighing (waste compositional analysis)



**How much did you waste on
Saturday?**



Questionnaires underestimate more than diaries

Amount of food waste recorded (grammes / week)



<https://www.sciencedirect.com/science/article/pii/S0956053X19301345?via%3Dihub>



Potential reasons questionnaires underestimate

- Relies on memory: people forget
- Hard for people to estimate amounts of food waste
- Hard to develop questions that obtain relevant information



Potential measurement methods

~~Food waste diaries~~

~~Questionnaires to households~~

Mass balance

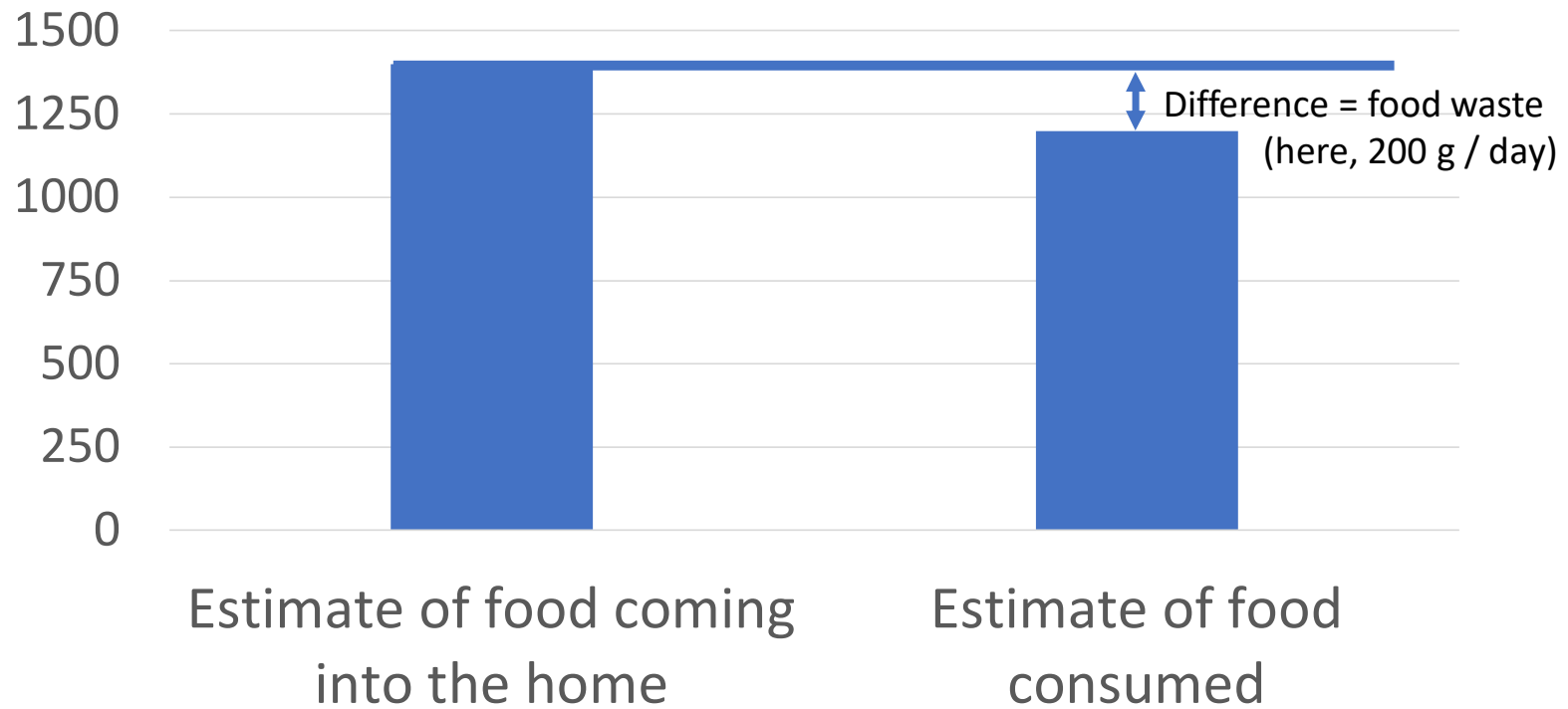
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Sorting and weighing (waste compositional analysis)



