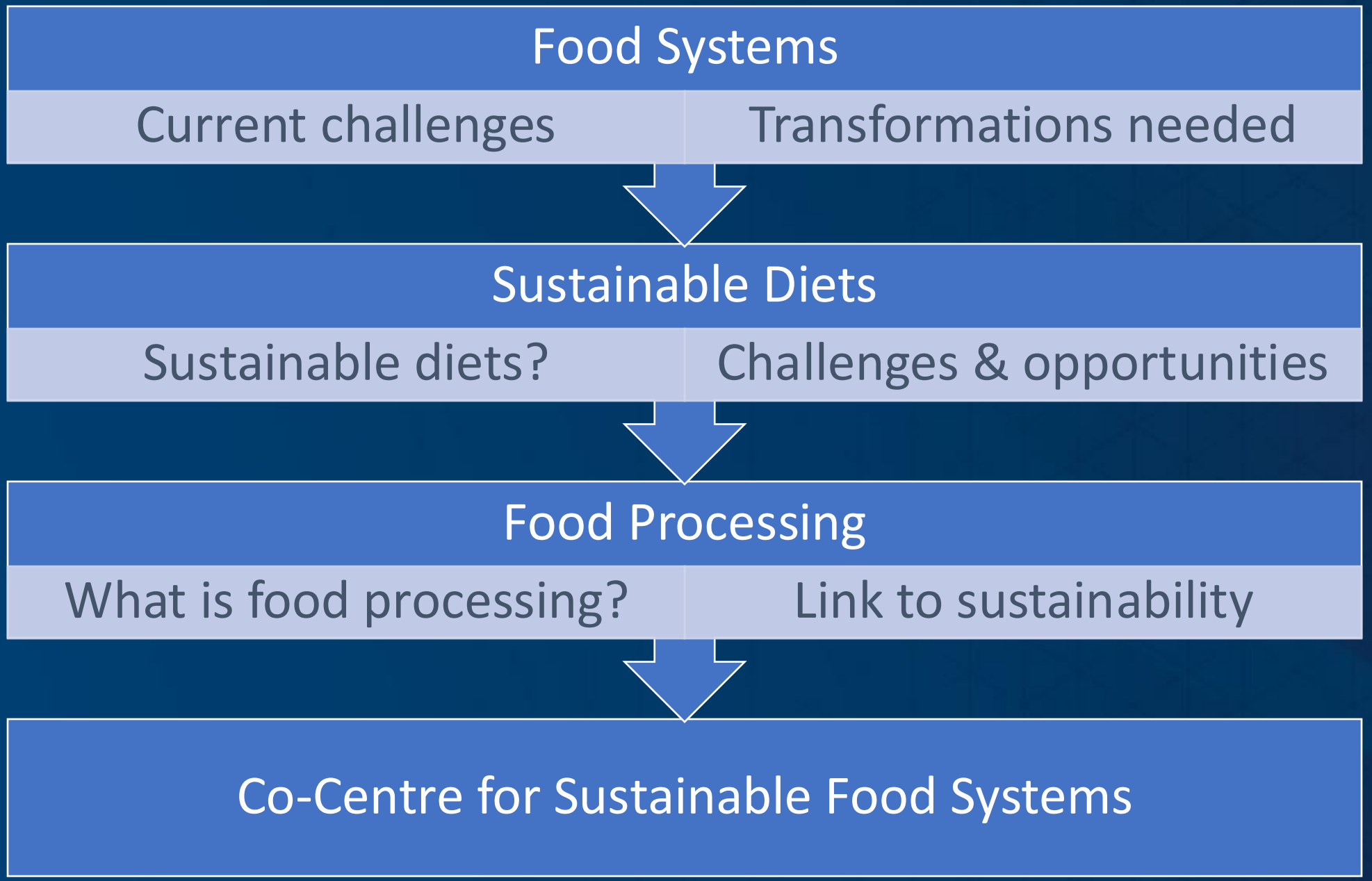
UCD Institute of Food and Health

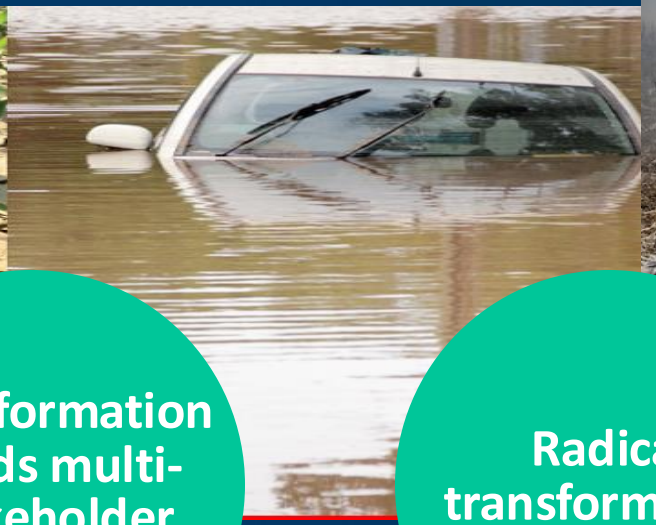
The Role of Food Processing in Achieving Sustainable and Nutritious Food Systems

Eileen Gibney

Outline


Food Systems
Current challenges
Transformations needed
Sustainable Diets
Sustainable diets?
Challenges & opportunities
Food Processing
What is food processing?
Link to sustainability
Co-Centre for Sustainable Food Systems

WHAT CHALLENGES DO OUR FOOD SYSTEMS FACE?



