



Food safety and circular economy

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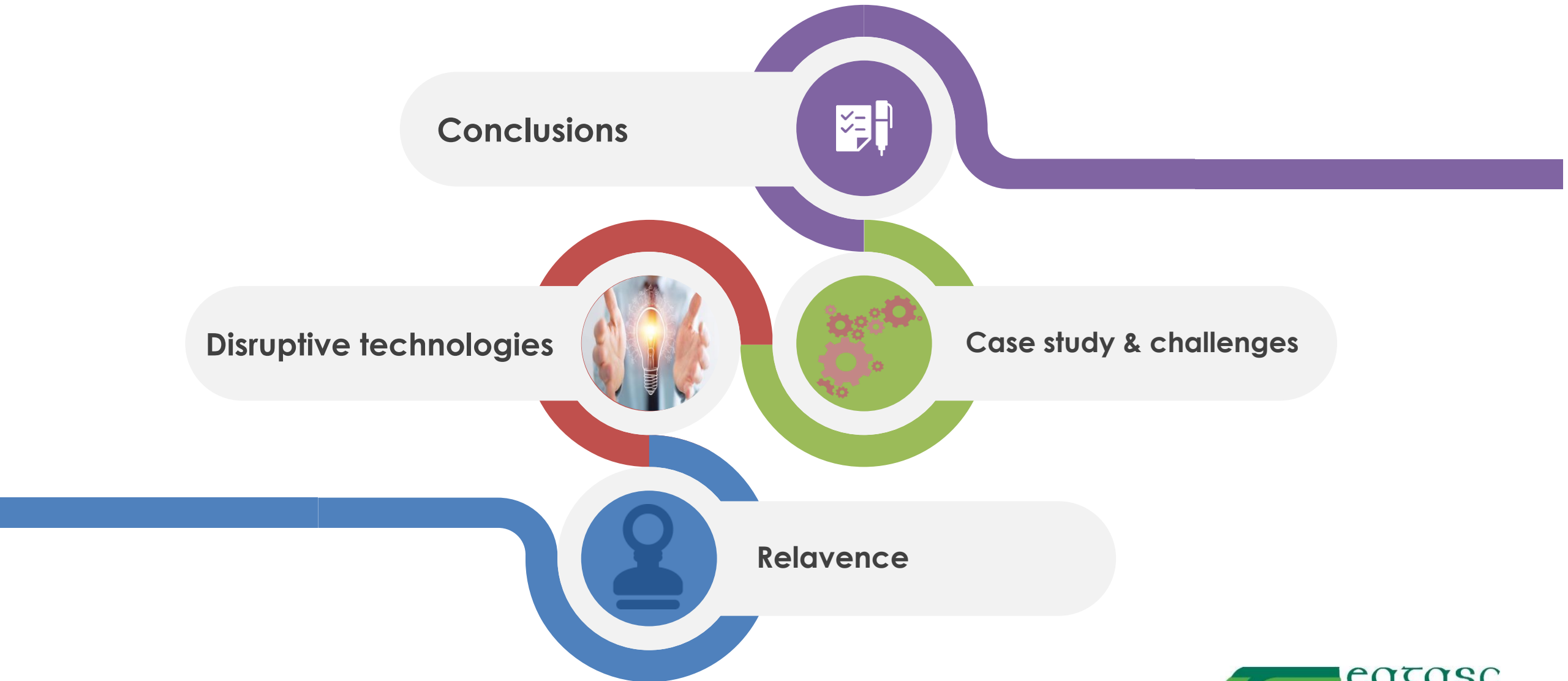
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Presentation outline



Global challenges for the future of food systems

- ✓ Agriculture productivity
- ✓ Conservation of resources and environment
- ✓ Improvement of nutrition and public health
- ✓ Food security
- ✓ Food Safety and Health
- ✓ Sustainability