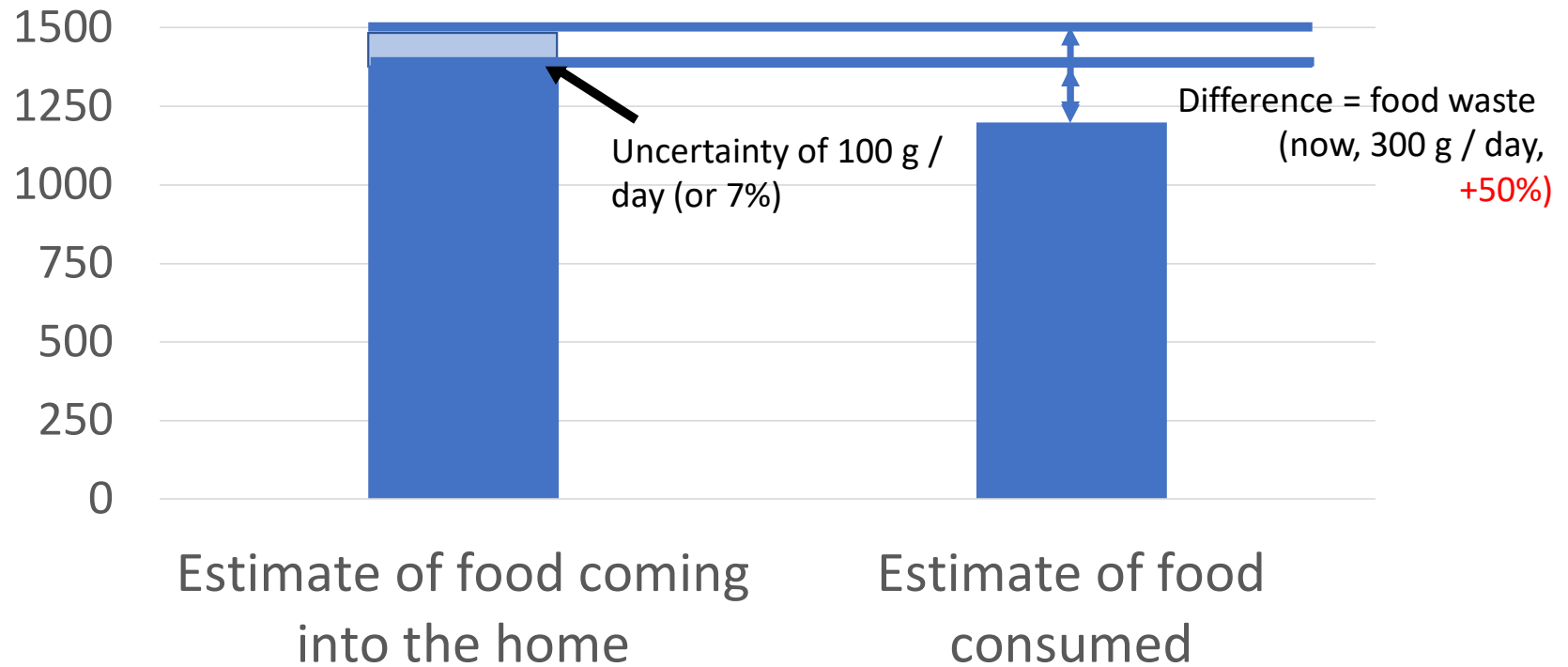
Mass Balance

Amount of food (grammes / day)



Mass Balance

Amount of food (grammes / day)



Inaccuracies in mass balance

- Need to have very accurate measures of
 - Amount of food going into people's homes
 - Amount of food eaten
- We get no information on where food waste ends up



Potential measurement methods

~~Food waste diaries~~

~~Questionnaires to households~~

~~Mass balance~~

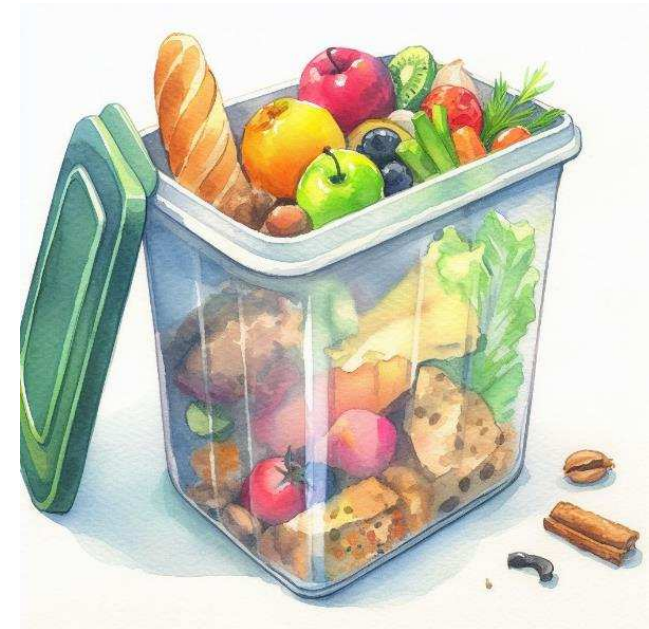
Weighing

Sorting and weighing (waste compositional analysis)



Weighing

- Possible where we have **food waste separated**, e.g. food waste recycling or collection schemes
- May lack nuance if not weighed for specific households
- **Do you have food waste collection schemes for households?**