No central governance

Transformation needs multi-stakeholder engagement

Radical transformation needed

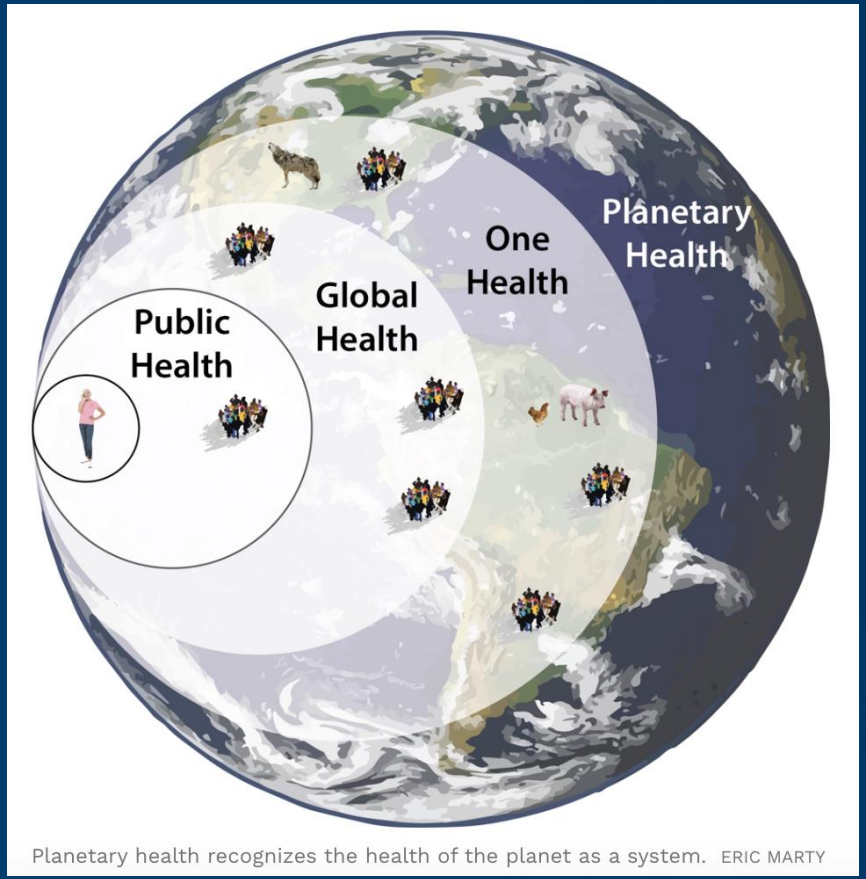
TRIPLE BURDEN OF MALNUTRITION

1/10
UNDERNOURISHED

25%
OVERWEIGHT

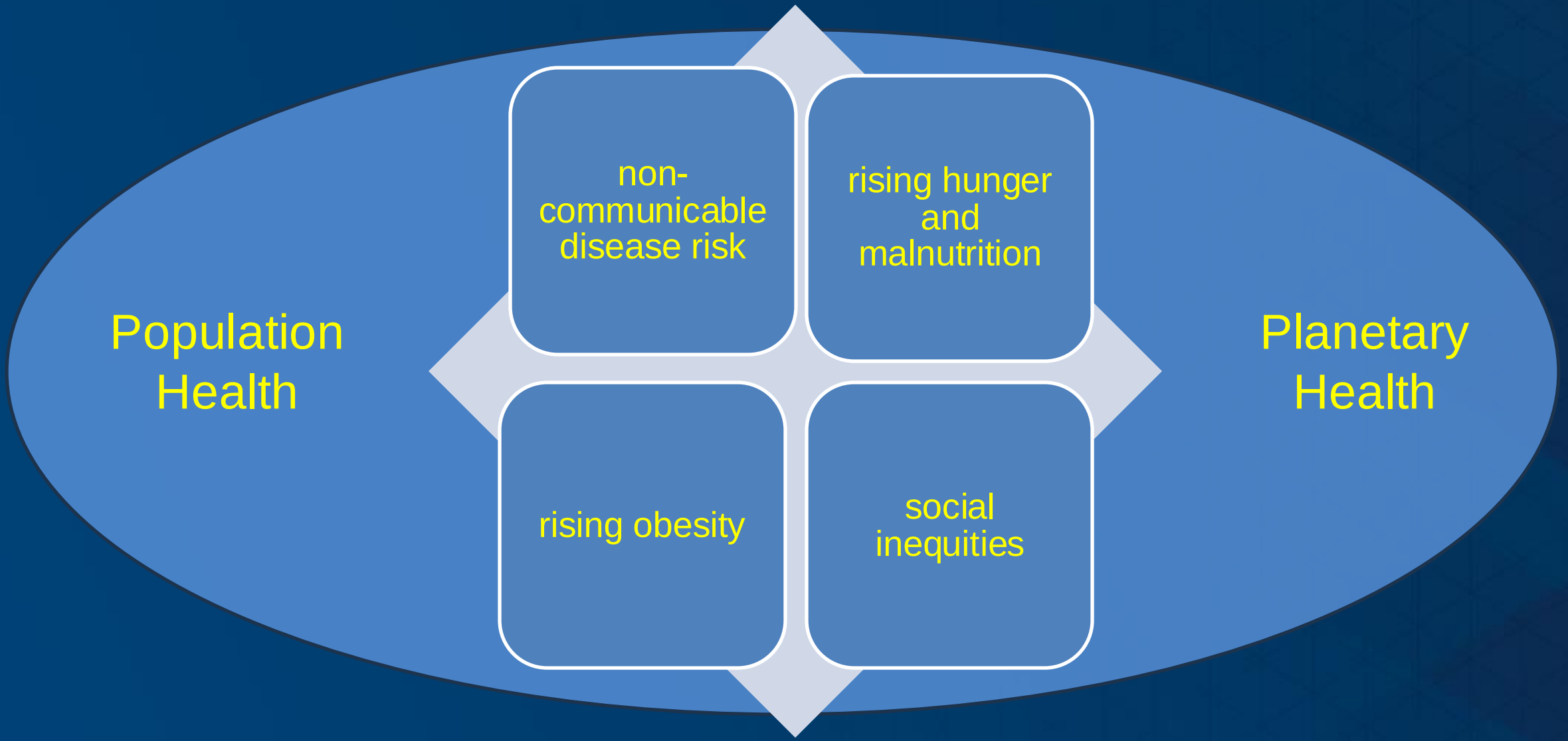
1/3
CANNOT AFFORD A HEALTHY MEAL

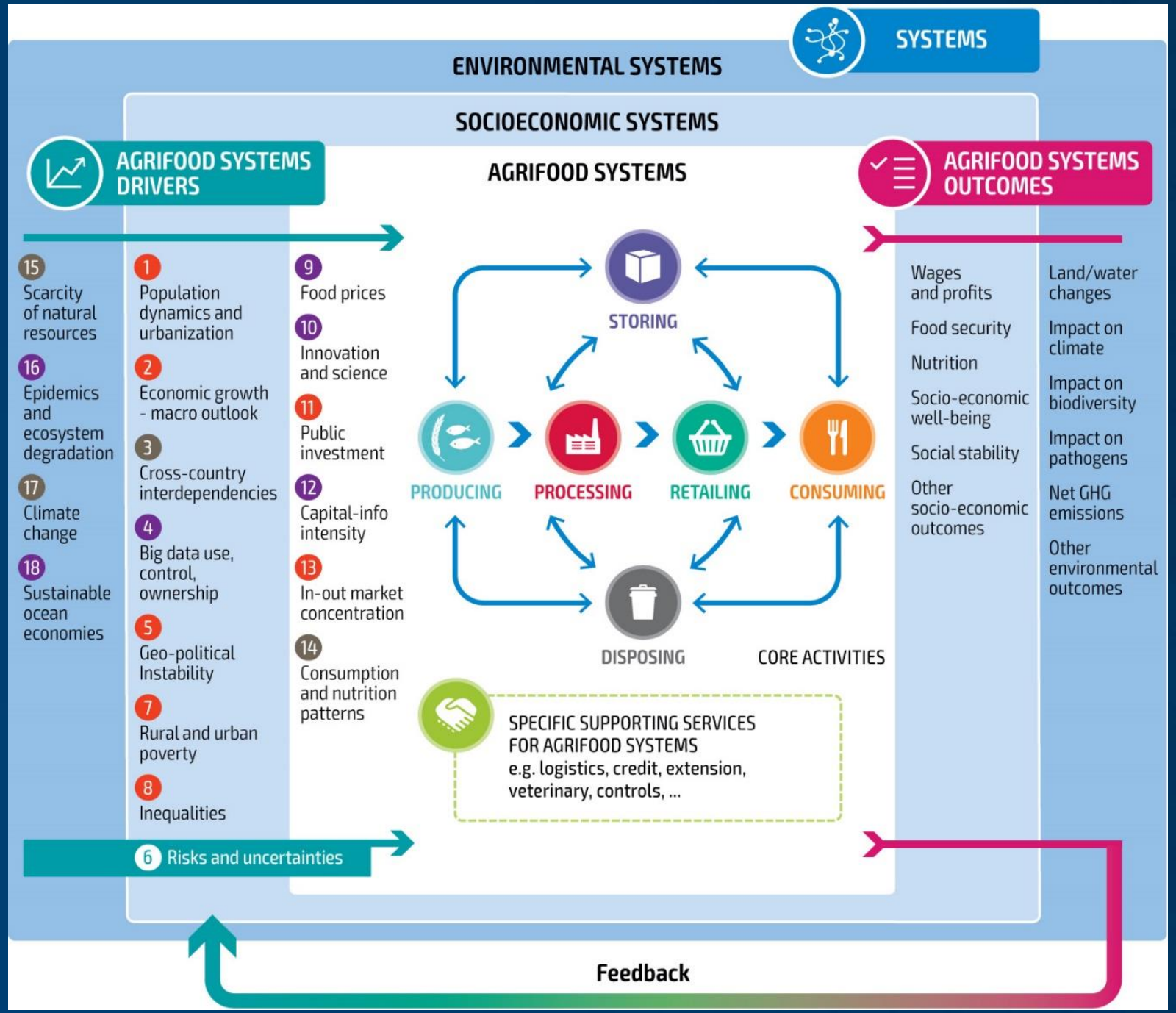
WHAT CHALLENGES DO OUR FOOD SYSTEMS FACE?



