FOOD stars — Innovative Food Product Development Cycle: Frame for Stepping Up Research Excellence of FINS

European Commission

Current issues of waste across the food chain

By-products, co-products and waste utilisation

Dr Brijesh K Tiwari

brijesh.tiwari@teagasc.ie

Horizon 2020 | European Union funding for Research & Innovation
Grant Agreement number: 692276 — FOODstars | H2020-TWINN-2015

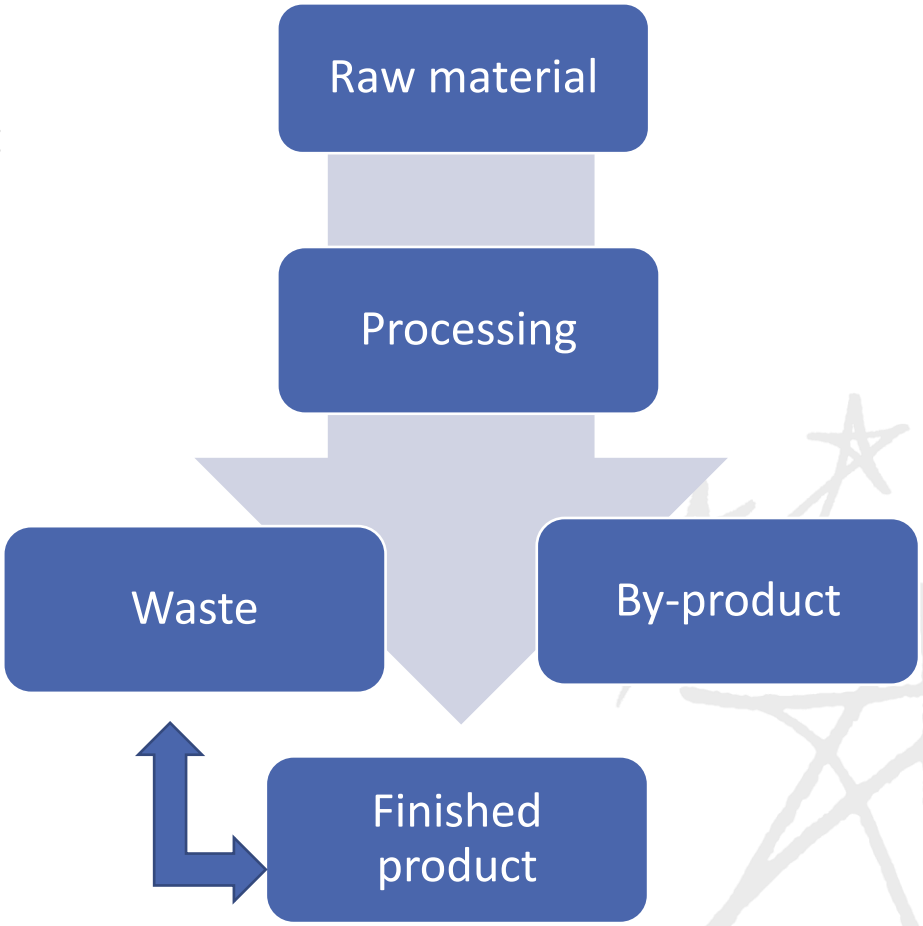
Definitions

Food Loss: The decrease in edible food mass at production, postharvest, processing, and distribution in value chains directed to human consumption.

Food Waste: Food fit for human consumption being discarded at the retail or consumer level.

Food Wastage: Encompasses “food loss” and “food waste.

By-product: Something produced in the making of something else or a secondary result.

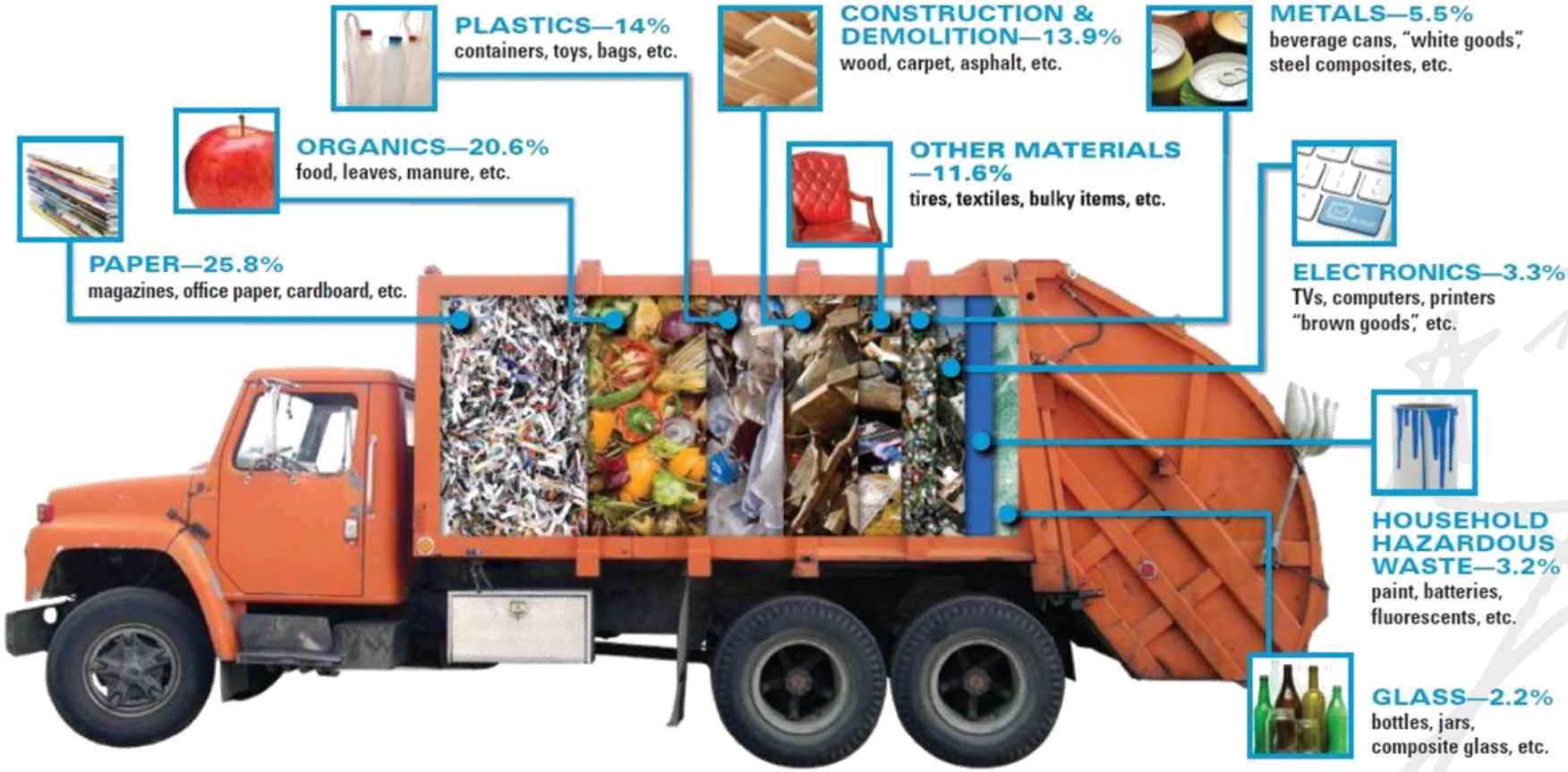


Definitions

- What proofs are relevant for *prima facie* evidence of a product/by-product ?
  - Economic value
  - Produced intentionally
  - Subject to product/use regulations
  - Use is permitted
  - Use for purpose intended

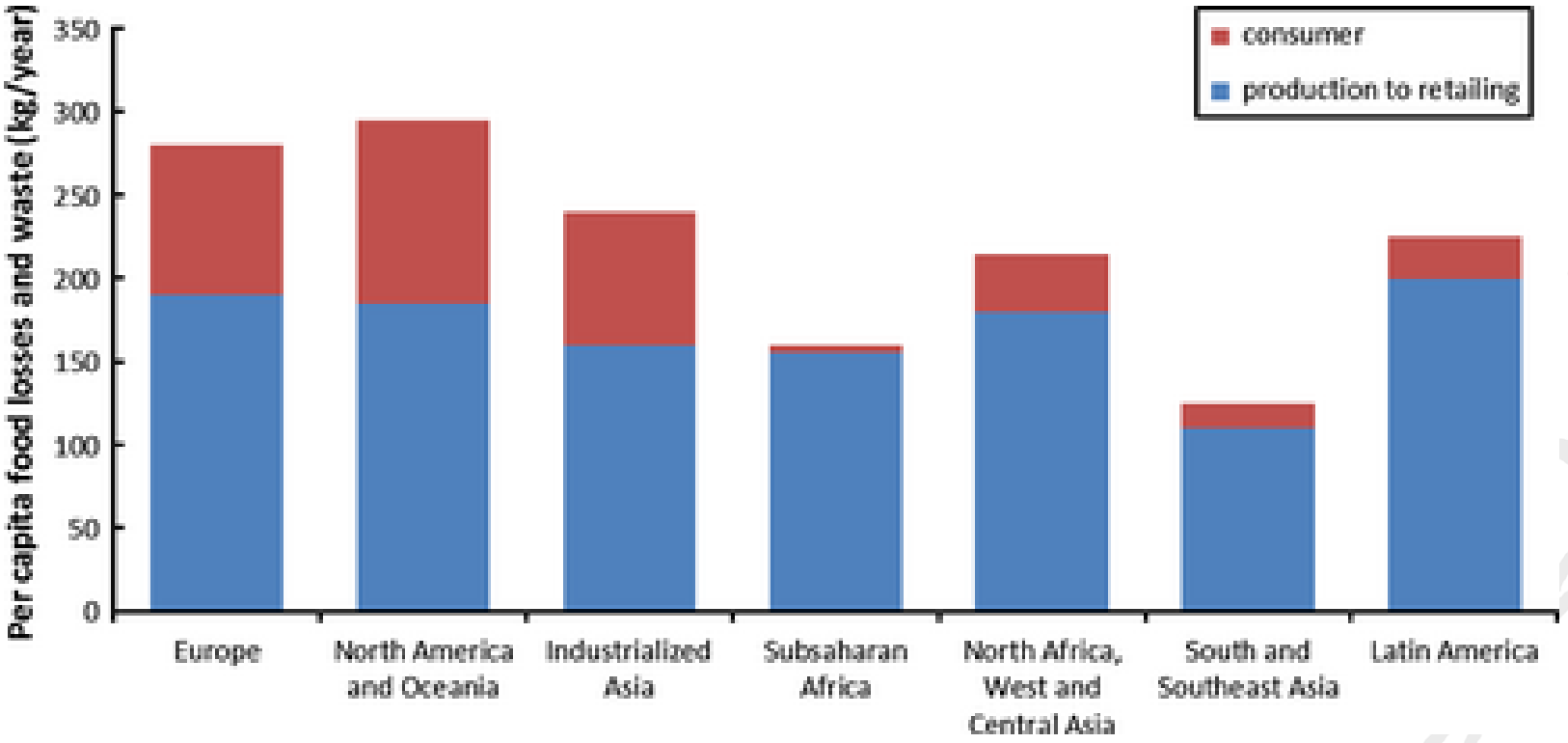
- In the case of a product the presumption is that they are not waste until proven otherwise.