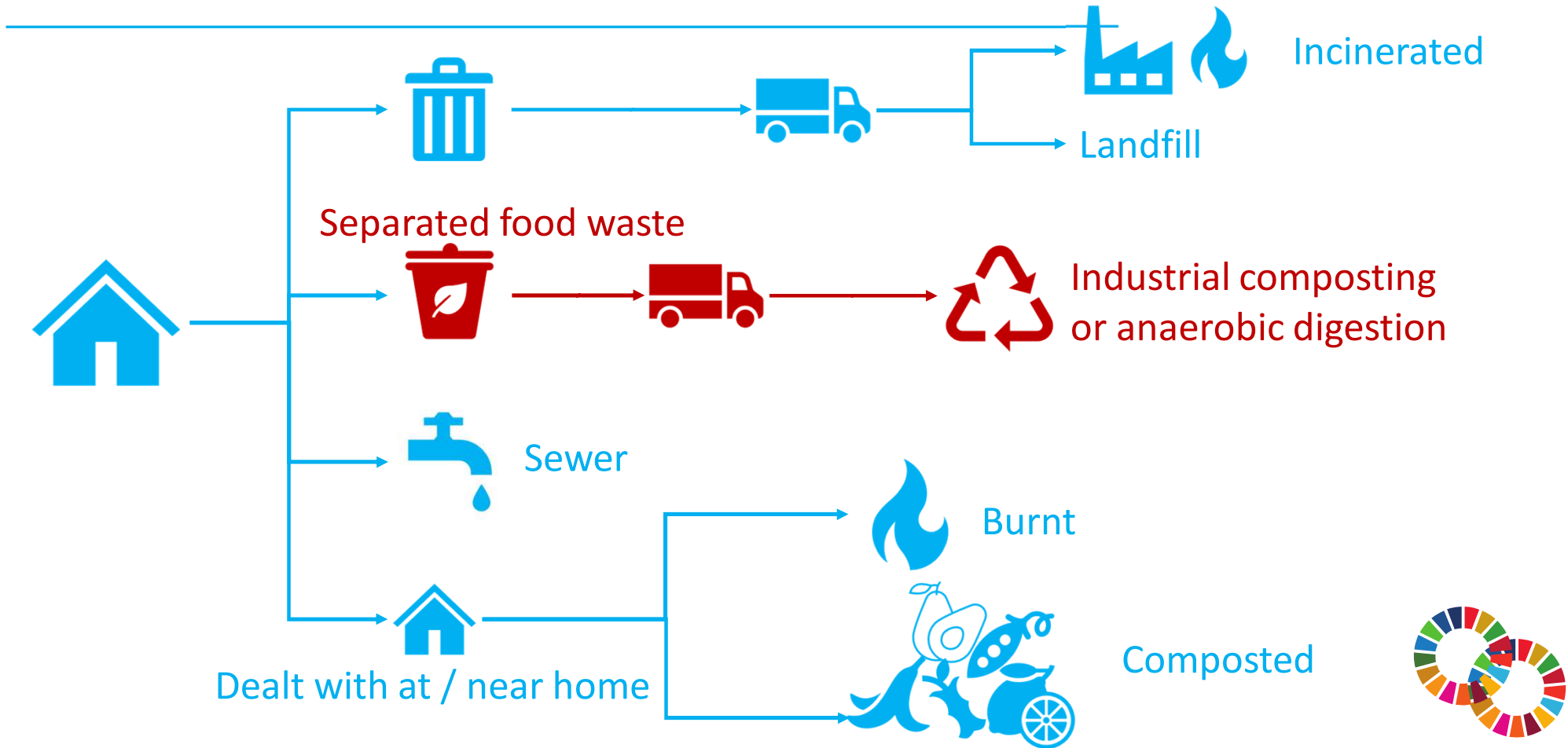


Waste Compositional Analysis

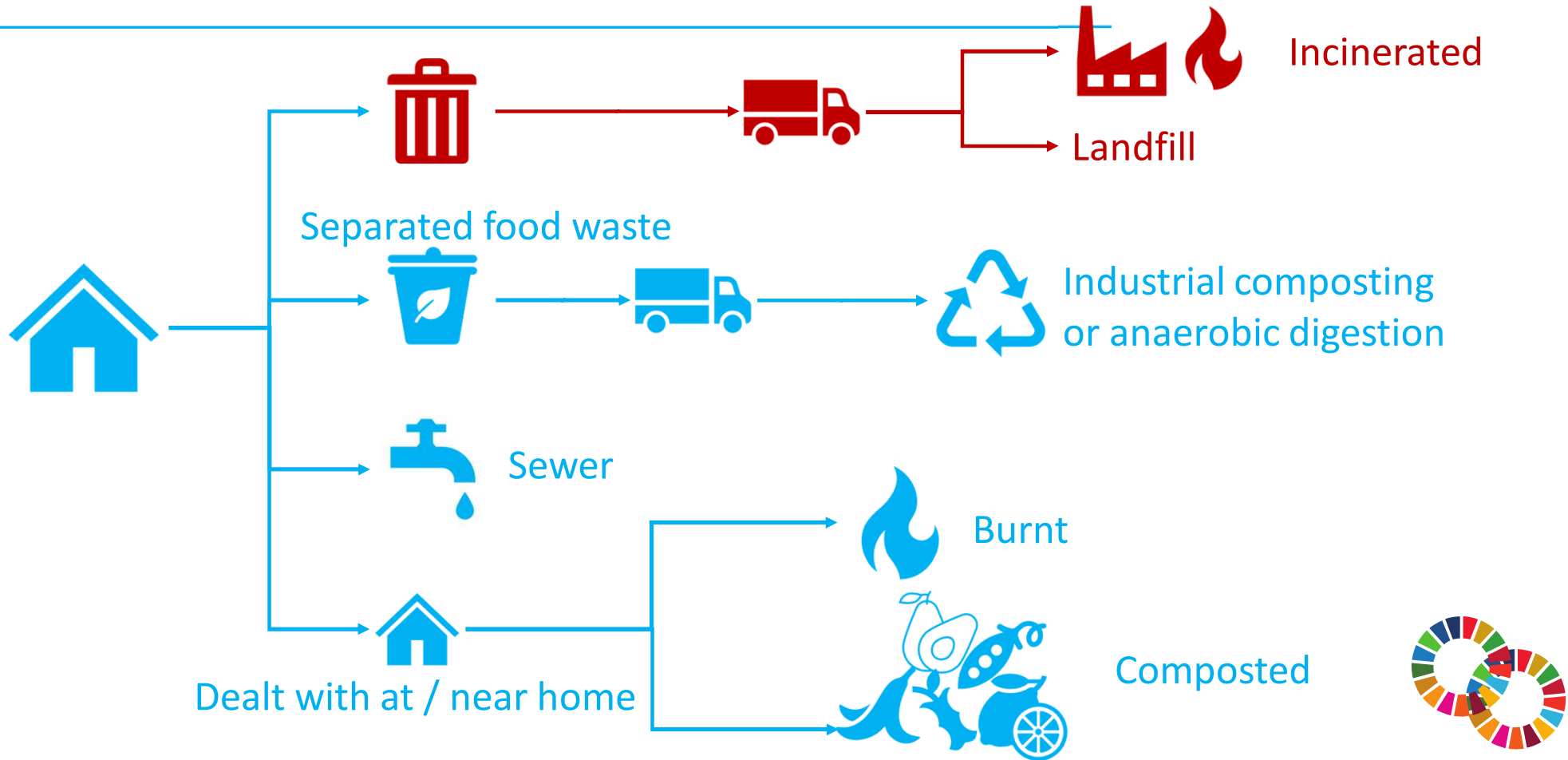
- Collecting, sorting and weighing of waste
- Many variations of this method
- General guidance in Chapter 4 in [Food Loss and Waste Standard's Guidance](#)
- Your country may have specific guidance or specifications (e.g. Standards)
 - These may need adapting to separate and weigh food waste specifically
 - It is useful to find guidance in your country and the people who develop these
- Other useful tool: [Waste Wise Cities Tool \(SDG 11.6\)](#)