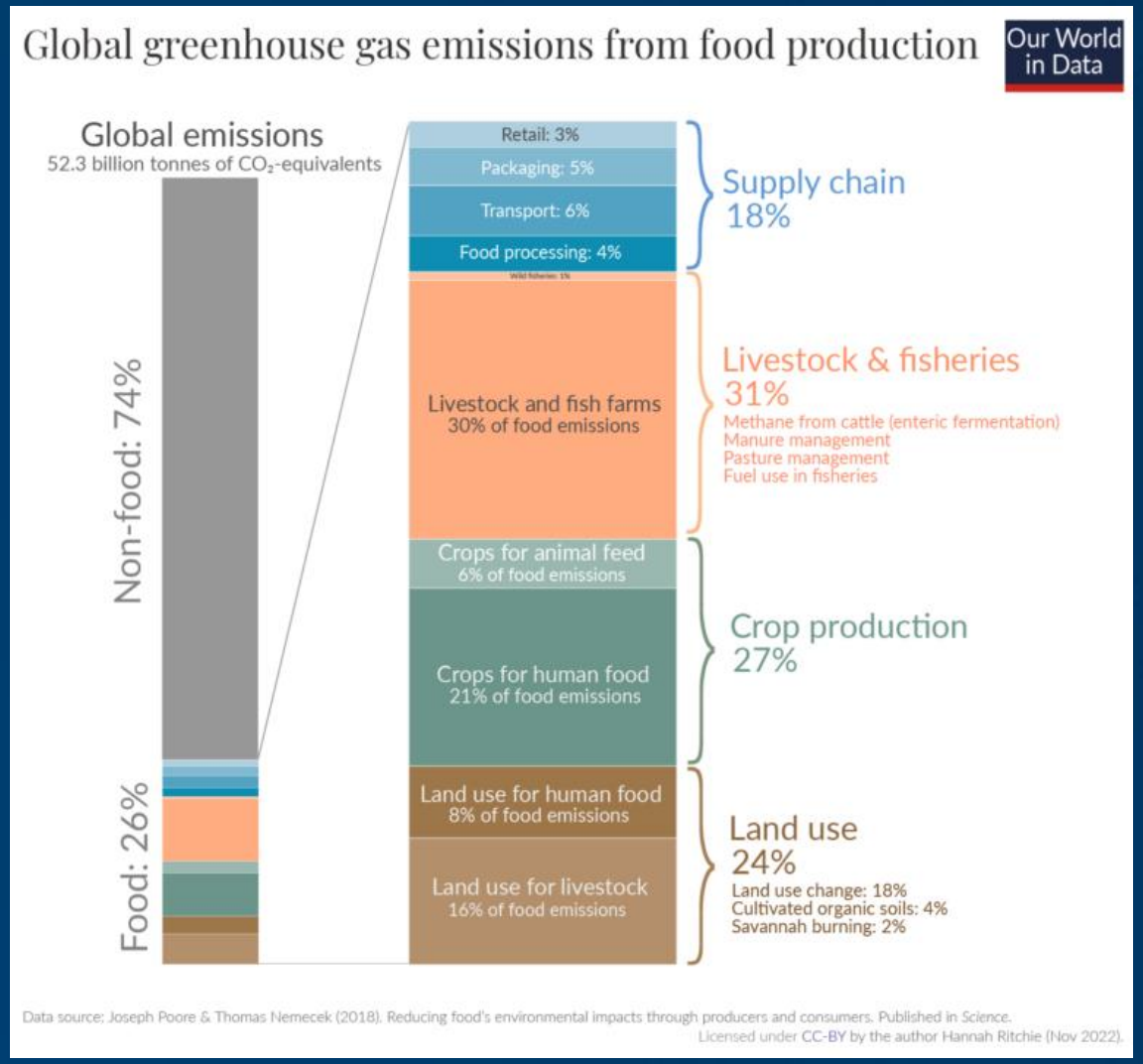
Planetary health recognizes the health of the planet as a system. ERIC MARTY

WHAT CHALLENGES DO OUR FOOD SYSTEMS FACE?

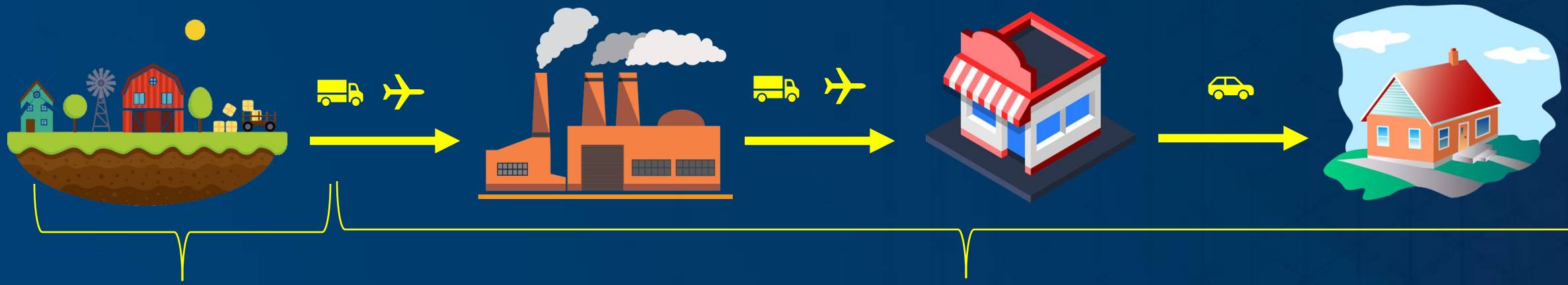



SYSTEMS
ENVIRONMENTAL SYSTEMS
SOCIOECONOMIC SYSTEMS
AGRIFOOD SYSTEMS
AGRIFOOD SYSTEMS DRIVERS
AGRIFOOD SYSTEMS OUTCOMES
15 Scarcity of natural resources
16 Epidemics and ecosystem degradation
17 Climate change
18 Sustainable ocean economies
1 Population dynamics and urbanization
2 Economic growth - macro outlook
3 Cross-country interdependencies
4 Big data use, control, ownership
5 Geo-political Instability
7 Rural and urban poverty
8 Inequalities
9 Food prices
10 Innovation and science
11 Public investment
12 Capital-info intensity
13 In-out market concentration
14 Consumption and nutrition patterns
STORING
PRODUCING
PROCESSING
RETAILING
CONSUMING
DISPOSING
CORE ACTIVITIES
SPECIFIC SUPPORTING SERVICES FOR AGRIFOOD SYSTEMS
e.g. logistics, credit, extension, veterinary, controls, ...
6 Risks and uncertainties
Wages and profits
Food security
Nutrition
Socio-economic well-being
Social stability
Other socio-economic outcomes
Land/water changes
Impact on climate
Impact on biodiversity
Impact on pathogens
Net GHG emissions
Other environmental outcomes
Feedback

How does food impact the environment?



How does food impact the environment?