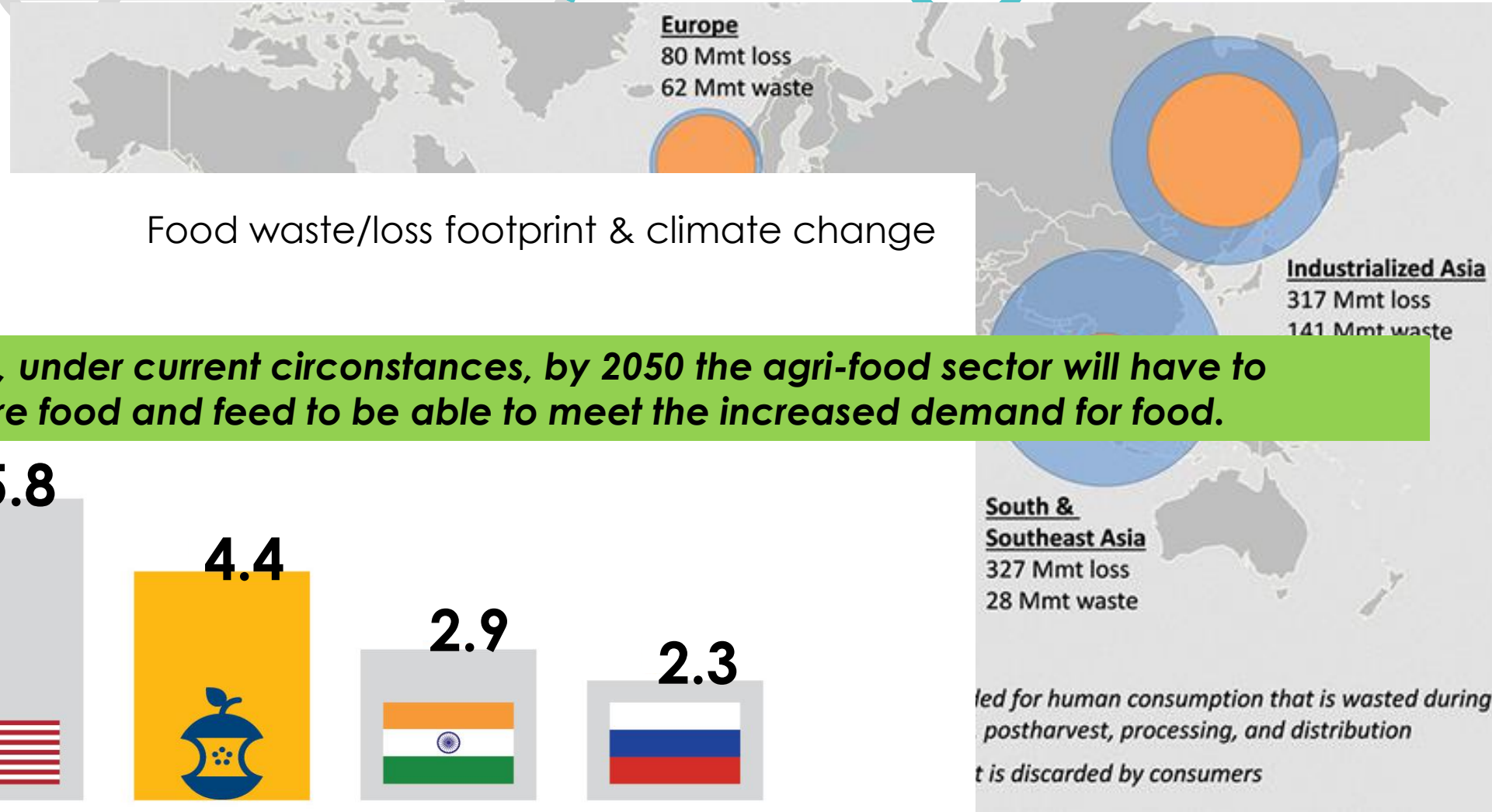
Addressing Food Safety challenges: Monitor and ensure that European food safety and quality standards are applied

Current status

26% GHG Emissions

32% Acidification

78% Eutrophication



10.7

5.8

4.4

2.9

2.3

According to FAO, under current circumstances, by 2050 the agri-food sector will have to generate 50% more food and feed to be able to meet the increased demand for food.



China



United States



Food loss and waste



India



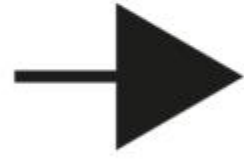
Russia

GT CO₂E (2011/12)*

Source: FAO

2018)