Separated food waste = sorting not necessary



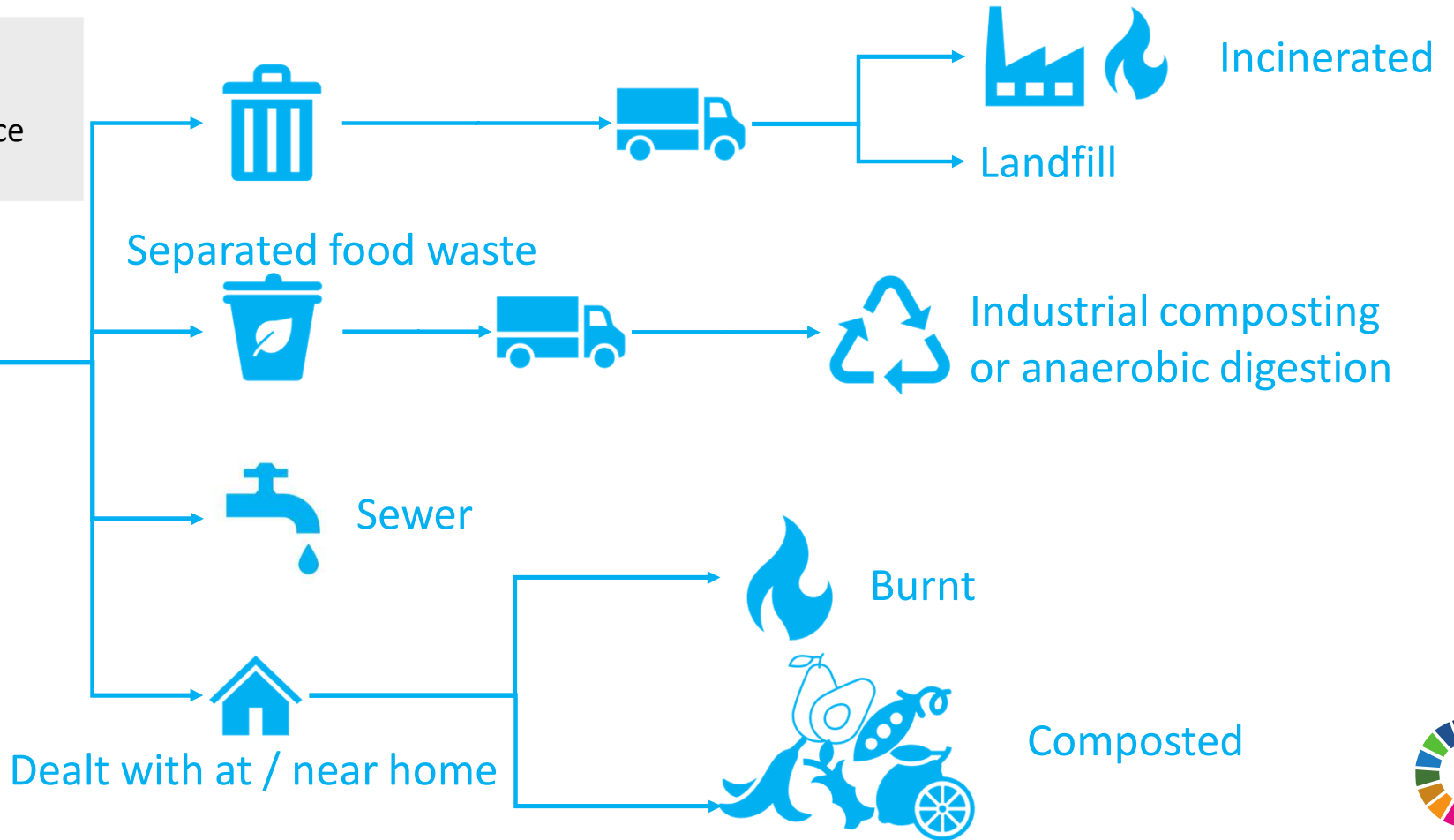
Mixed waste = sorting necessary



Collecting household data

Where and how to collect waste?

1. **Direct from households:** Ask households to place waste in bags



1. In-home interception

- Determine **sample** of households (covered later)
- **Recruit** households & determine demographics
- Distribute bags to households
- For 8 days, households **put all their waste in bags**: one bag for each day (or each 2-3 days) – discard first day
- Researchers **pick up bags** periodically through the week, take to sorting site
- Researchers **weigh total** waste for each household
- Researchers **sort waste** into different materials and weigh each material for each collection area
- **Divide food waste** by number of people to get 'per capita' figure



1. Advantages and disadvantages



- Can be deployed even where there are no formal waste collections
- Can identify waste from specific households where they otherwise share bins (e.g. block of flats)
- Potentially covers all solid food waste, if solid food waste which is treated at home (e.g. composting) is also put in the bag

- By asking households to do something different, they might change their behaviour
- Cannot determine what would have been the end destination of the waste unless otherwise asked of participants
- Can be more costly due to higher level of engagement required