80% of emissions

20% of emissions

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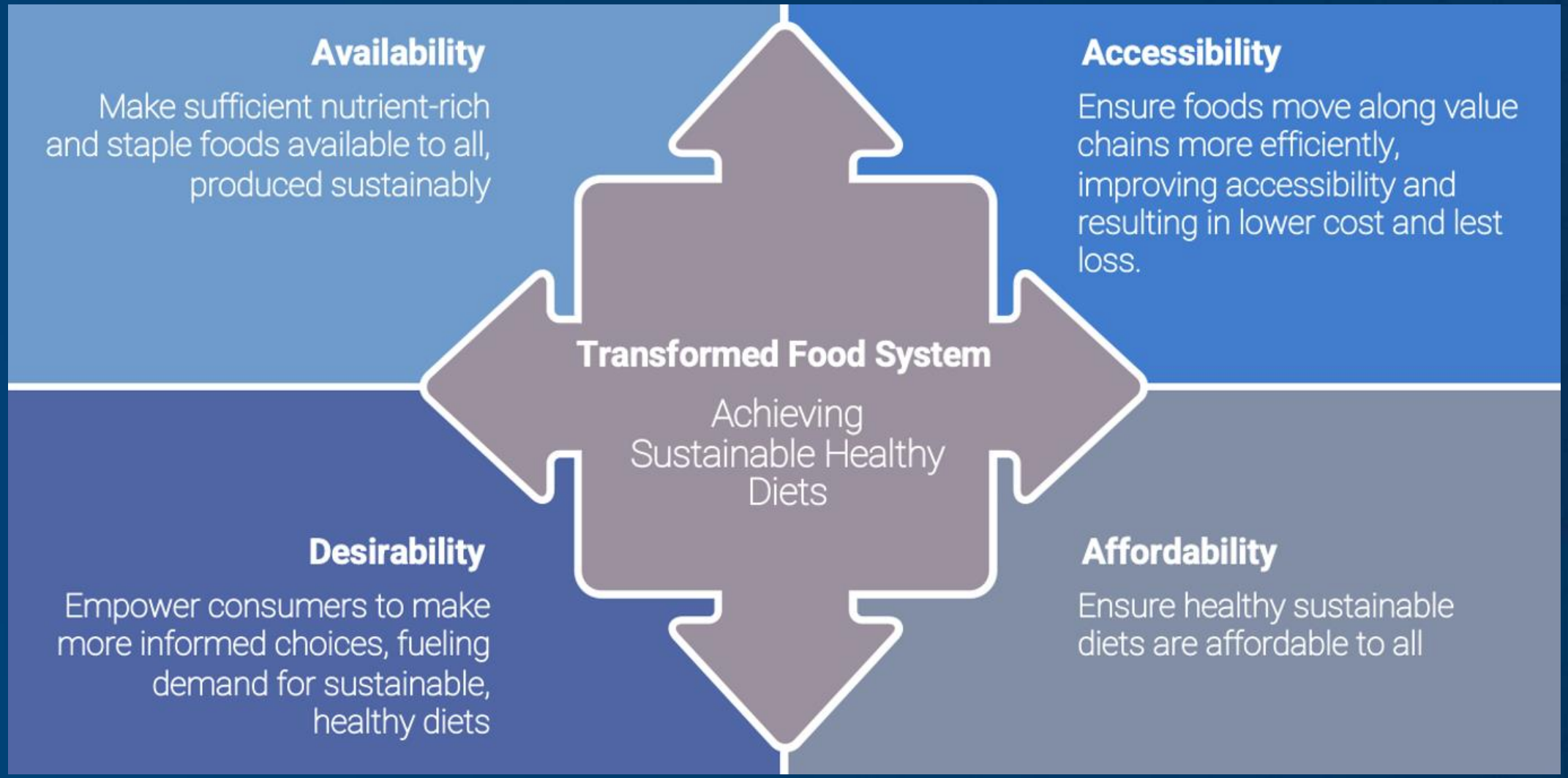

Adapted from Webb et al. "The urgency of food system transformation is now irrefutable." *Nature Food* 1.10 (2020): 584-585.

- Sustainable Diets….

  What is a healthy and sustainable diet?
  What needs to change?

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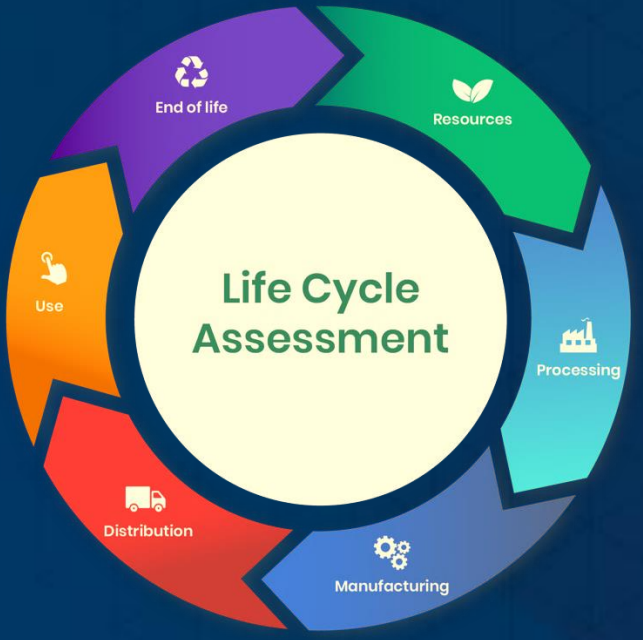
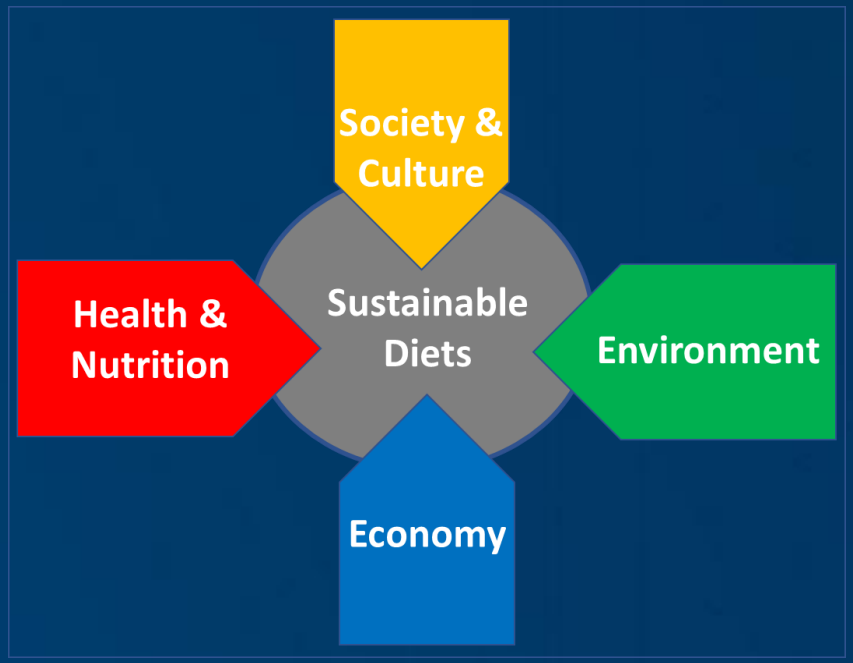
Diet-related environmental impact



- Beef, lamb
- Shellfish
- Dairy products
- Other meats

- Starches
- Vegetables
- Fruits
- Beans, peas, lentils

Colombo PE et al. Am J Clin Nutr. 2021;114(2):530-9



UN FAO

- *low environmental impacts*
- *nutrition security and to healthy life*
- *culturally acceptable, accessible*
- *economically fair and affordable*

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A. and Jonell, M., 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The lancet*, *393*(10170), pp.447-492.

FAO, 2010, Sustainable Diets and Biodiversity.