FOOD SPEND



SOCIETAL COSTS RELATED TO

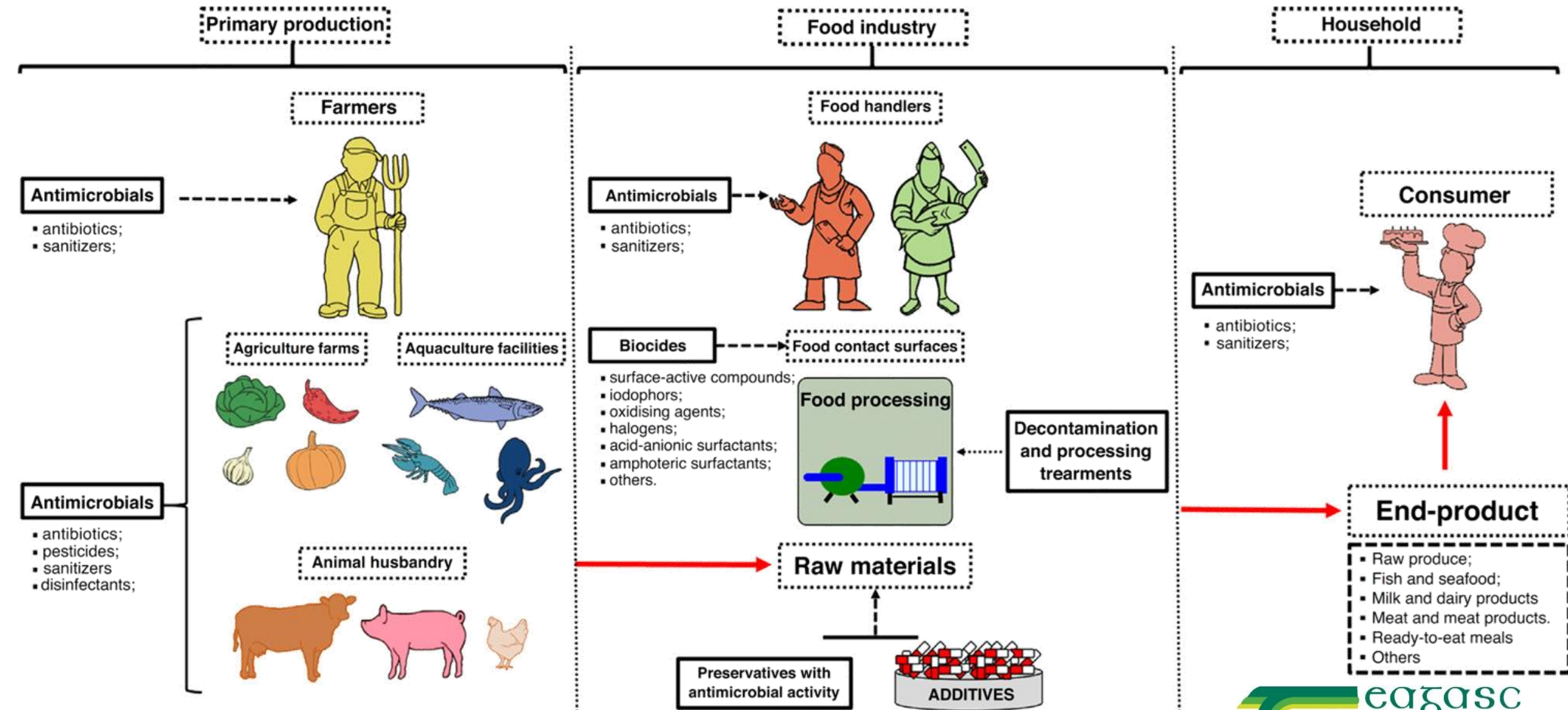
CONSUMPTION



PRODUCTION



Food safety issues along a Food Chain

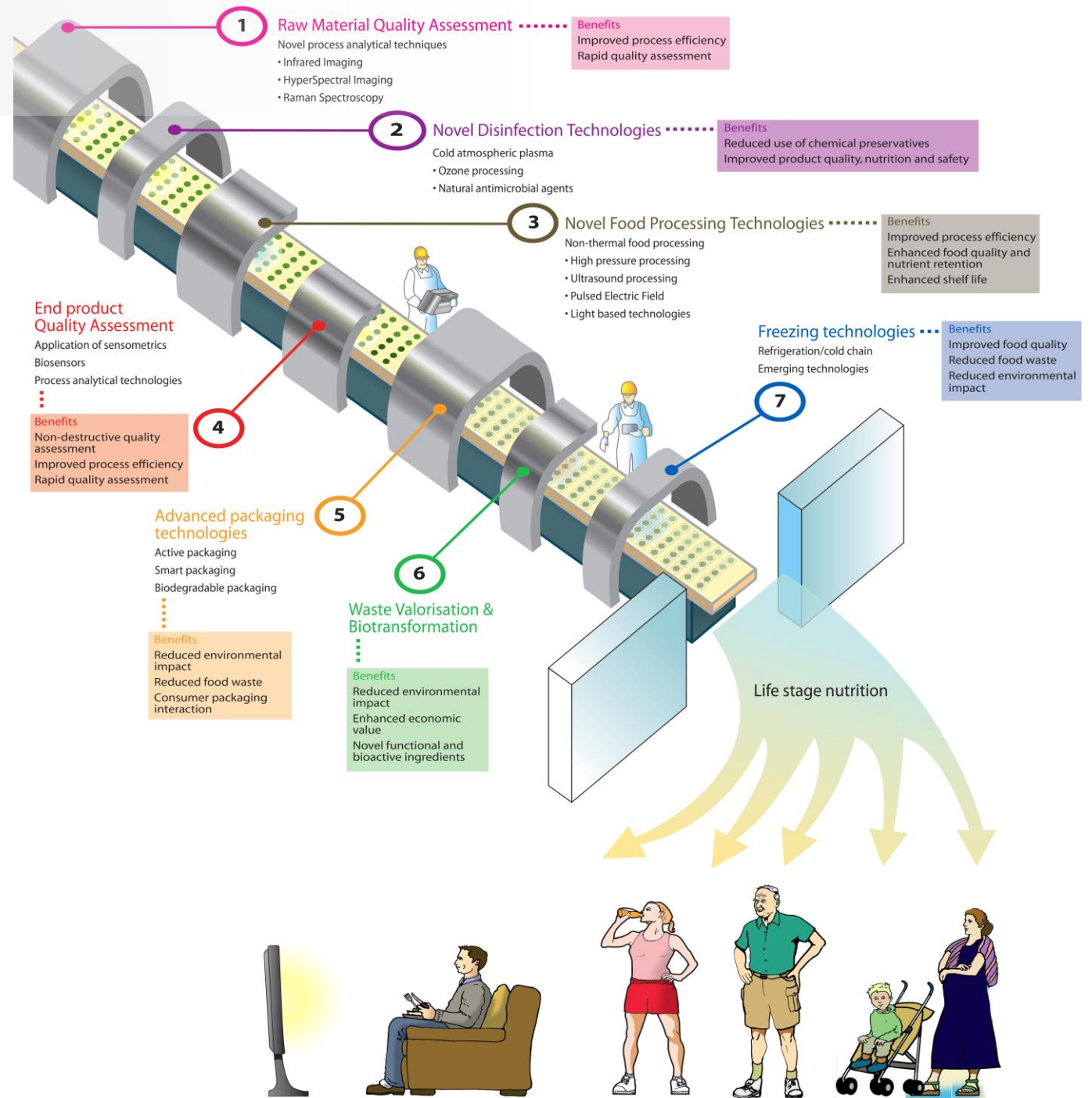


Disruptive technologies



Food chain

- ✓ Introducing disruptive technologies
 - ✓ Process Analytical Technologies
 - ✓ Processing Technologies
- ✓ Reduced **energy** and **water** consumption
- ✓ Clean and green solutions to key challenges faced by the food industry
- ✓ Reduced human interventions
- ✓ Employ new interventions for developing safe and healthy food products underpinning key health, nutrition and wellness challenges