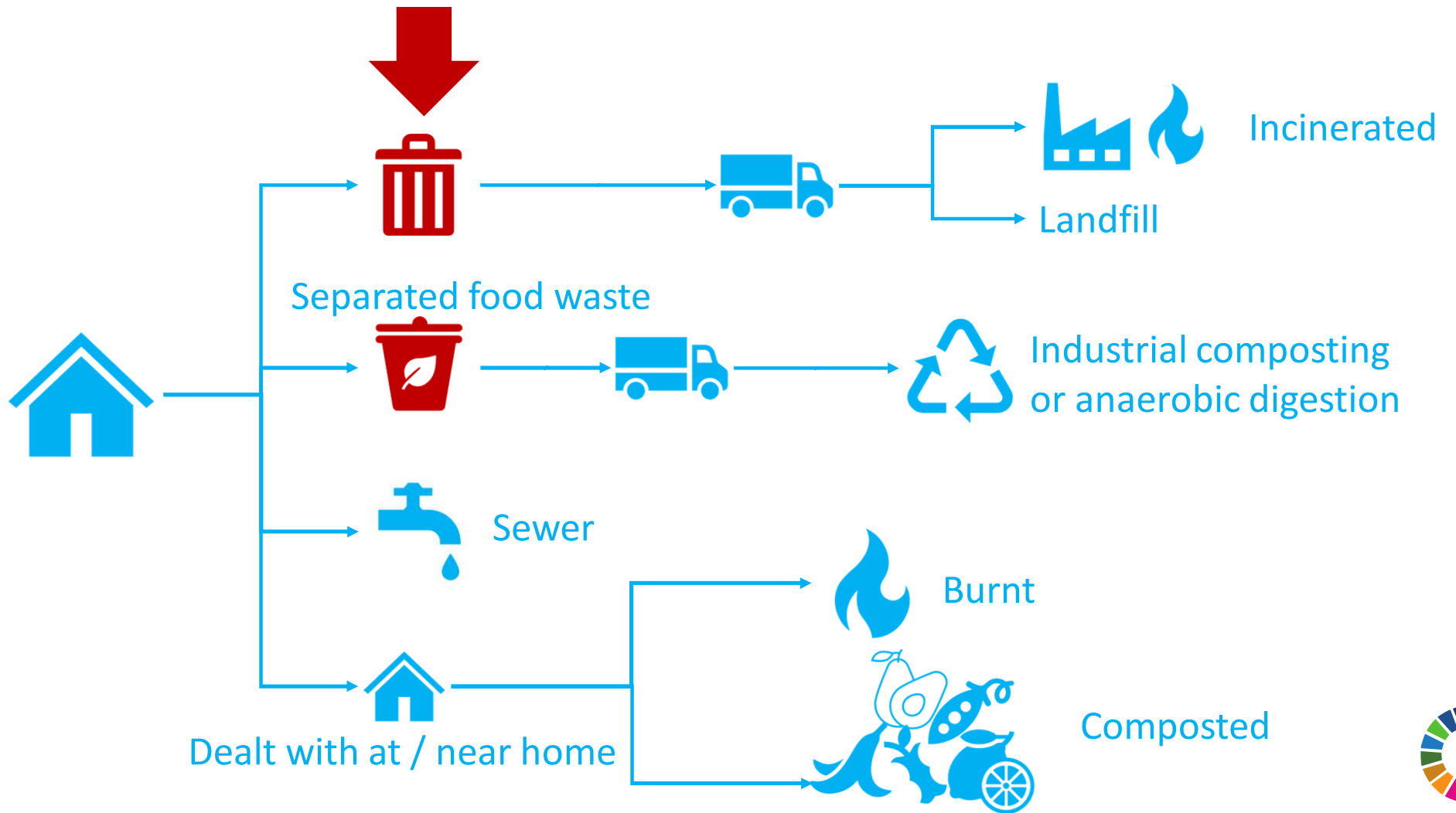


1. Direct from households

- Considerable overall with [Waste Wise Cities tool \(WaCT\)](#) for SDG 11.6 reporting in cities
- Possibility for synergies with adaptations
 - WaCT is for cities, Food Waste Index is for a whole country
 - Minimum WaCT sample is 90 households (for one city), Food Waste Index is 400 households
 - Useful to categorise food waste into edible and inedible parts



2. **Intercept collections:** intercept waste from formal collections ahead of usual collection



2. Intercept collections

- Determine **sample** of households (covered later)
- **Recruit** households & determine demographics
- Arrange with usual waste collectors for researchers to **pick up waste for a particular collection**, rather than the waste collectors
- Researchers **intercept waste** from receptacles of households on chosen date, keeping waste from different households separate and marked
- Researchers **weigh total waste, sort** waste into different materials and weigh each material
- **Divide food waste** by number of people to get 'per capita' figure