Sustainable dietary guidelines

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Food Group	*Country/Organization*								
	FAO	**BDA**	**Denmark**	**Germany**	**Sweden**	**Qatar**	**Canada**	**Brazil**	**Netherlands**
Whole grains			Choose whole grains	Opt for whole grains	Pick wholemeal	Choose whole grain	Consume regularly	Opt for whole	4-5 servings daily
Tubers/starchy vegetables									
Vegetables (all)			Increase	3 servings a day	Eat 'lots'	3-5 servings/day	"Plenty"/half of plate	Consume regularly	Plenty and seasonal if possible (250 g)
Fruit			increase	2 servings a day	Eat 'lots'	2-4 servings/day	"Plenty"/half of plate	Consume regularly	>2 servings and seasonal if possible
Dairy	Moderate	Moderate	Pick low fat	Daily	Choose low-fat	Daily of skimmed/low fat	Low-fat		2 dairy servings and 40 g cheese
Animal protein		Reduce	Eat less	300-600 g/week					
Red meat	Small	70 g/day			<500 g/week				
Processed meat	Small	Avoid							
Pork	Small								
Poultry	Moderate					Choose skinless or lean			
Eggs	Moderate								
Fish	Moderate	From sustainable sources	Choose more	1-2x per week	2-3x per week	2x per week			Eat sustainably
Plant protein							Choose more often than animal sources	Choose unprocessed, plant proteins	Includes vegetarian alternatives
Legumes						Eat daily			Increase
Nuts									25g unsalted/day
Fat			Choose vegetable oils		Pick healthier/ unsaturated			Limit	<40 g per day
Saturated							<10% energy intake		
Added sugar		Avoid	Eat less	Avoid	Avoid	Reduce and avoid	<10% energy intake	Limit	Reduce
High salt/fat foods		Avoid	Eat less	Avoid	Avoid	Reduce and avoid	Avoid eating regularly	Limit	Reduce

1 Regular and abundant

2 Avoid / Do not consume regularly / Reduce

3 Regular and abundant / Increase / Choose more

Davies, KP, Gibney, ER, O'Sullivan, AM. Moving towards more sustainable diets: Is there potential for a personalised approach in practice? *J Hum Nutr Diet*. 2023; 1–12. https://doi.org/10.1111/jhn.13218

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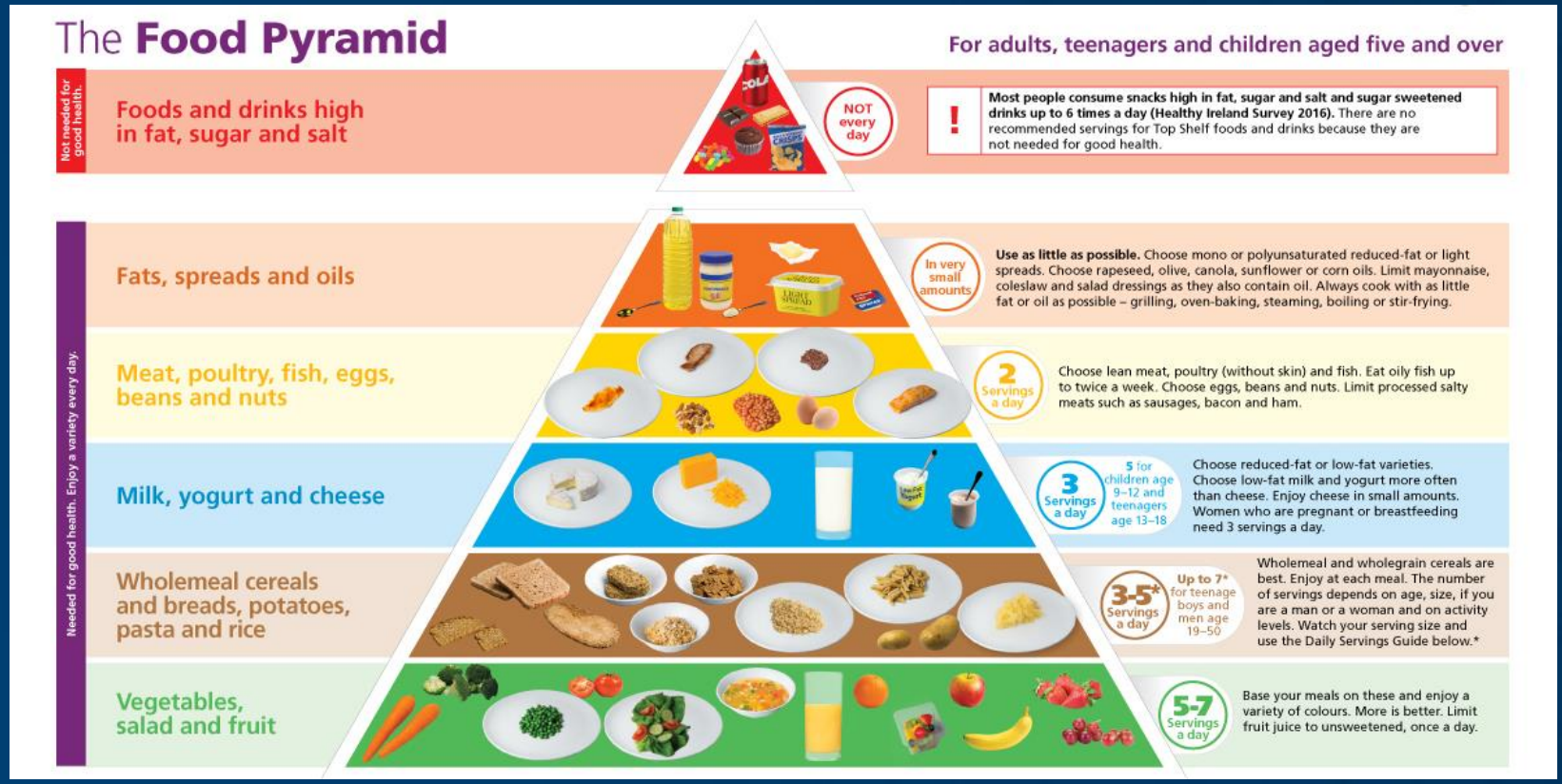

To eliminate all nutrient deficiencies

To optimize nutrient intake to minimize NCD

Food must be Available * Affordable* Acceptable

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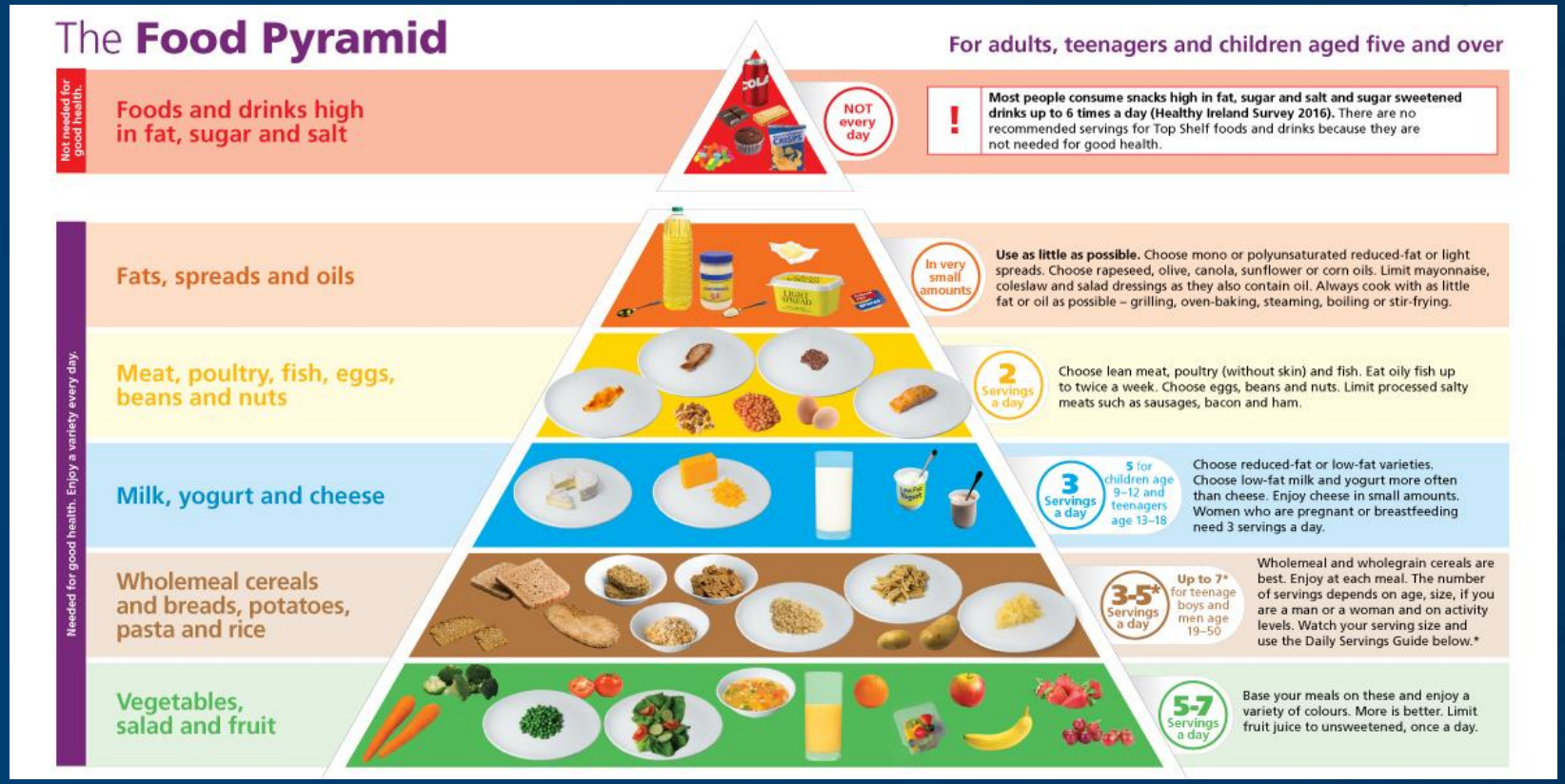