What is waste ?



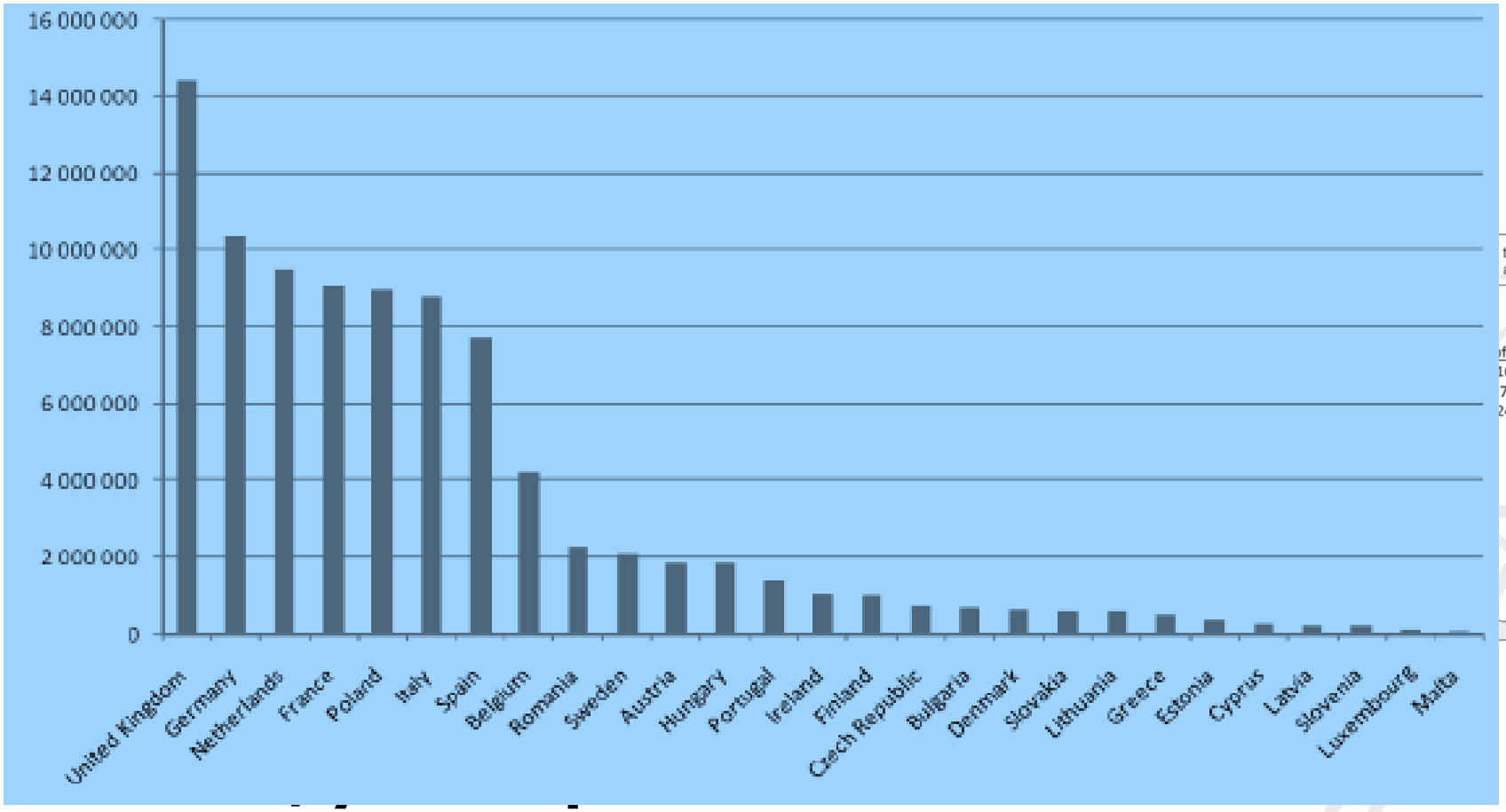
Around one third of the food produced globally is lost or wasted

Per capita food losses and waste, at consumption and pre-consumption stages, in different regions



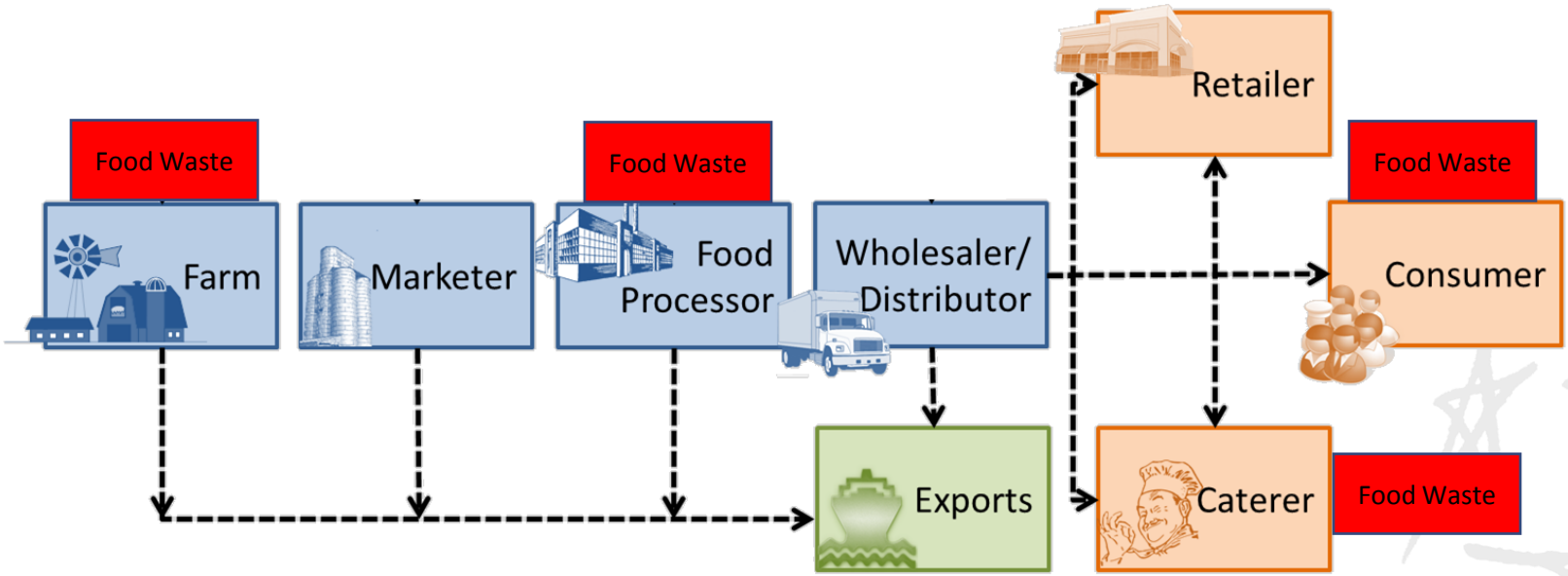
Balu et al. 2012. *ChemSusChem* **5**:1694–1697.