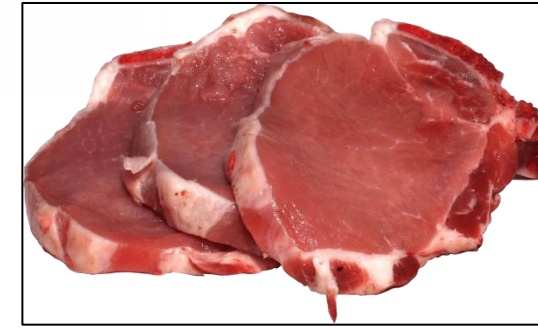
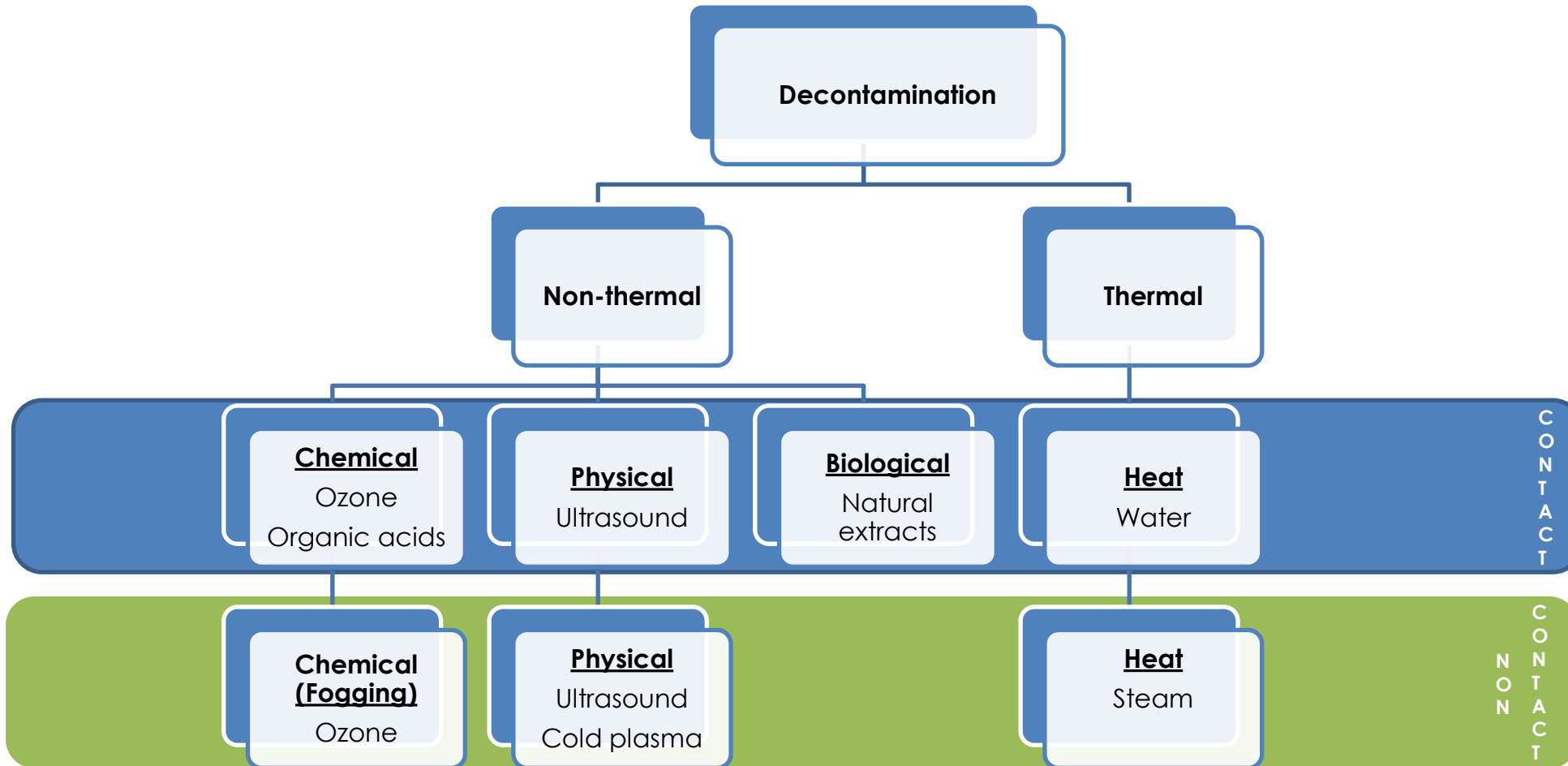



Microbial aspects of novel technologies

Key mechanisms	HPP	PEF	US	Cold plasma	UV light	Ozone	Thermal
	Pressure	Electroporation	Sonoporation	Oxidation			Heating
Vegetative cells							
Damages to cell membrane	+++	+++	+++	+++	+++	++	+++
Inactivation of key enzymes modulating growth of cells	++	++	++	+	+		+++
Oxidative damages to cell membrane constituents (peptidoglycan layers)	++	++	+	+++	+++	+++	+++
Damage to DNA/Nucleic acid	-	-	-	++	+++	++	+++
Spores							
Damage to spore coat	++	++	+++	++	++	++	+++
Chemical modification in spore core and cortex	+	++	+	++	+	+	+++

- +++: key mechanism of action
- ++: some synergistic effects
- +: based on limited scientific information
- : Not reported