To eliminate all nutrient deficiencies

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Table 1. Summary of micronutrient constraints identified as limiting (included in the optimized diet at the level defined in the constraint) in diet optimization studies.

	Minerals								Vitamins						
Study	Fe	Na	Zn	Ca	I	Se	K	Mg	A	C	B_{12}	D	B_6	B_2	B_9
Kesse-Guyot et al. [56]	✓[1]	✓	✓[1]	–	–	–	–	–	–	✓	–		–	–	–
Kesse-Guyot et al. [59]	✓[1]	✓	✓[1]	–	–	–	–	–	–	–	–		–	–	–
Salome et al. [60]	✓[1]	✓	✓[1]	–	✓	–	–	–	✓	✓	✓		✓	–	–
Fouillet et al. [61]	✓[1]	✓	-[1]	✓	✓	–	–	–	✓	–	✓		–	✓	–
Dussiot et al. [62]	✓[1]	✓	✓[1]	–	✓	–	✓	–	✓	✓	–		–	–	–
Vieux et al. [63]	✓[2]		✓[2]	✓	✓	–		✓	–	–	–	✓	–	–	–
Dussiot et al. [64]	-[1]	✓	-[1]	–	✓	–	–	–	✓	✓	–		–	–	–
Sobhani et al. [71]	–	✓	–	✓				–	✓	✓	✓		✓	–	✓
Eustachio Colombo et al. [53]	✓[3]	✓	–	✓	✓	✓	–	–	✓	–	–	✓	–	–	–
Nordman et al. [54]	✓		–	✓	–	✓	–	–	–	–	–		–	–	–
Ferrari et al. [55]	✓		✓	✓							–				
Verly-Jr et al. [72]	–		–	✓			✓	–	–	–	–		–	–	–
Tompa et al. [58]	✓	✓	✓	✓			✓	–	–	–	✓	✓	–	–	–
Total (12)	10	9	7	8	6	2	3	1	6	5	4	3	2	1	1

Key: ✓, limiting micronutrient; -, non-limiting micronutrient included as a constraint.
[1]Bioavaiable intakes.
[2]The iron constraint assumed high iron losses through menstruation for females under 50 years, and the zinc constraint was reported to be appropriate for the levels of phytate.
[3]Intake based on increased DRV for iron for plant-based diets.
Abbreviations: Ca, calcium; Fe, iron; I, iodine; K, potassium; Mg, magnesium; Na, sodium; Se, selenium; Zn, zinc.

Leonard UM, Kiely ME. Can micronutrient requirements be met by diets from sustainable sources: outcomes of dietary modelling studies using diet optimization. Ann Med. 2024 Dec;56(1):2389295

Table 1. Summary of micronutrient constraints identified as limiting (included in the optimized diet at the level defined in the constraint) in diet optimization studies.

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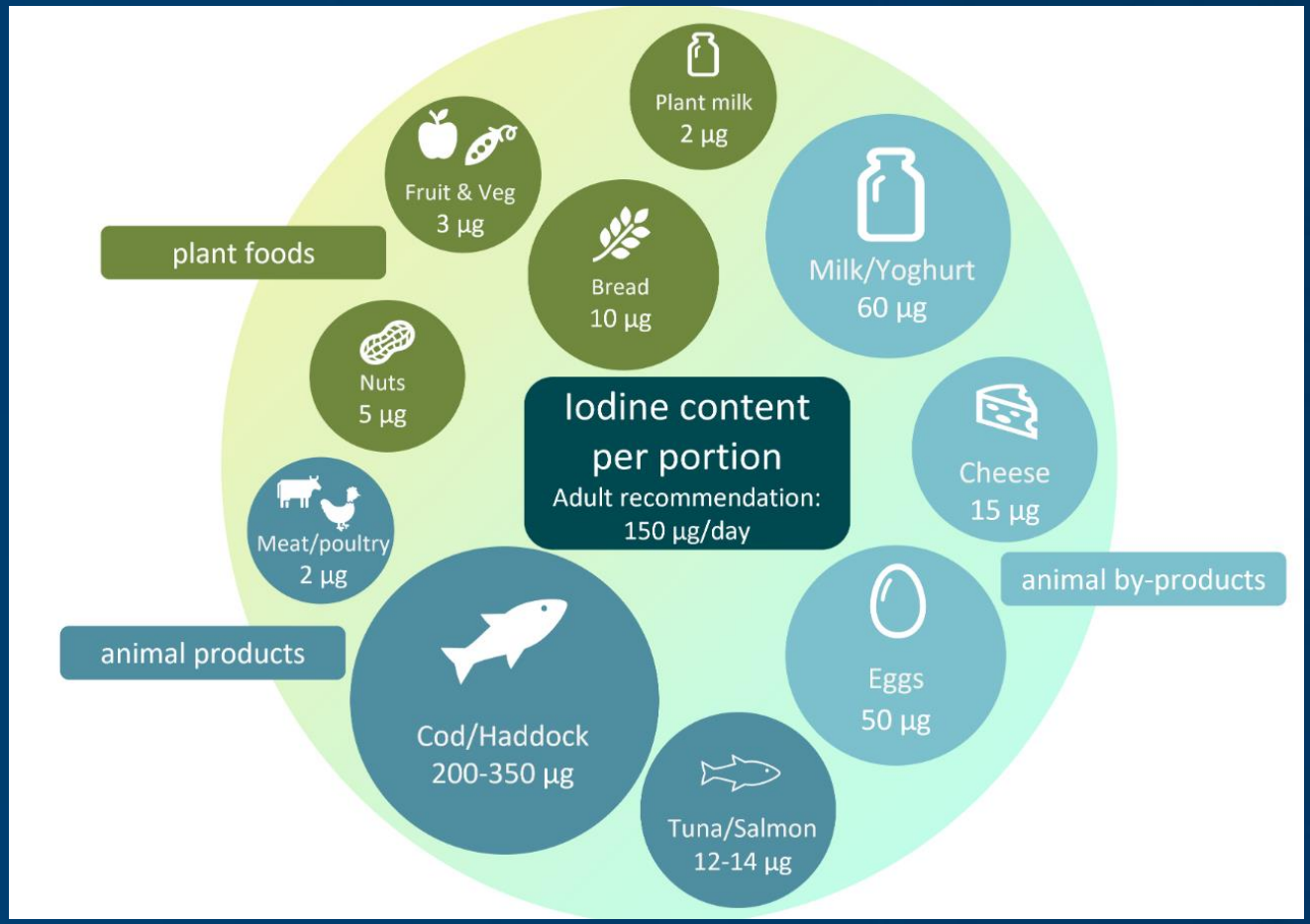
Iodine



Nicol K, Nugent AP, Woodside JV, Hart KH, Bath SC. Iodine and plant-based diets: a narrative review and calculation of iodine content. Br J Nutr. 2023 Aug 25:1-11. doi: 10.1017/S0007114523001873.