Food waste in Europe

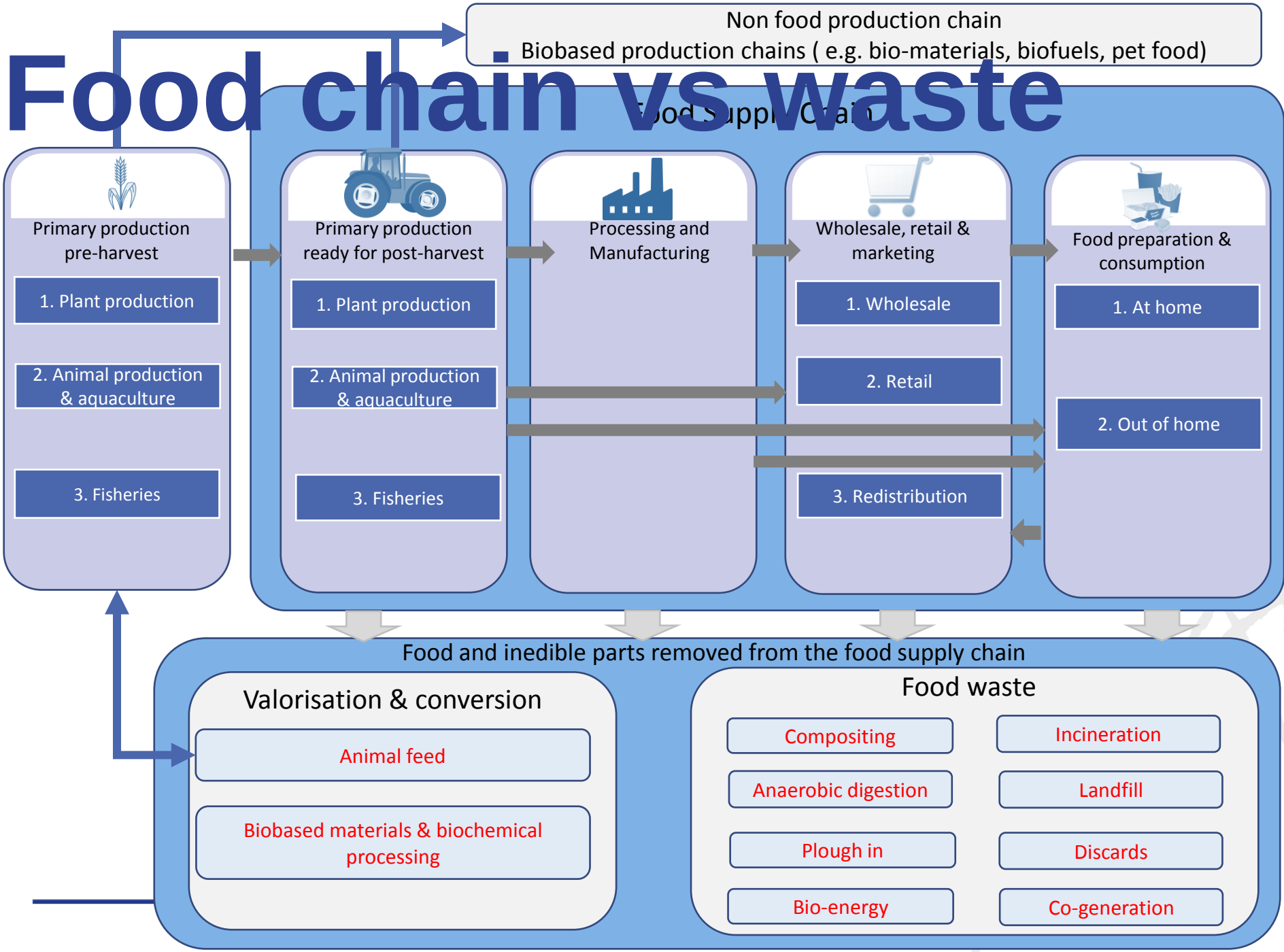


D Vanham et al 2015 Environ. Res. Lett. 10 084008 doi:10.1088/1748-9326/10/8/084008

Food chain

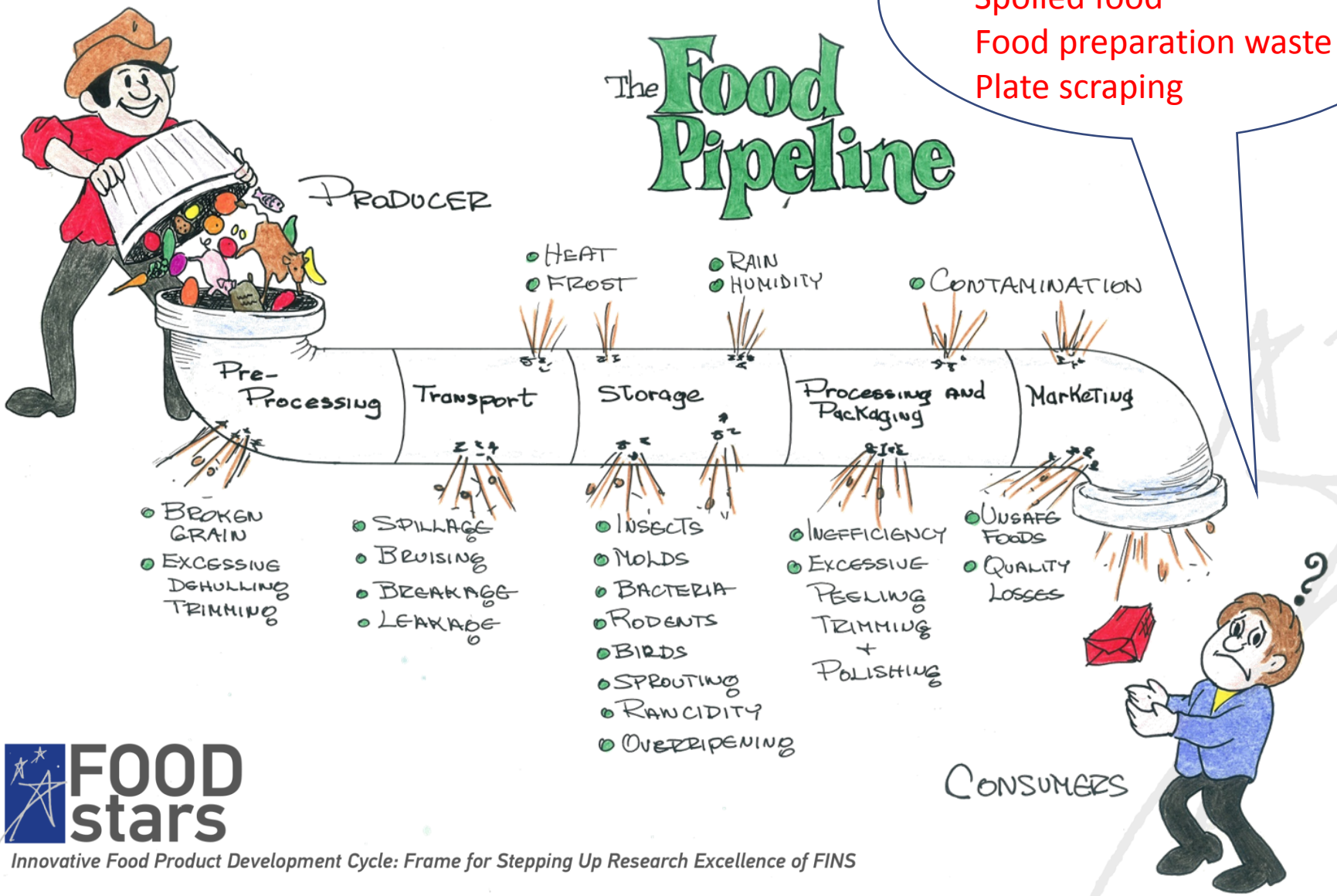

Food Waste
Farm
Food Waste
Marketer
Food Waste
Food Processor
Wholesaler/ Distributor
Retailer
Food Waste
Consumer
Exports
Caterer
Food Waste

Food chain vs waste



Types of losses

Waste during storage
Surplus cooking
Spoiled food
Food preparation waste
Plate scraping

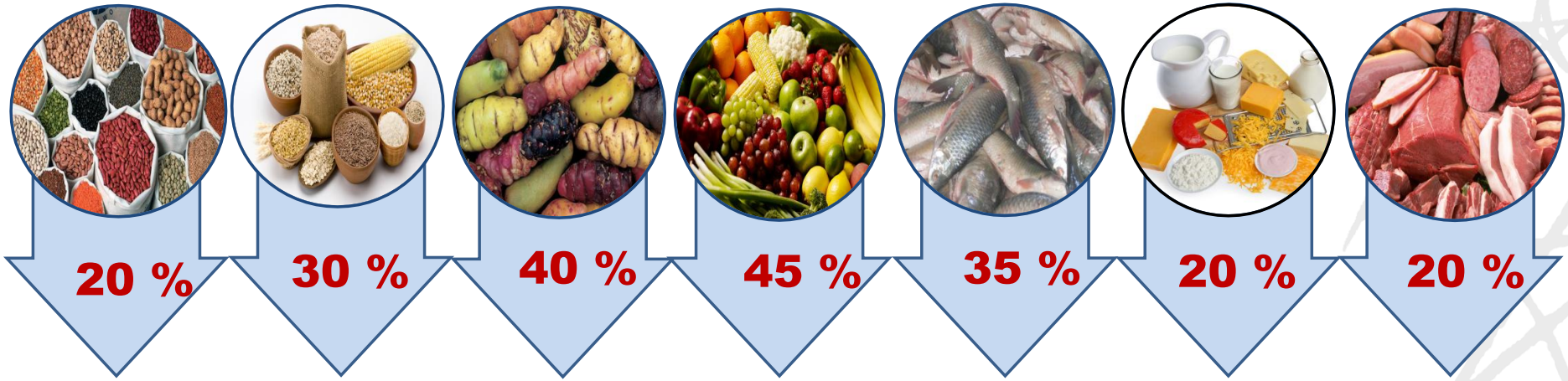


Loss Across the Value Chain

- **Agricultural Production Loss:** Spilled or damaged agricultural output during harvest, sorting, and handling.
- **Postharvest Handling and Storage Losses:** Losses due to spillage and degradation during handling, storage, and transportation off the farm.
- **Processing Losses:** Losses due to spillage and degradation during industrial or domestic processing, including crops sorted out or lost during process interruptions.
- **Distribution Losses:** Losses experienced while in the market system, e.g., in wholesale markets, supermarkets, retailers, and wet markets.
- **Consumption Waste:** Waste incurred at the household level, typically due to discards.

Where food waste occurs

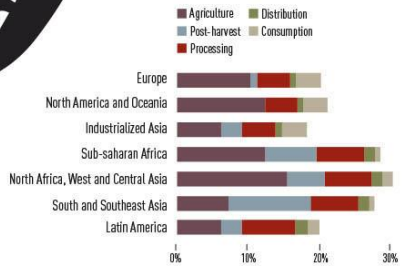
Where food waste occurs



20%
OILSEEDS & PULSES
FOOD LOSSES

Every year, 22% of the global production of oilseeds and pulses is lost or wasted.