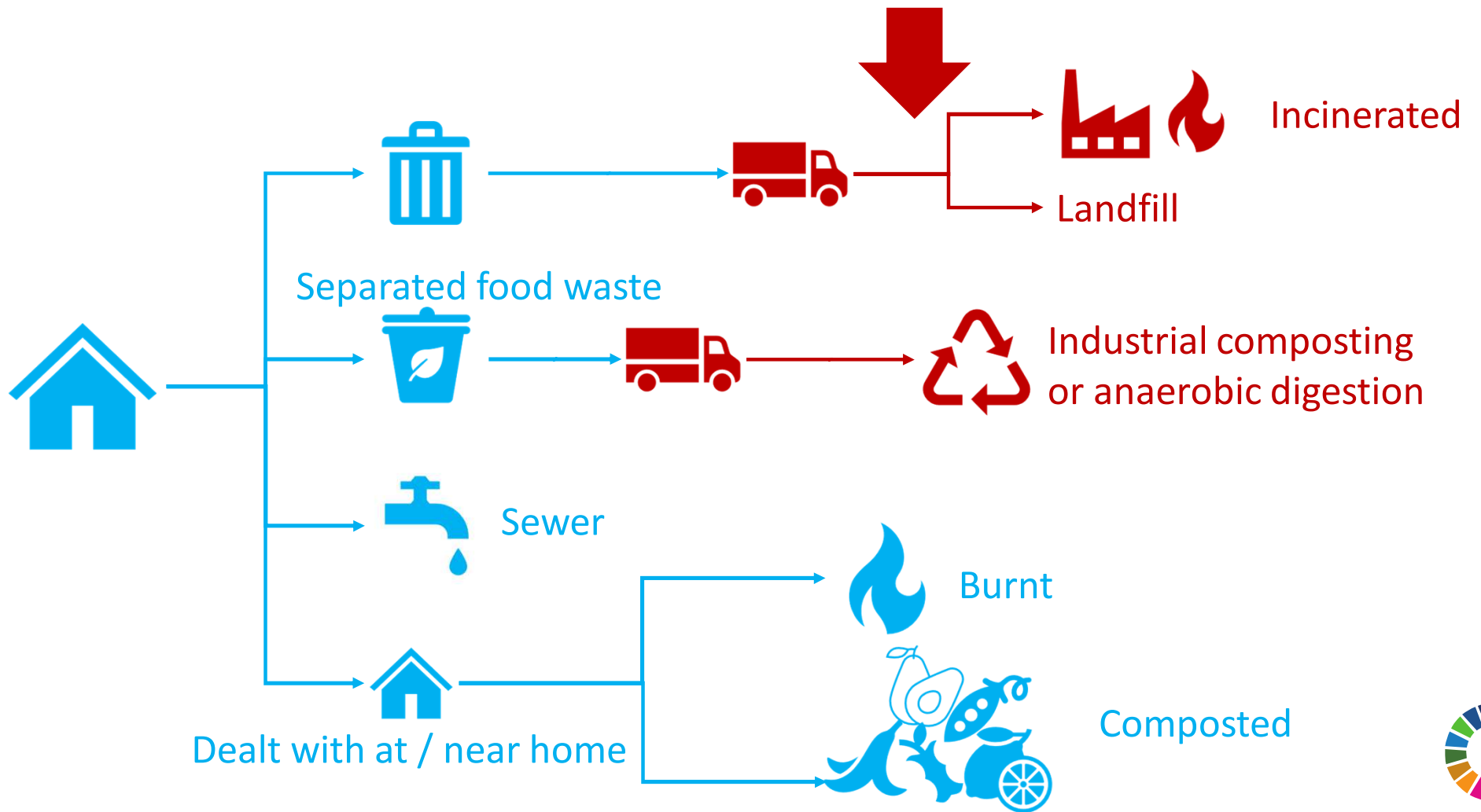
2. Advantages and disadvantages

- Low level of interaction with households reduces chances of behaviour change
- Data can be linked to specific households

- Only works where formal collections already exist
- Limited in situations where waste cannot be identified to a specific household, such as in a block of flats
- Only covers what is in formal collections



3. **Bulk sampling:** Sample from trucks at waste transfer station or disposal / treatment site



3. Bulk sampling

- Determine **waste sites and collection routes** to sample from
- Arrange with site staff to **intercept specific loads** of waste
- Researchers **intercept waste** from trucks on chosen date
- Researchers **weigh total waste, sort** waste into different materials and weigh each material
- To calculate 'per capita' food waste, need to apply % food waste from above to **data on total amount of waste** in that waste stream for the whole country and then divide by population



3. Advantages and disadvantages



- Usually the cheapest option
- Requires the least transport

- Cannot link data to specific households, only particular waste rounds or neighbourhoods
- Food waste gets squashed in the process, making sorting more difficult
- Does not cover all waste disposal routes
- Requires existing waste collections
- Risk of contamination from non-household waste (small businesses) creating inaccuracies
- Requires additional data on residents in households to get accurate per capita figures



Summary: where to collect waste?

	In-home interception	Bin interception	Bulk sampling
Interception	Before waste leaves home	From waste bins / bags set out for collection	From waste vehicles
Can work in absence of formal waste system?	✓	✗	✗
Can work if waste from households gets mixed	✓	✗	✓
Asking households to do something different?	Yes – could lead to underestimate	No	No
Need other waste data	No	No	Yes – total household waste in country
Relative cost	High	High	Low



Where to use each approach?

Method 1: Direct from households	Useful in areas with low coverage of formal waste collections, or where it is difficult to identify waste from individual households Can be used in most circumstances
Method 2: Intercept collections	Where most food waste is found in formal waste collections AND there is knowledge of which households use the receptacles/bins
Method 3: Bulk sampling	Where most food waste is found in formal waste collections, but it is difficult to identify waste from individual households

You may need to use different methods in different areas of your country!



**Which approach(es) might
work in your country?**



Sampling & scaling

Three key steps

Measure food waste at a **sampling unit**

- **Individual household**
- *Shared receptacle (e.g. block of flats)*

Normalise measurement with a relevant factor

- Divide sampled waste by relevant factor
- Number of individuals in the households to get per capita waste

Scaling data by a representative factor for a national estimate

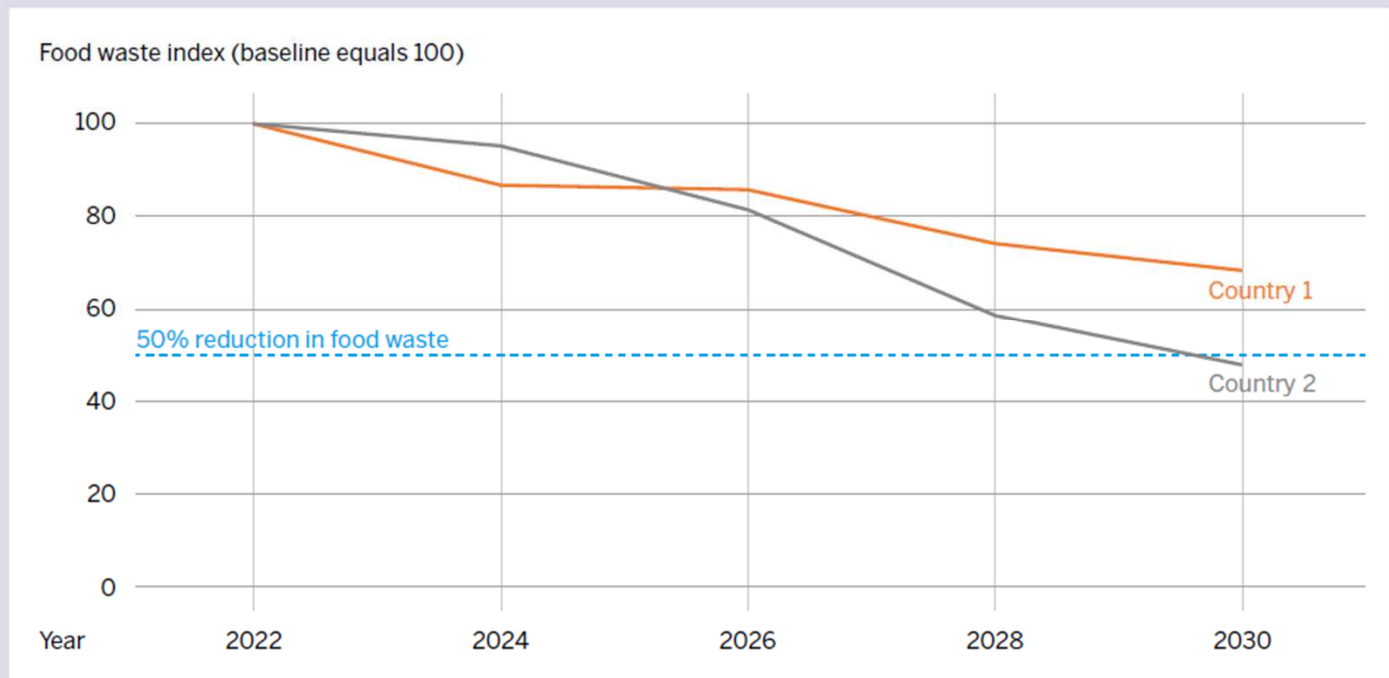
- With a **representative** sample, the normalised figure could be multiplied by relevant population figures