Accepted manuscript

Iodine and plant-based diets – a narrative review and calculation of iodine content

Published online by Cambridge University Press: **25 August 2023**

K. Nicol, A.P. Nugent, J.V. Woodside, K. H. Hart and S.C. Bath

Show author details

	Contribution to total iodine intake					
	Milk/dairy products (%)	Fish (%)	Egg (%)	Meat (%)	Total animal products (%)	Iodised salt policy
Belgium	14	7	0	7	28	V
Denmark	30	7	2	1	40	M
Finland	37	10	4	13	64	V
France	21	13	4	5	43	V
Iceland	30	47	2	3	82	N
Ireland	53	6	6	4	58	N
The Netherlands	15	4	2	3	24	V
Norway	36	21	5	3	65	V
Spain	12	32	13	5	62	V
UK	34	10	7	10	61	N

Nicol K, Nugent AP, Woodside JV, Hart KH, Bath SC. Iodine and plant-based diets: a narrative review and calculation of iodine content. Br J Nutr. 2023 Aug 25:1-11. doi: 10.1017/S0007114523001873.

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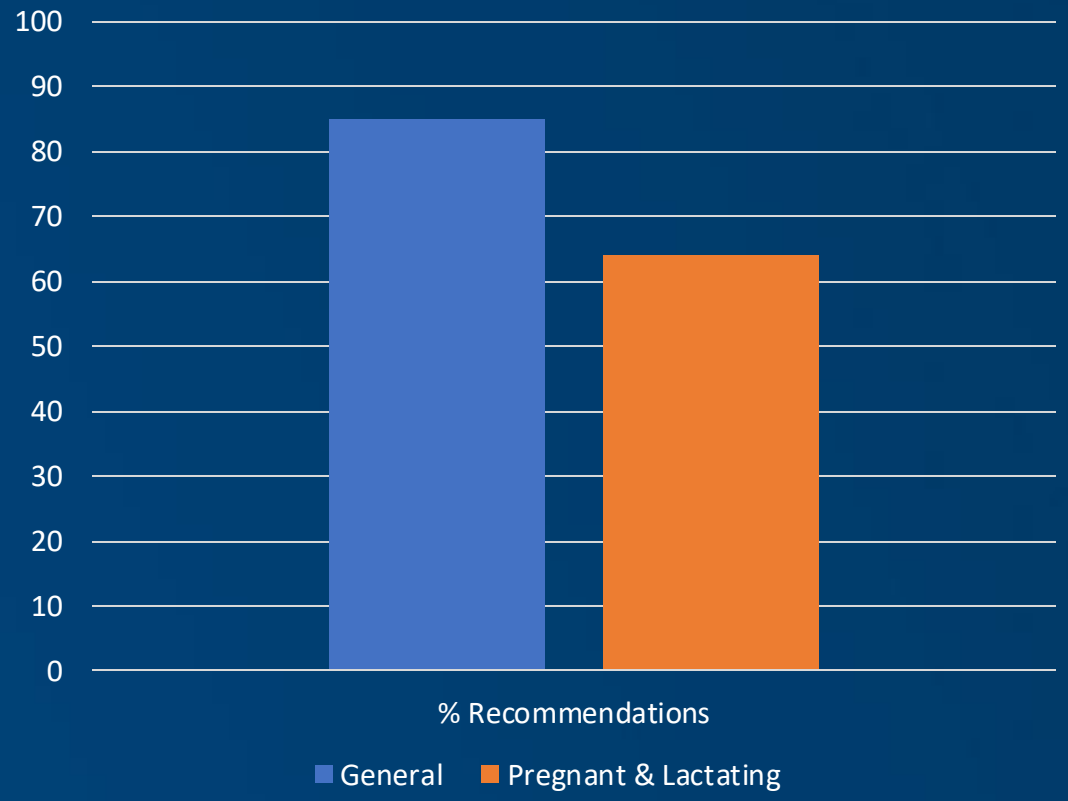
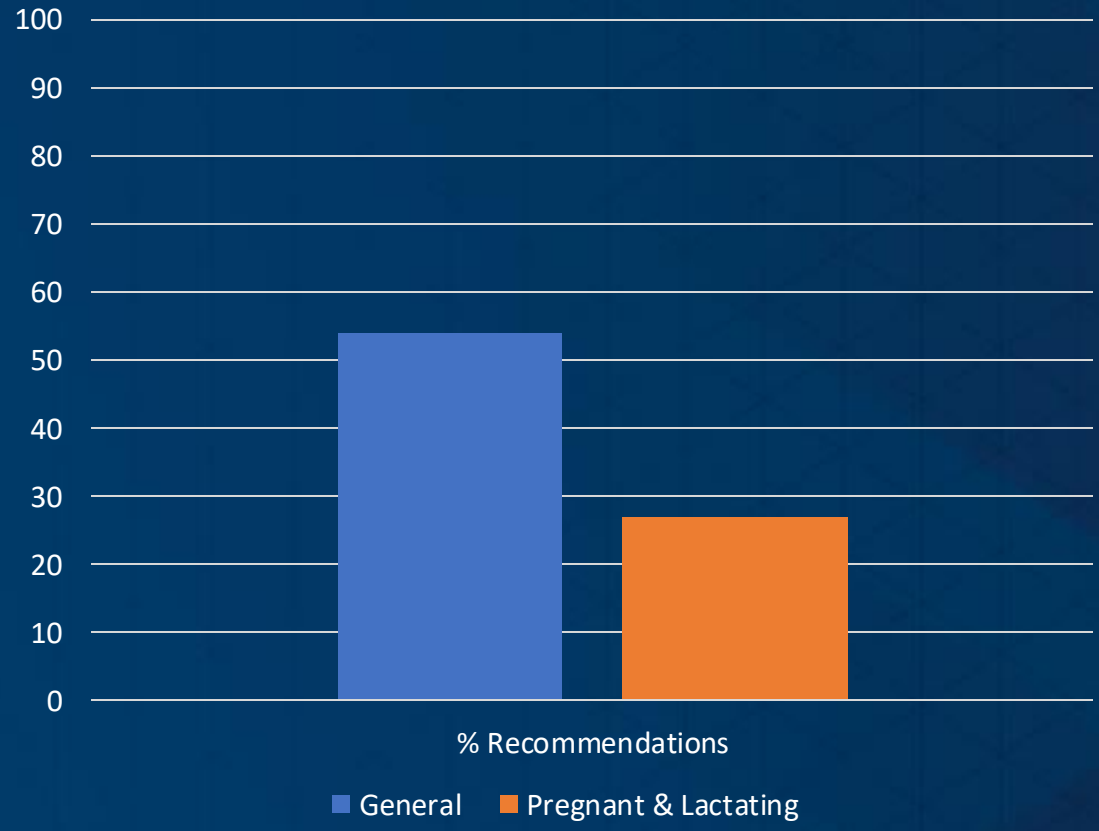
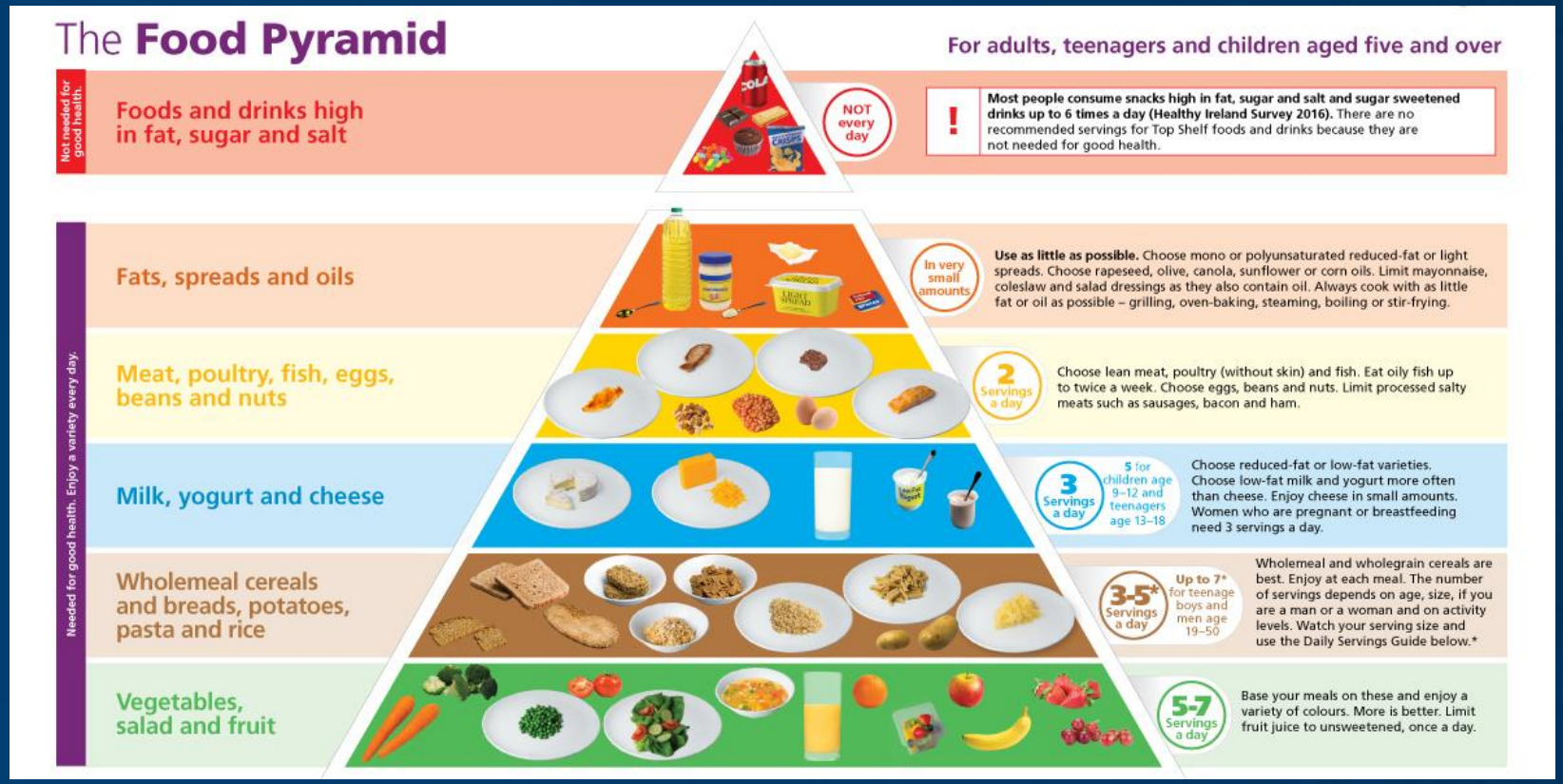
EAT Lancet Diet – 128 ug/day