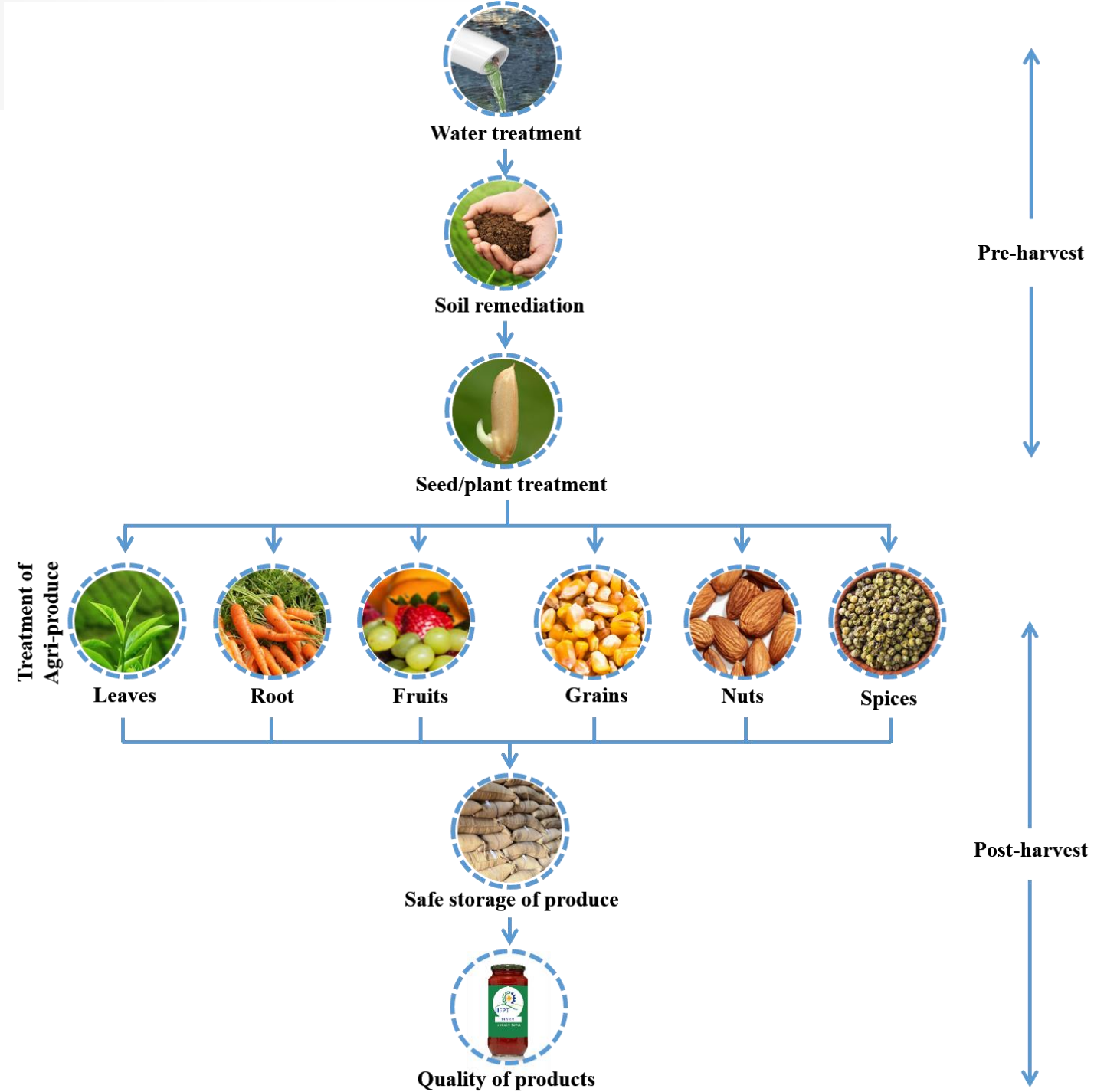
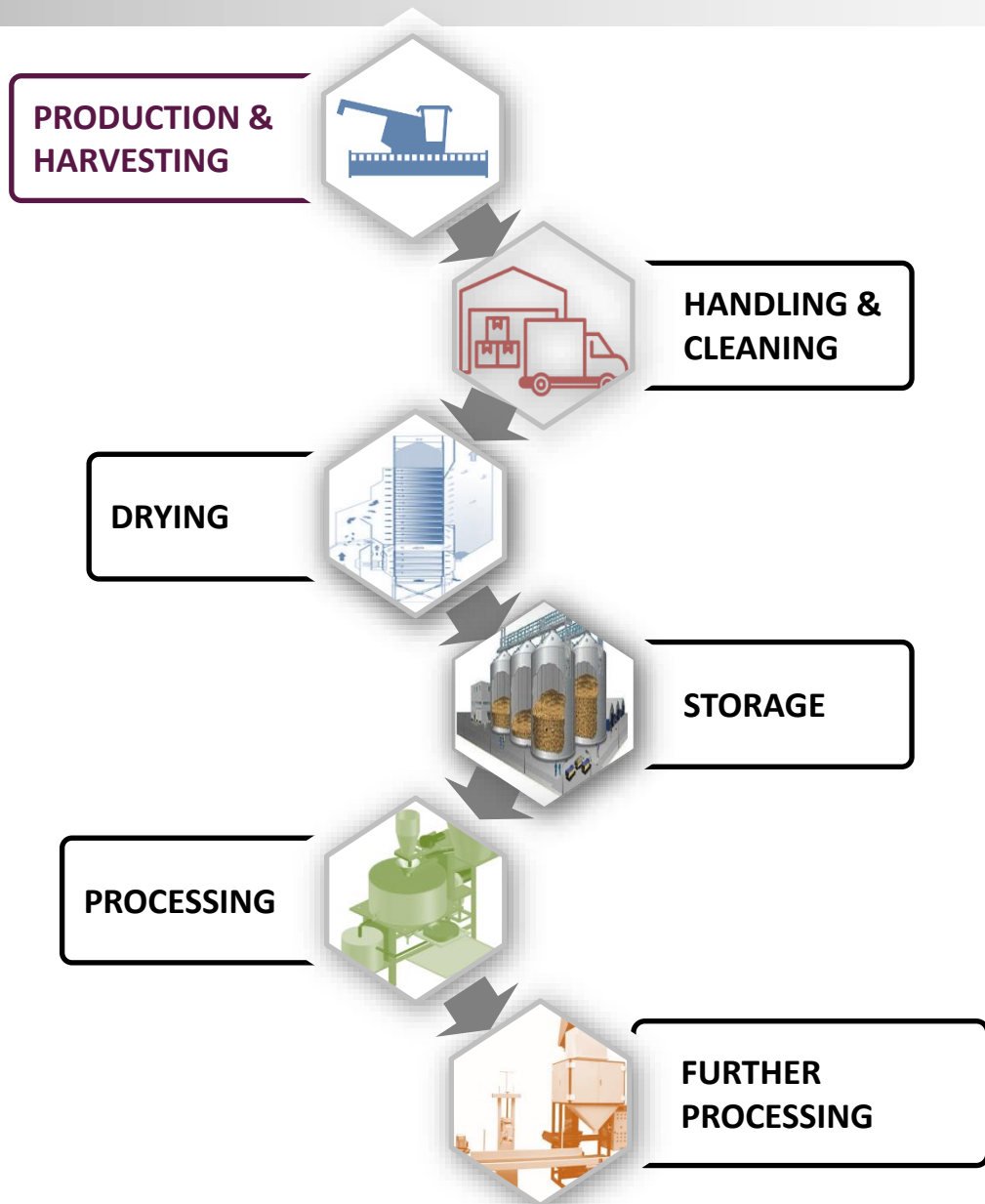
Surface Decontamination Technologies