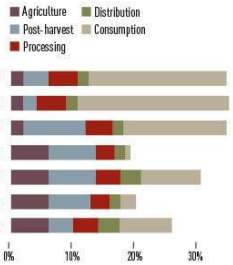
This is the same as the olives needed to produce enough olive oil to fill nearly 11 000 Olympic-sized swimming pools.



30%
CEREALS
FOOD LOSSES

In industrialized countries, consumers throw away 286 million tonnes of cereal products.

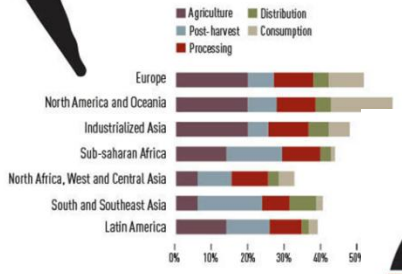
763 billion boxes of pasta



45%
ROOTS & TUBERS
FOOD LOSSES

In North America & Oceania alone, 5 814 000 tonnes of roots and tubers are wasted at the consumption stage alone.

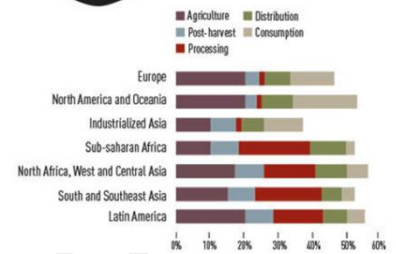
This equates to just over 1 billion bags of potatoes.



45%
FRUIT & VEGETABLES
FOOD LOSSES

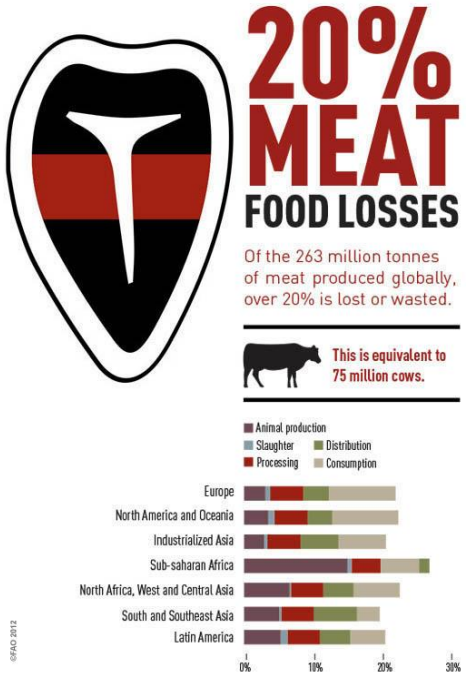
Along with roots and tubers, fruit and vegetables have the highest wastage rates of any food products; almost half of all the fruit and vegetables produced are wasted.

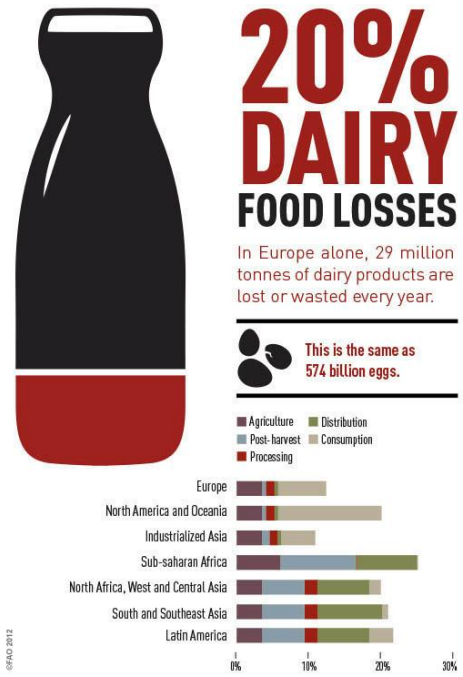
3.7 trillion apples



FOOD stars

Innovative Food Product Development Cycle: Frame for Stepping Up Research Excellence of FINS





FOOD stars

Innovative Food Product Development Cycle: Frame for Stepping Up Research Excellence of FINS

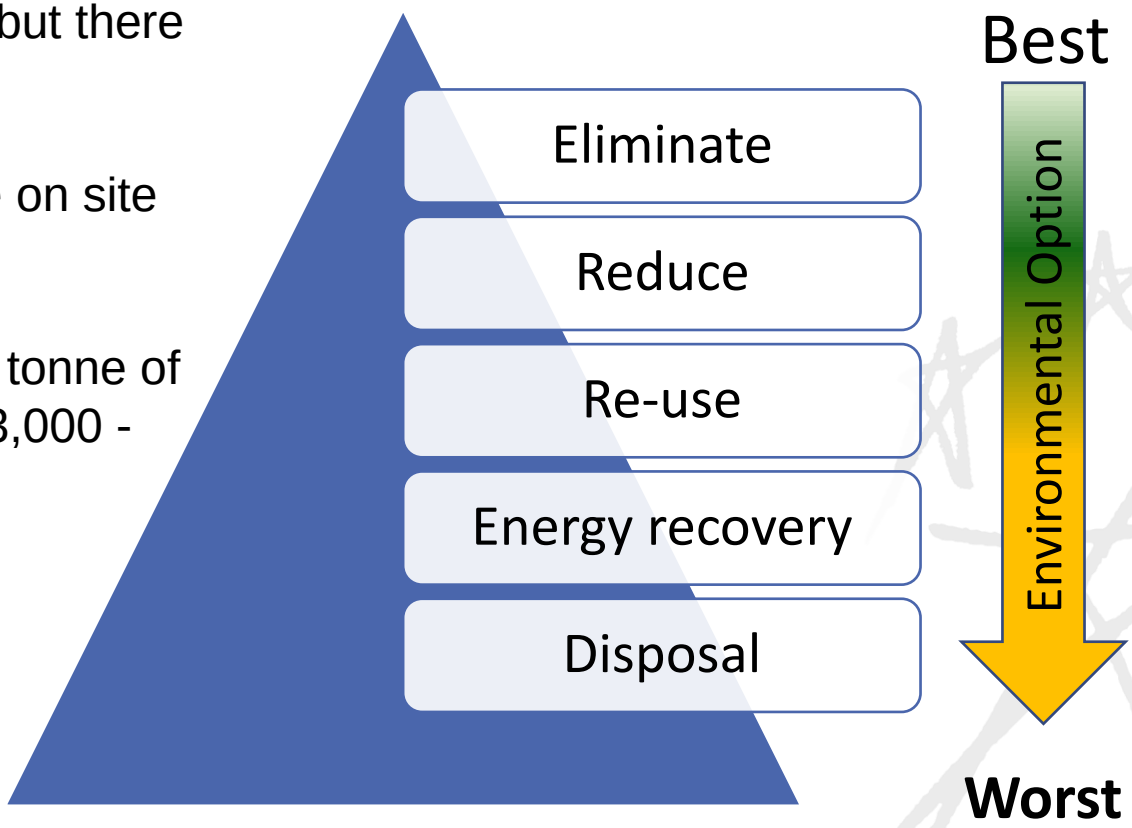
Impact of food waste

Environmental impact of food waste in North America and Europe. BCFN 2013.

Waste utilisation

- Not just the disposal costs – but there are other costs to consider
  - Costs to buy
  - Costs to cook & manage on site
  - Cost of disposal

It has been estimated that each tonne of food waste can cost between €3,000 - €4,000



Food waste – possible solutions

Preventing food waste = 1st priority

- Awareness raising, information & education
- Food redistribution programmes
- Logistical improvements
- Role of food packaging

Transforming unavoidable food waste into a resource

- Feed & energy recovery → separate collection of food waste necessary

What food is being throwing out?

60% Avoidable:

- plate scrapings
- leftovers
- gone off fruit and veg etables
- Best before date items
- damaged stock which cannot be used due to H&S, etc.

20% Potentially Avoidable

- bread crusts or heels made into bread crumbs
- vegetable trimmings used for stock and soups
- meat and fish bones used for stock
- discarded butter for cooking
- old fruit for jams and smoothies, etc.

20% Unavoidable

- banana skins
- animal bones (before or after used to make stock),
- unusable prep waste (e.g. potato peels with soil on them), etc.

Challenges...!