How many households to sample?

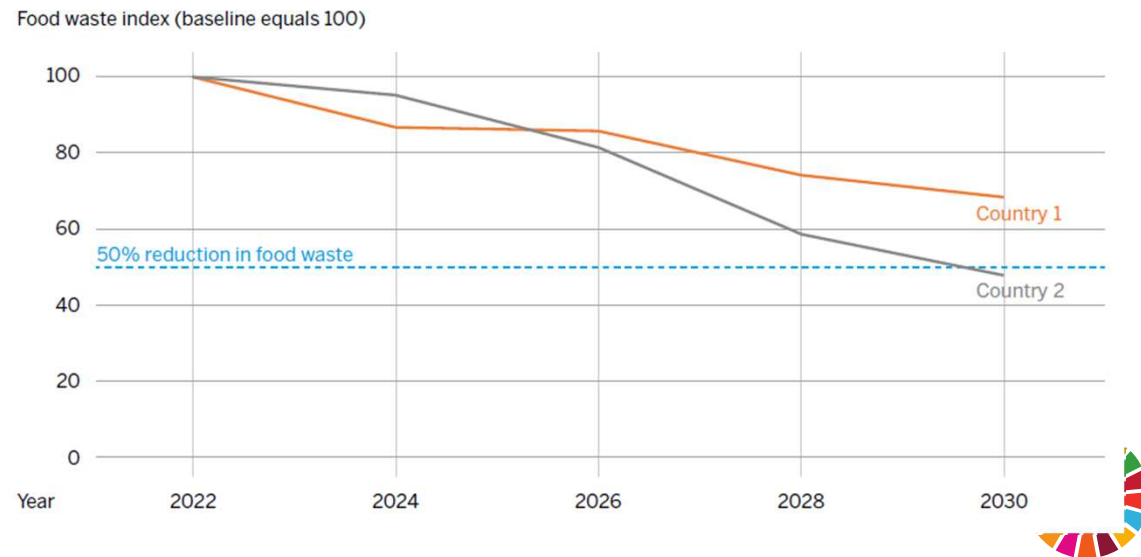
First, we need to know how accurate the results need to be

Figure 5: Food Waste Indices for two hypothetical countries



How many households to sample?

- Minimum accuracy: 95% confidence interval = 10% of estimate
- For example, household food waste = 80 ± 8 kg / person / year
- Allows evaluation of target in 2030 and where substantial progress is being made



How many households to sample?

More variation in food waste between households => larger sample size required

$$\text{Sample size} \approx \left(2 \times \frac{\text{Standard Deviation}}{\text{Desired 95\% confidence interval}} \right)^2$$

More accuracy (smaller confidence interval) => larger sample size

$$\text{Sample size} \approx \left(2 \times \frac{\text{Standard Deviation} / \text{Mean}}{\text{Desired 95\% confidence interval} / \text{Mean}} \right)^2$$

Standard deviation / mean ≈ 1

Desired 95% CI / mean $\approx 10\%$

$$\text{Sample size} \approx \left(2 \times \frac{1}{0.1} \right)^2 \approx 20^2 \approx 400 \text{ households}$$



How many households to sample?

- **Minimum sample size households = 400 households**
- **Accurate enough for tracking nationally ($\pm 10\%$) – Level 2**
- **For Level 3, more households required to generate useful information, e.g.,:**
 - Differences between types of households / areas
 - More info on types of food



Which households to sample?

- **Ensure sample households reflect your nation**
- **Sample should be representative:**
 - Time-related;
 - Geographical;
 - Urban / rural;
 - Socio-economic;
 - Types of household and types of waste collection;
- **Within these constraints, pick areas & households randomly where possible**
- **[Waste Wise Cities \(WWC\) Tool](#)**



Representative sample

- **Time-related representativeness**

- Take samples over at least one week
- Reflect variation across year – minimum two phases/seasons

- **Geographical representativeness:**

- Include households across different geographic regions
- Urban, peri-urban, rural areas should be considered

- **Socioeconomic representativeness:**

- Should capture multiple socioeconomic groupings
- At least three (low, medium, high) categories – locally defined

- **Types of household and waste collection**

- Single household, family households, blocks of flats, slums etc. – capture the diversity
- Households with door-to-door waste collection and those without

- **Plus anything else...**

- Further groupings which might influence how much food waste is generated



Building sample from sub-samples

- Sorting and weighing waste usually geographically clustered. Multiple levels needed to create sample:

- Select **cities / provinces / areas / municipalities**
- Select **collection rounds / neighbourhoods**
- Select **households**



Image from: [Waste Wise Cities \(WWC\) Tool](#)



Example sampling

Budget available for sampling 500 households in 50 clusters. Income level and urban / rural important.