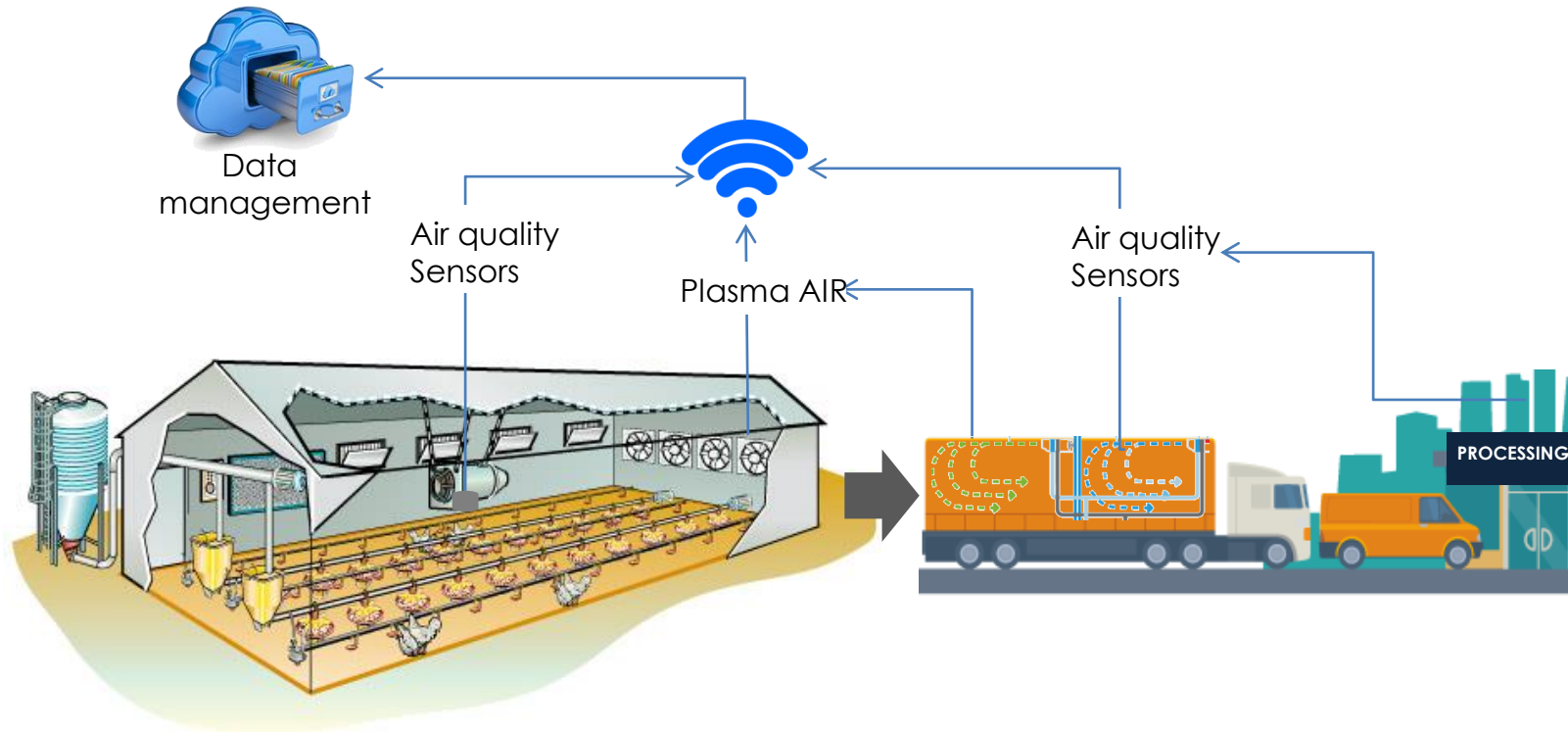


Case studies

Applications food chain

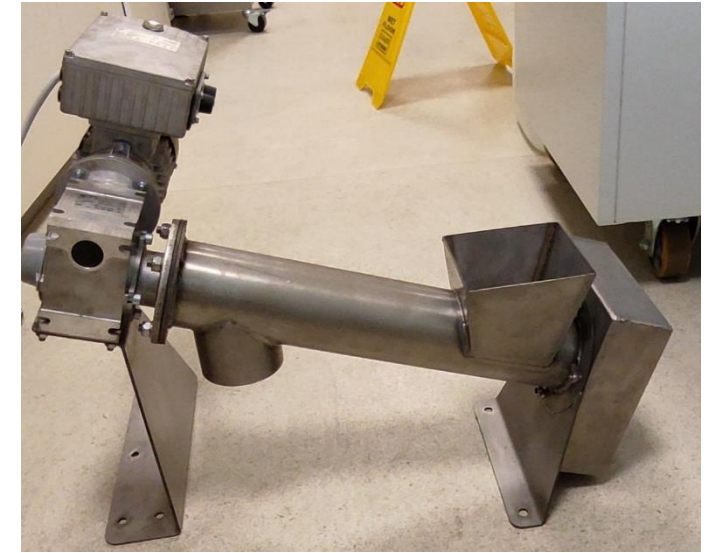
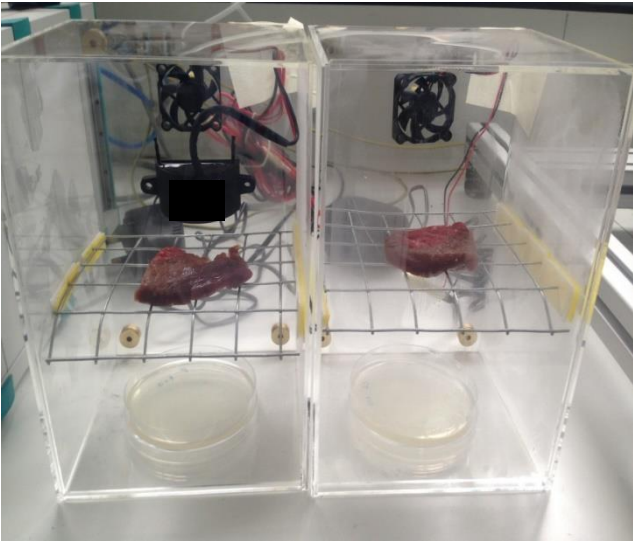



Production & food storage



Delayed spoilage of tomatoes treated with plasma (left) compared to control (right).

Plasma applications – prototypes





Challenges

Selection of technologies

Novel Technologies

Vegetative cells
inactivation

No

Yes

Technological
modification
required

Spores

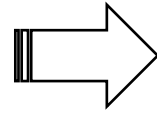
No

Yes

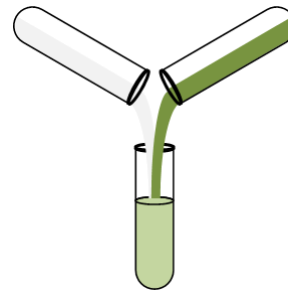
Combination

Process
efficiency

Commercial validation



Model solutions



Conventional and
Novel technologies

> 5 log

Liquid foods



Thermal processing
High pressure processing
Pulsed electric field
Ozone applications
Ultrasonics
Light based technologies