Business challenges

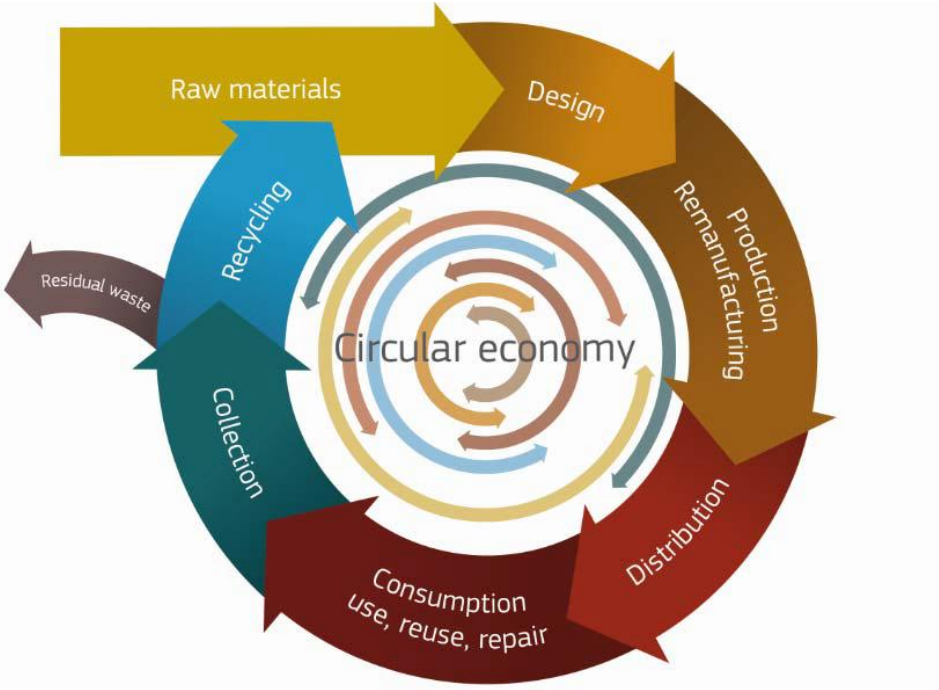
- Raw materials availability (volumes, seasonality)
- Logistics
- Market potential of products (volumes, value)
- Investment – Reducing risk
- Business models
- Economic and environmental impact

Research challenges

- Detailed compositional data of food waste materials
- Implementation of green processing technologies
- Integration of processing with technologies
- Process scalability & process economics
- Functionalisation of molecules to suit market applications/Consumer

Possible solutions

- Reduce waste
- Utilise waste for valuable compounds
- ‘Design out’ waste involving innovation throughout the value chain



Targets by 2030

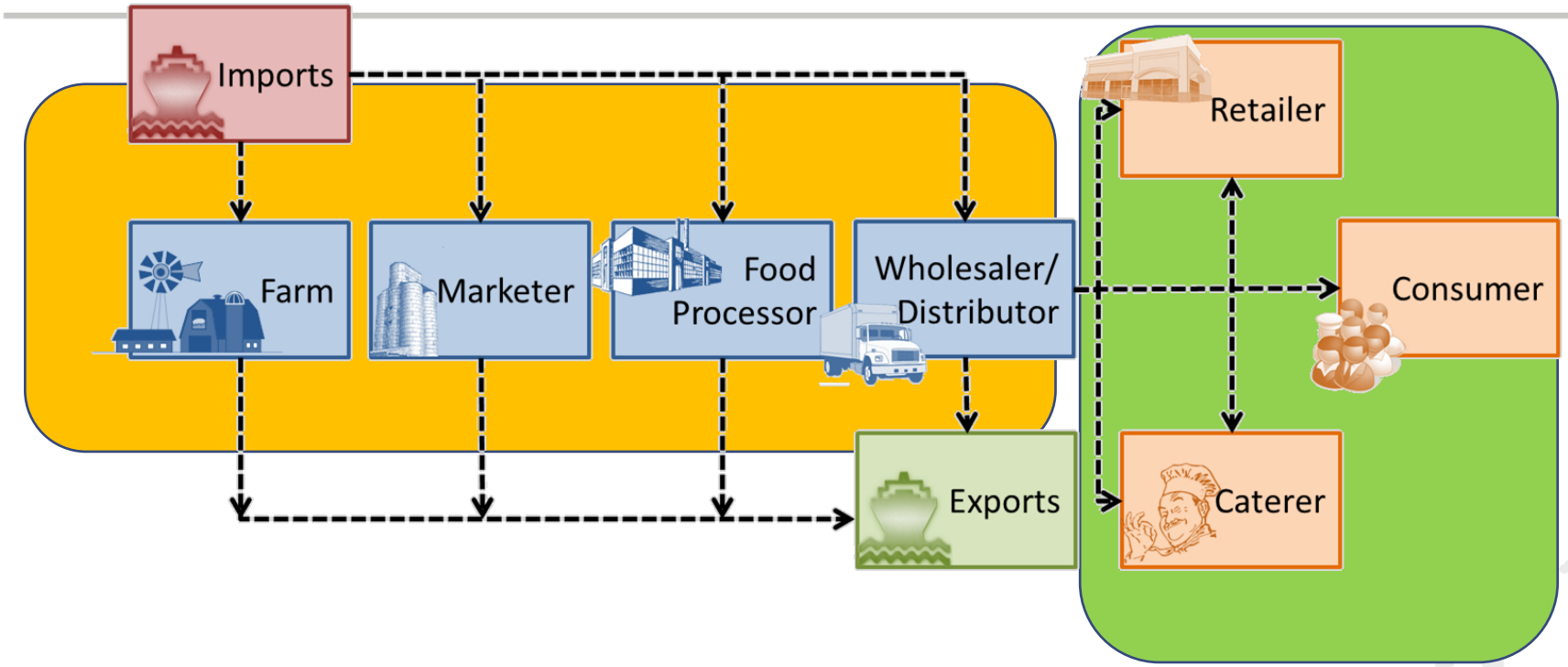
- Reduce material input by 17-24
- Saving potential €630 bn
- Reduce total GHG emissions

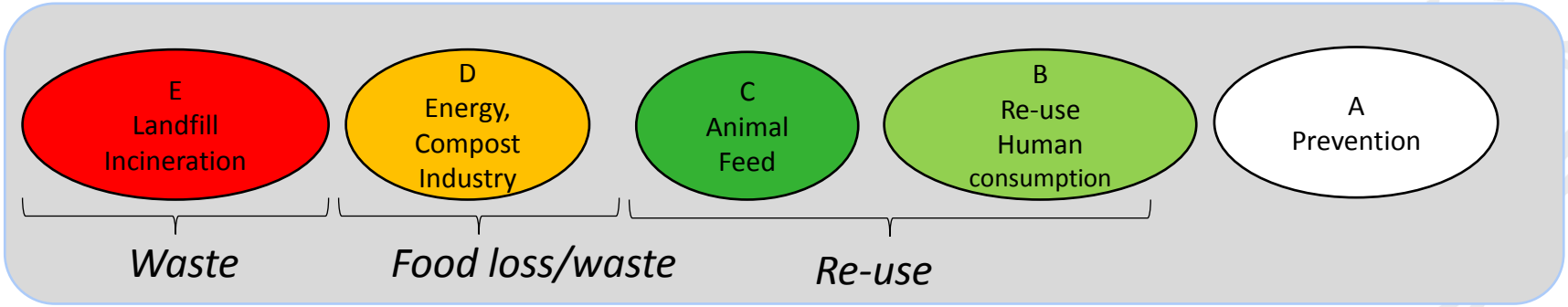
Towards a circular economy: A zero waste programme for Europe, European Commission, 2014 value chain

Bakery waste composition (per 100 g)

Content	Pastry	Cake	Wheat bran
1.N/A, data not available.			
Moisture	34.5 g	45.0 g	N/A
Starch (dry basis)	44.6 g	12.6 g	N/A
Carbohydrate	33.5 g	62.0 g	15.0 g
Lipids	35.2 g	19.0 g	6 g
Sucrose	4.5 g	22.7 g	N/A
Fructose	2.3 g	11.9 g	N/A
Free sugar			1.5 g
Fiber	N/A	N/A	50 g
Protein (TN × 5.7) (dry basis)	7.1 g	17.0 g	14.0 g
Total phosphorus (dry basis)	1.7 g	1.5 g	N/A
Ash (dry basis)	2.5 g	1.6 g	N/A

Zhang et al., 2013. Green Chem. 15:690–695. 62
Van-Thuoc et al.,2008. J. Appl. Microbiol. 104:420–428


Imports
Farm
Marketer
Food Processor
Wholesaler/ Distributor
Retailer
Consumer
Caterer
Exports


E
Landfill
Incineration
D
Energy,
Compost
Industry
C
Animal
Feed
B
Re-use
Human
consumption
A
Prevention
Waste
Food loss/waste
Re-use

DISCLAIMER:

The FOODstars project receives funding from
the European Union's Horizon 2020 research and innovation programme
under Grant Agreement No 692276.
This presentation reflects only
the opinion of authors and not the opinion of European Commission.

FOOD stars
Innovative Food Product Development Cycle: Frame for Stepping Up Research Excellence of FINS

European Commission

NAPOMENA:

Projekat FOODstars se finansira iz fondova
Evropske Unije, iz programa Horizont 2020 za istraživanja i inovacije
(broj ugovora 692276). Sadržina ove prezentacije
odražava samo mišljenje autora, a ne mišljenje Evropske komisije.