Share of population:

	Urban	Rural
Low income	16%	35%
Middle income	19%	9%
High income	14%	7%

Number of clusters:

	Urban	Rural
Low income	8	17
Middle income	9	5
High income	7	4

To select location first cluster, 1) list all low-income, urban areas in country, 2) select three at random for sampling.

Then select 10 households within that area.



When to sample?

- **Food-waste measurement should reflect variation within a year**
- **As a minimum, sample in two distinct phases, for example:**
 - 200 households in dry season
 - 200 households in wet season
- **Ideally, spread the measurements through the year**



Summary: who and when

- 400 household minimum sample size
- Ensure sample reflects your nation (income, urban / rural, etc.)
- Sample throughout the year (minimum of two distinct phases)



Exercise

- **For your country, plan out:**
 - What are suitable measurement methods?
 - How could you collect waste from households?
 - What are the most important factors for a representative sample?



Household level 3

Data questionnaire / 3 levels

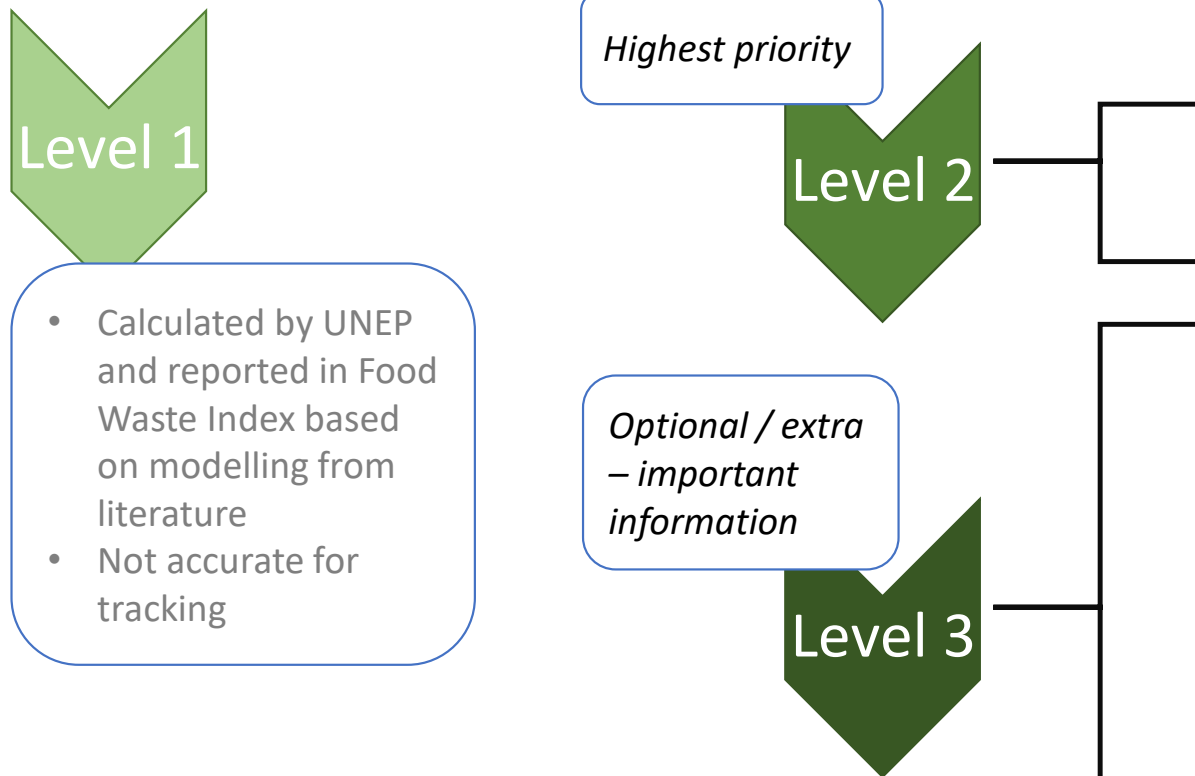


Table F1: Food Waste Generation and Management

Line	Category	Unit
1	Total food waste generated (=2+3+4)	tonnes
2	<i>Amounts generated by:</i> Retail trade, except of motor vehicles and motorcycles (ISIC 47)	tonnes
3	Food Service (ISIC 49-52, 55, 56, 84, 85)	tonnes
4	Households	tonnes
5	Total food waste generated: edible parts (=6+7+8)	tonnes
6	<i>Amounts generated by:</i> Retail trade, except of motor vehicles and motorcycles (ISIC 47)	tonnes
7	Food Service (ISIC 49-52, 55, 56, 84, 85)	tonnes
8	Households	tonnes
9	Total food waste treated or disposed of (=10+11+13+14+15+16)	tonnes
10	<i>Amounts going to:</i> Codigestion / anaerobic digestion	tonnes
11	Composting / aerobic process	tonnes
12	<i>of which: by households</i>	tonnes
13	Incineration / Combustion	tonnes
14	Landfilling	tonnes
15	Sewer	tonnes
16	Other, please specify in the footnote	tonnes
17	Food loss generated at Manufacturing level	tonnes



Data questionnaire / 3 levels

Highest priority

Level 2

Optional / extra
– important
information

Level 3

Table F1: Food Waste Generation and Management

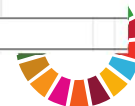
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Data questionnaire / 3 levels

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Data questionnaire / 3 levels

Edible / inedible parts

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Waste destinations

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Manufacturing losses

17	Food loss generated at Manufacturing level	tonnes																	
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Data questionnaire / 3 levels

Edible / inedible parts

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Causes of waste

Not included in reporting, but very useful information to gather for designing strategy