Up to 5 log

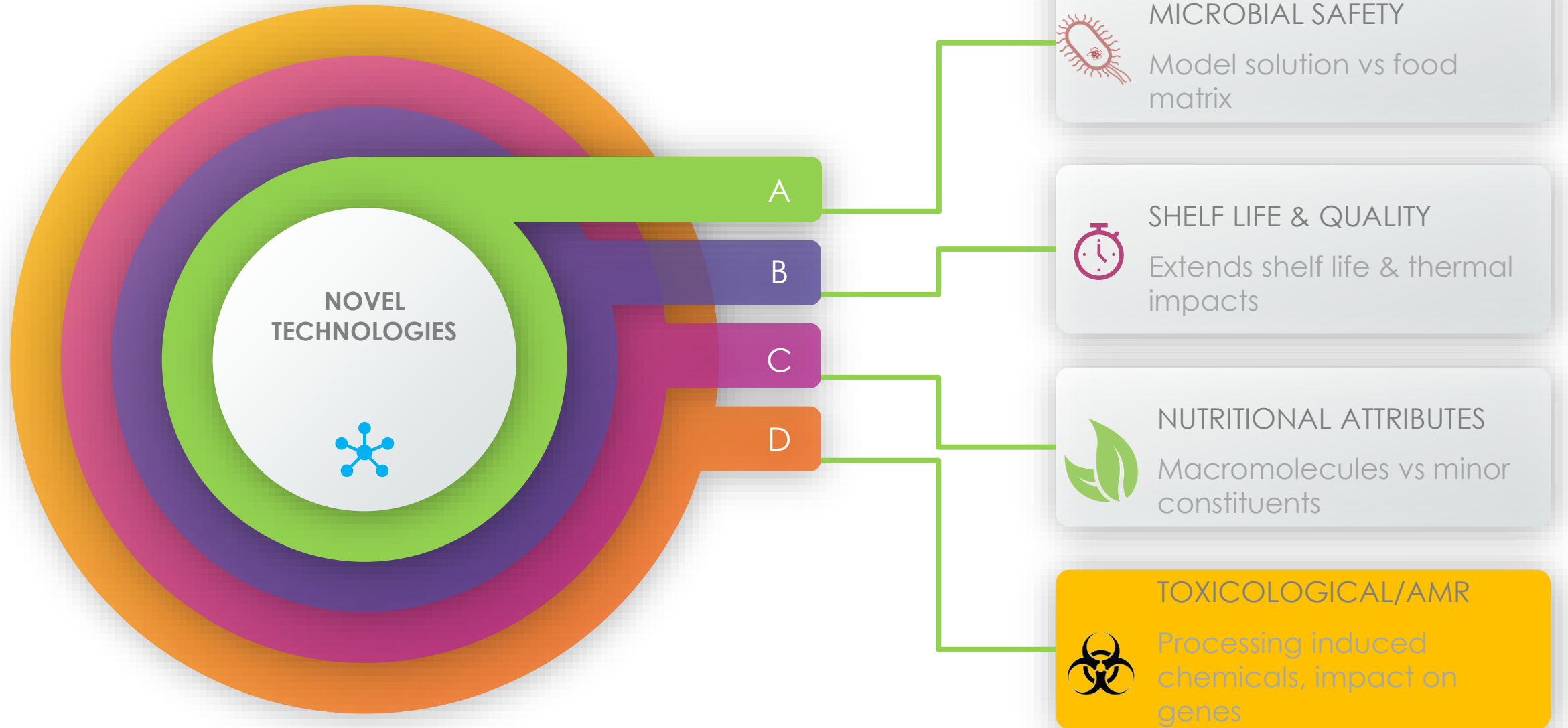
Solid foods



Ozone
Cold plasma
Airborne acoustics
Light based technologies

1 – 2 log reductions

Known and unknowns of novel technologies



Sustainability evaluation

Technologies

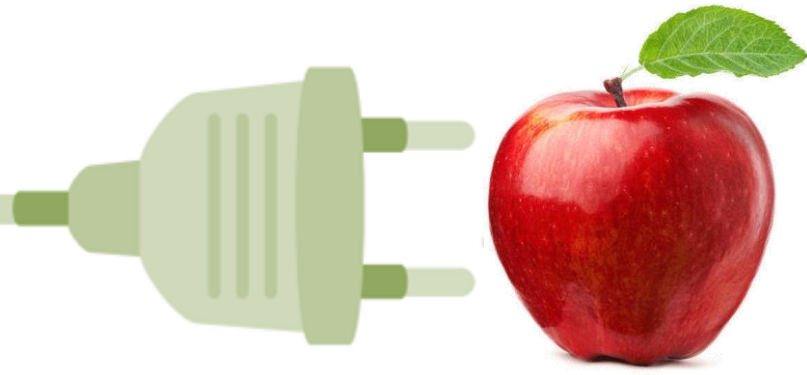
- A. Greenhouse Gas Emissions
- B. Particulate Matter Formation
- C. Freshwater Ecotoxicity
- D. Freshwater Eutrophication
- E. Human Toxicity
- F. Metal Consumption
- G. Water Consumption
- H. Land Occupation

Energy consumption

Food safety & Shelf life

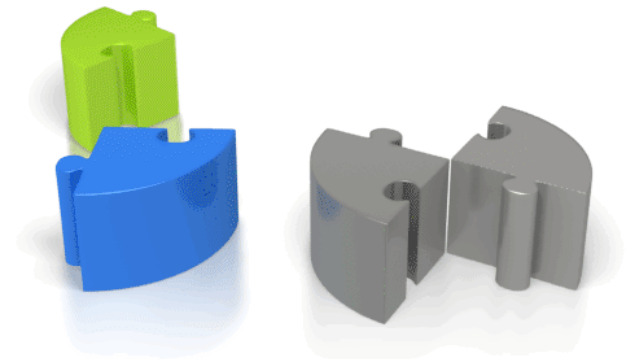
Health & Wellness

Nutritional attributes



Conclusions

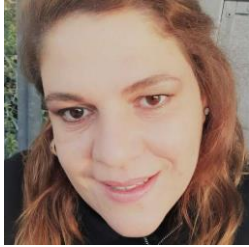
- ✓ Addressing EFSA guidelines while developing new food/feed value chains
- ✓ Evaluation of technologies in real life scenarios (TRL >6)
- ✓ Toxicological aspects of new interventions
- ✓ Transformation and translational approach



Acknowledgements

PhD Students

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Yuchen



Yunlu



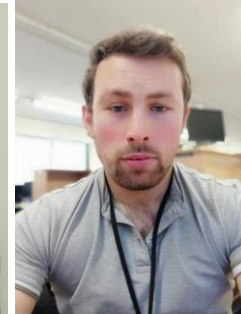
Jack



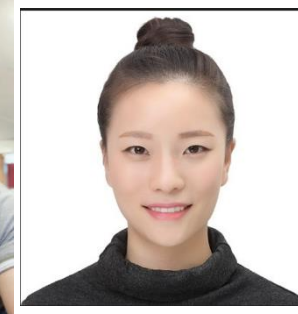
Ailbhe



Animesh



Jack



Gaoya



Mohammadhosein



Zhipeng



Dileswar



Shaba



Laura Healy



Jiafei



Gontorn



Rahel

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Thank you for
listening