FOOD stars

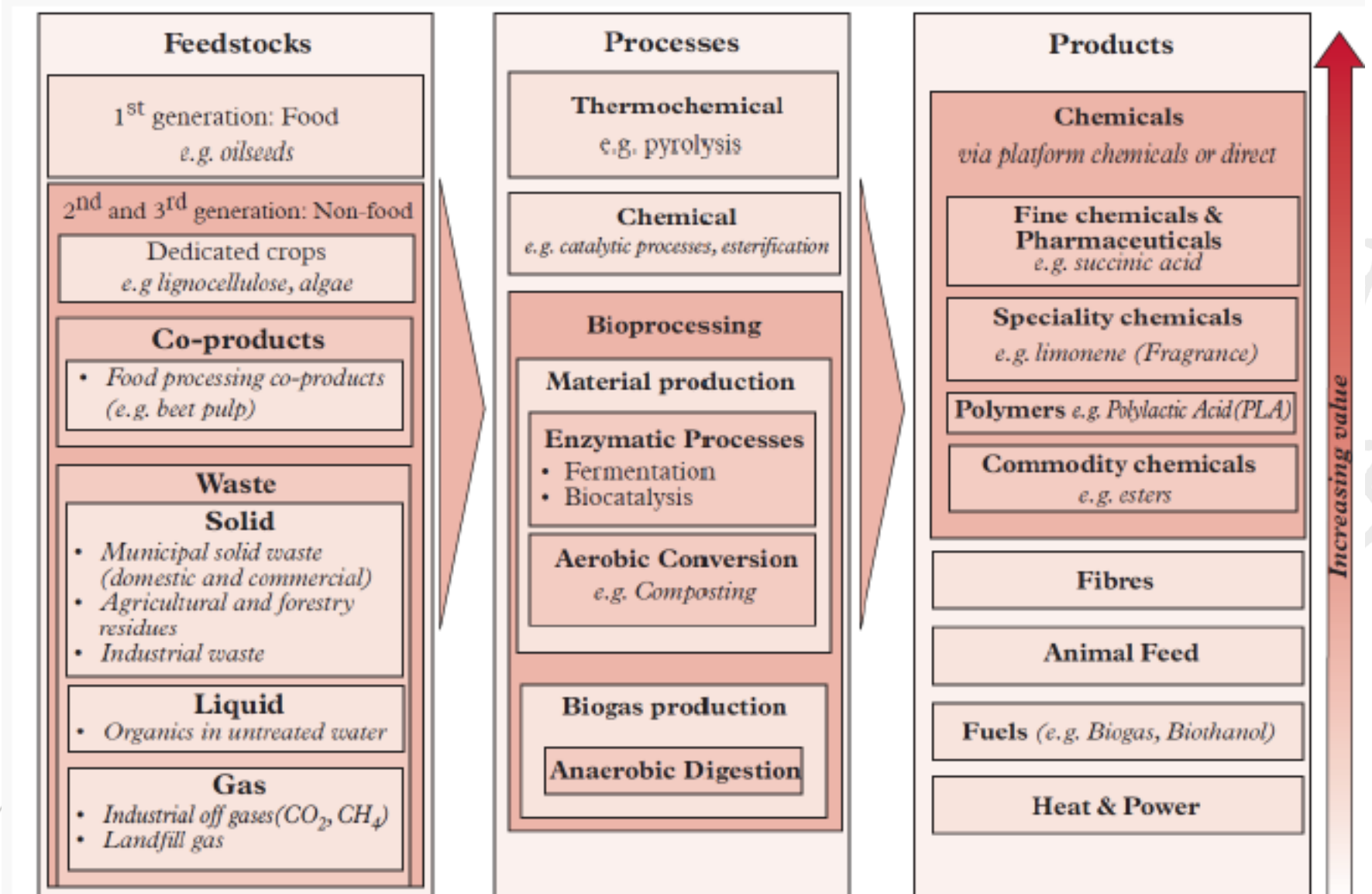
Innovative Food Product Development Cycle: Frame for Stepping Up Research Excellence of FINS

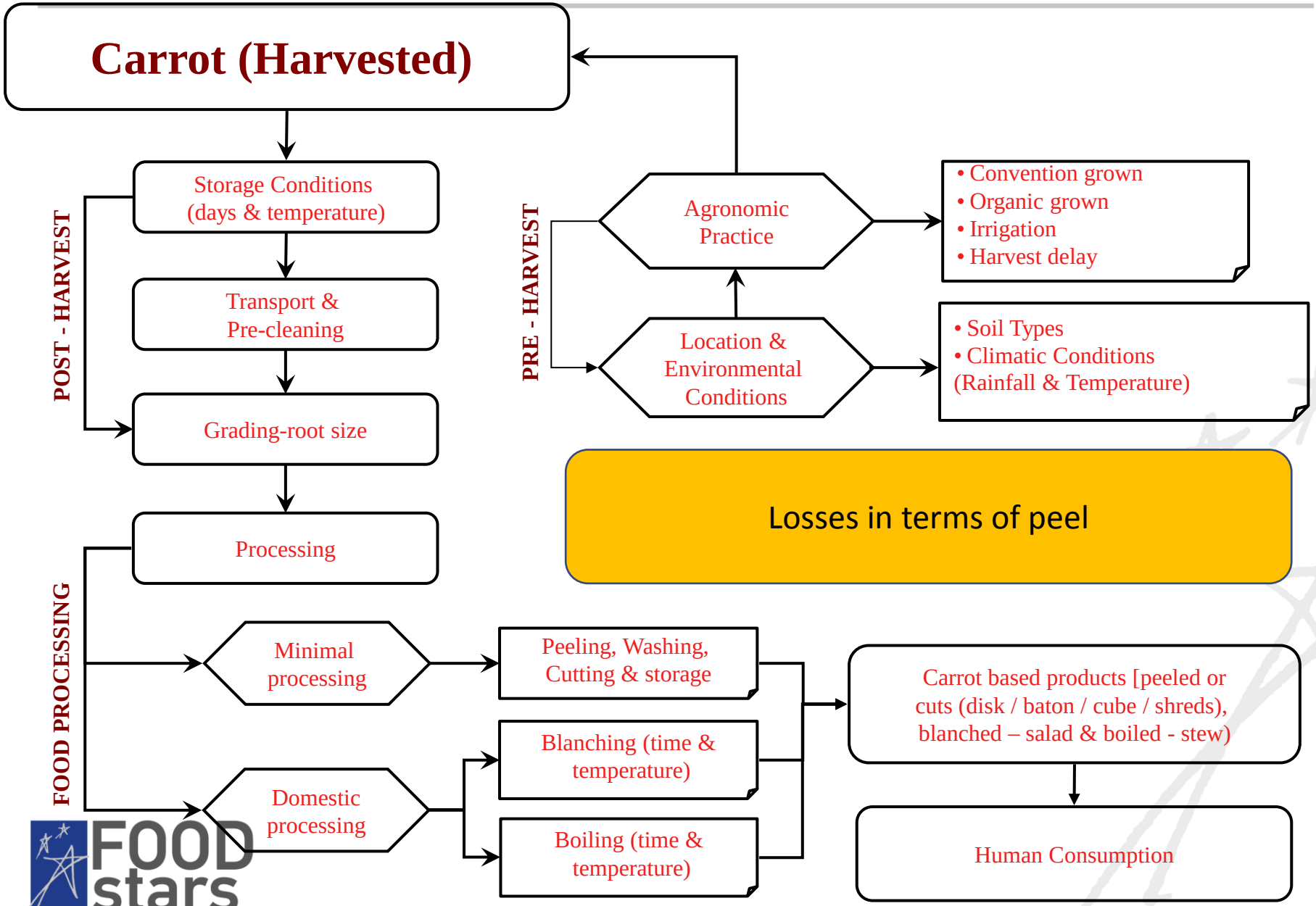
European Commission

By-product/Waste utilisation

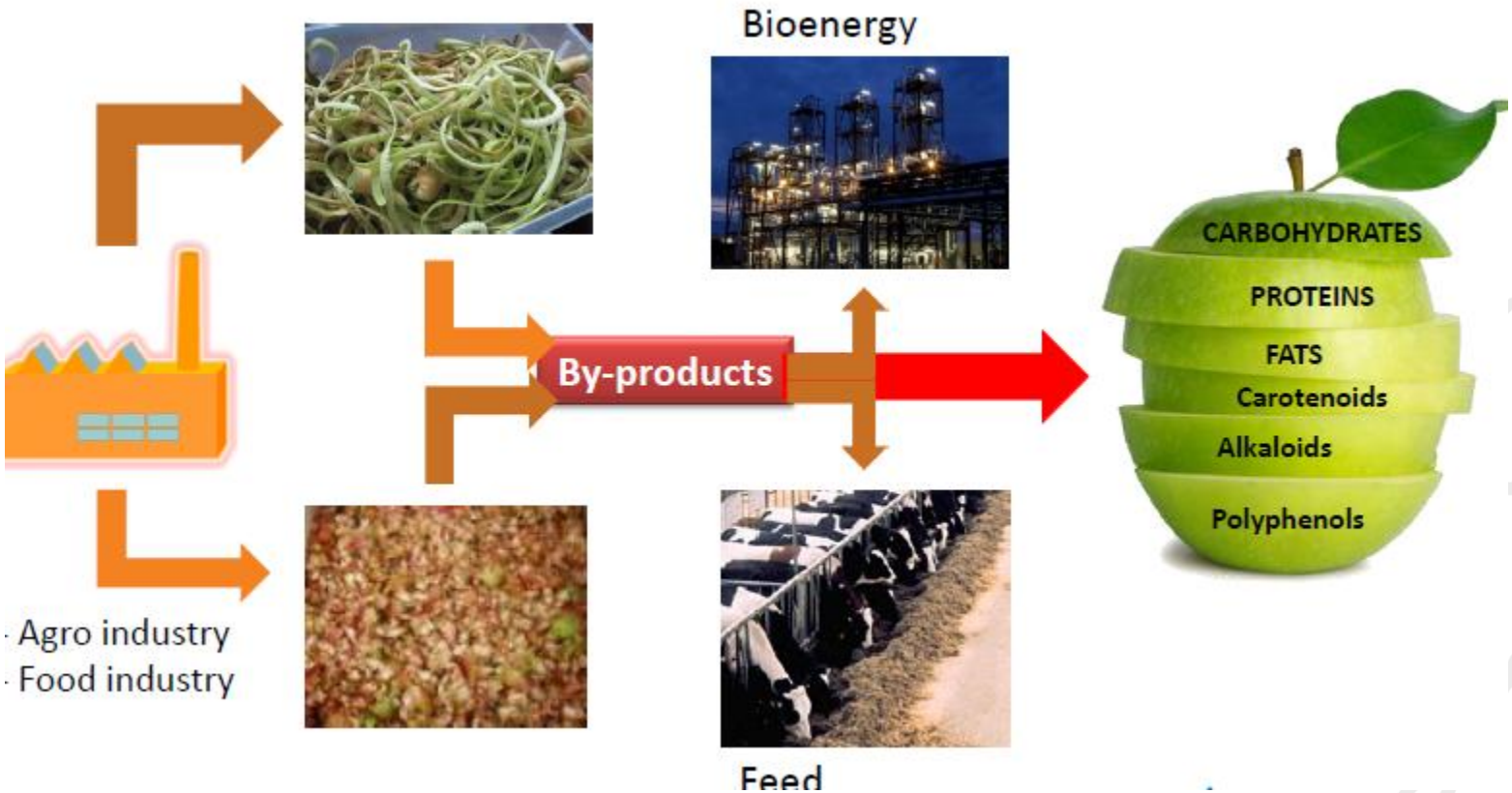
Horizon 2020 | European Union funding for Research & Innovation
Grant Agreement number: 692276 — FOODstars | H2020-TWINN-2015

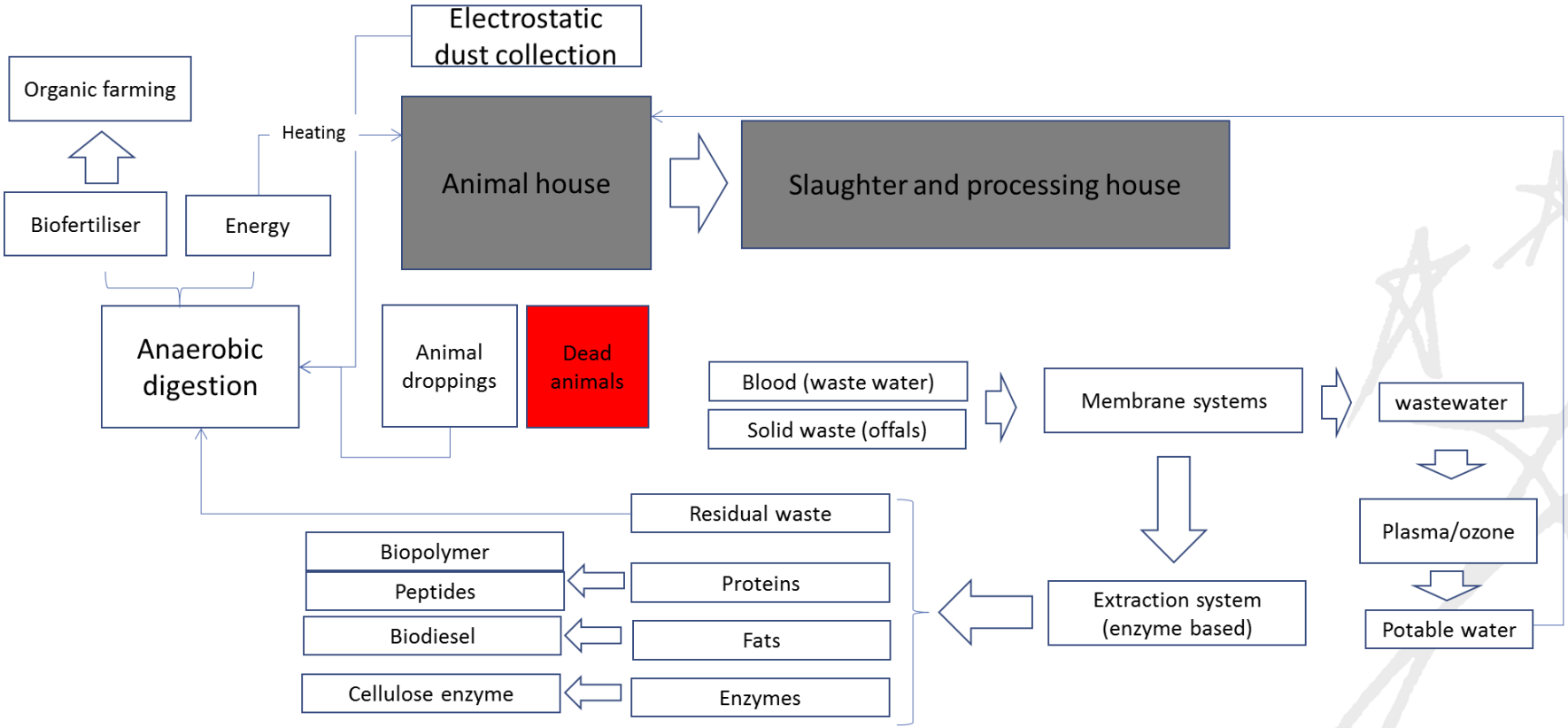
Feedstocks, processes and products in a bioeconomy



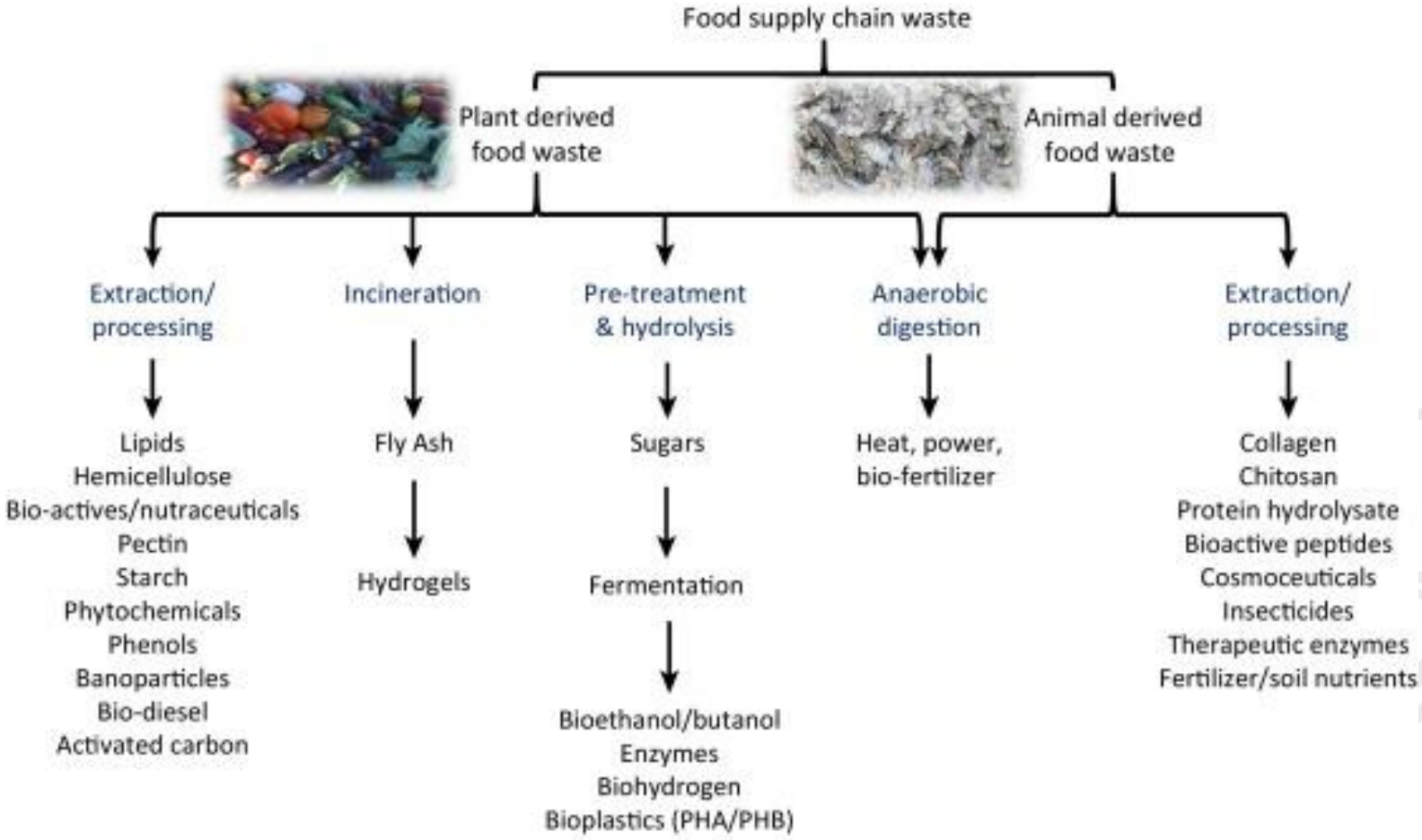

Carrot (Harvested)
POST - HARVEST
Storage Conditions (days & temperature)
Transport & Pre-cleaning
Grading-root size
Processing
PRE - HARVEST
Agronomic Practice
• Convention grown
• Organic grown
• Irrigation
• Harvest delay
Location & Environmental Conditions
• Soil Types
• Climatic Conditions (Rainfall & Temperature)
Losses in terms of peel
FOOD PROCESSING
Minimal processing
Peeling, Washing, Cutting & storage
Domestic processing
Blanching (time & temperature)
Boiling (time & temperature)
Carrot based products [peeled or cuts (disk / baton / cube / shreds), blanched – salad & boiled - stew)
Human Consumption

Food procesing by-product valorisation



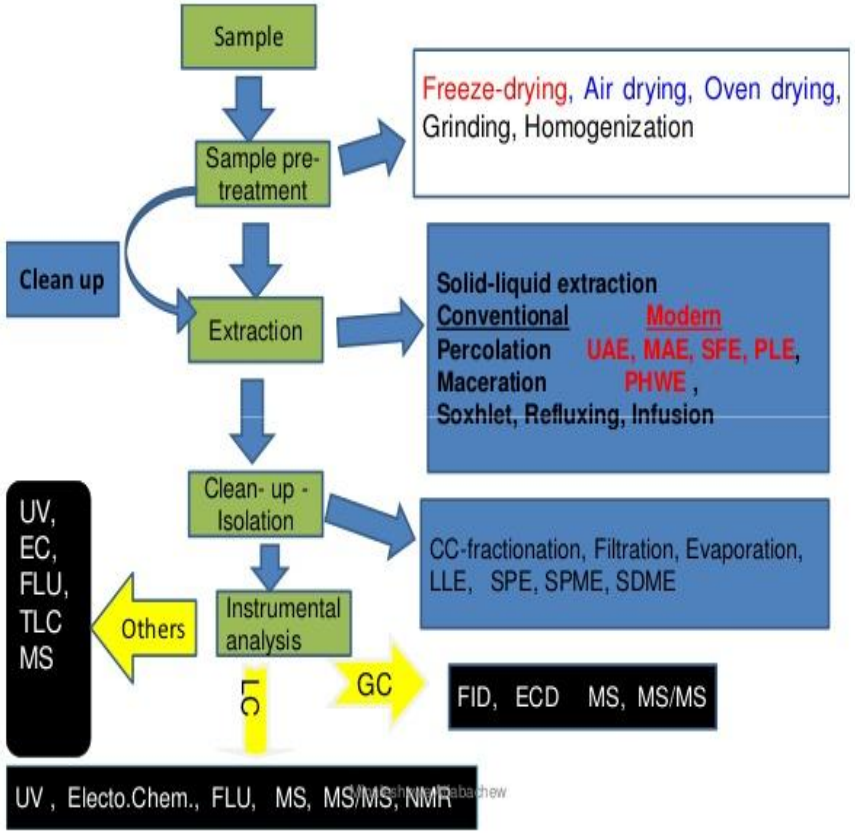


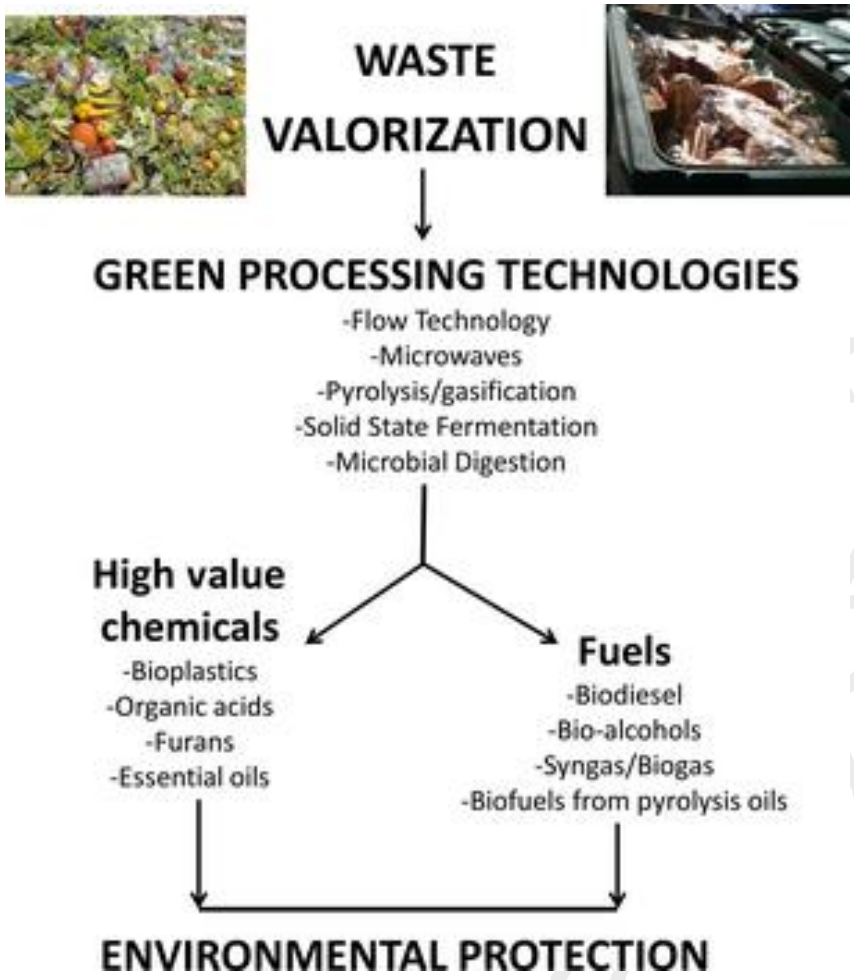
Horizon 2020 | European Union funding for Research & Innovation
Grant Agreement number: 692276 — FOODstars | H2020-TWINN-2015

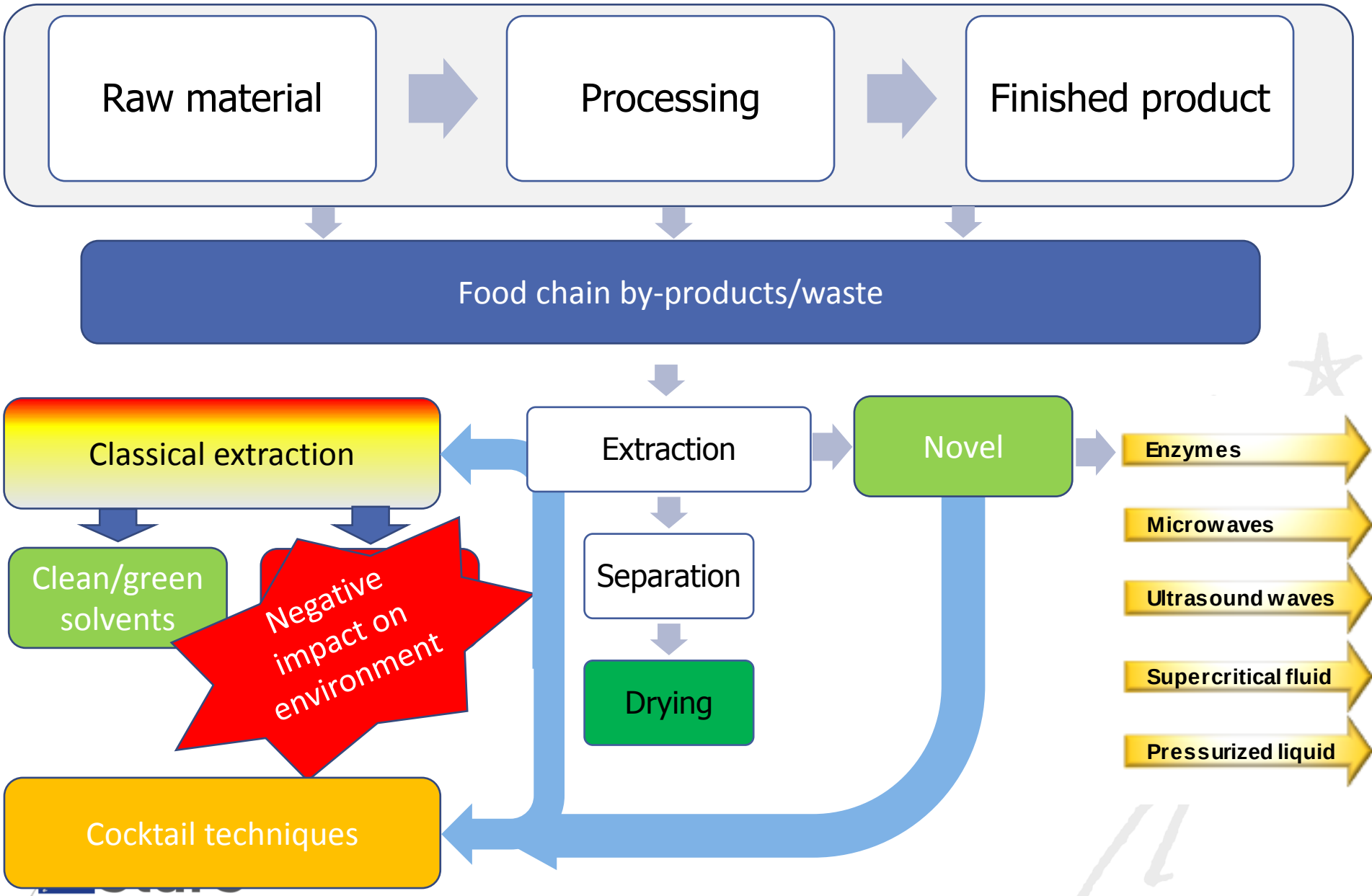


Trends in Biotechnology

Extraction ?


Sample
Sample pre-treatment
Freeze-drying, Air drying, Oven drying, Grinding, Homogenization
Clean up
Extraction
Solid-liquid extraction
Conventional
Percolation
Maceration
Soxhlet, Refluxing, Infusion
Modern
UAE, MAE, SFE, PLE,
PHWE ,
Clean- up - Isolation
CC-fractionation, Filtration, Evaporation, LLE, SPE, SPME, SDME
UV, EC, FLU, TLC MS
Others
Instrumental analysis
LC
GC
FID, ECD MS, MS/MS
UV , Electo.Chem., FLU, MS, MS/MS, NMR


WASTE
VALORIZATION
GREEN PROCESSING TECHNOLOGIES
-Flow Technology
-Microwaves
-Pyrolysis/gasification
-Solid State Fermentation
-Microbial Digestion
High value chemicals
-Bioplastics
-Organic acids
-Furans
-Essential oils
Fuels
-Biodiesel
-Bio-alcohols
-Syngas/Biogas
-Biofuels from pyrolysis oils
ENVIRONMENTAL PROTECTION


Raw material
Processing
Finished product
Food chain by-products/waste
Classical extraction
Extraction
Novel
Clean/green solvents
Negative impact on environment
Separation
Drying
Cocktail techniques
Enzymes
Microwaves
Ultrasound waves
Supercritical fluid
Pressurized liquid

DISCLAIMER:

The FOODstars project receives funding from
the European Union's Horizon 2020 research and innovation programme
under Grant Agreement No 692276.
This presentation reflects only
the opinion of authors and not the opinion of European Commission.

FOOD stars
Innovative Food Product Development Cycle: Frame for Stepping Up Research Excellence of FINS

European Commission

NAPOMENA:

Projekat FOODstars se finansira iz fondova
Evropske Unije, iz programa Horizont 2020 za istraživanja i inovacije
(broj ugovora 692276). Sadržina ove prezentacije
odražava samo mišljenje autora, a ne mišljenje Evropske komisije.