EAT-Lancet reference diet + Milk replaced with unfortified plant-based alternatives – 54ug/day



Nicol K, Nugent AP, Woodside JV, Hart KH, Bath SC. Iodine and plant-based diets: a narrative review and calculation of iodine content. Br J Nutr. 2023 Aug 25:1-11. doi: 10.1017/S0007114523001873.



To eliminate all nutrient deficiencies

To optimize nutrient intake to minimize NCD

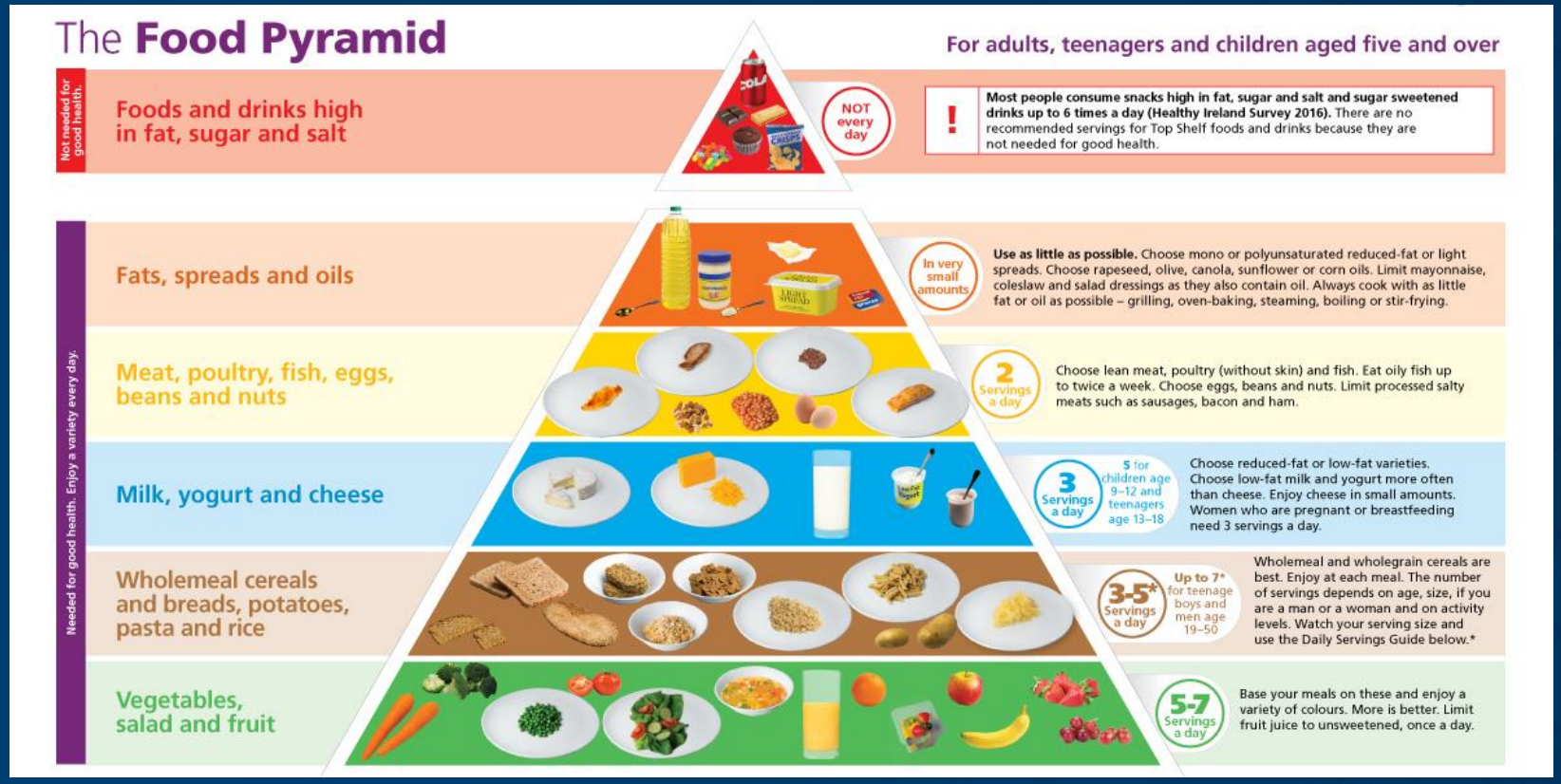
Food must be Available * Affordable* Acceptable

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	p-trend
Cardiovascular disease						
Cases	2104	2068	1964	1937	1758	..
Person-years	904 156	908 271	909 118	910 133	910 302	..
Model 1	1 (ref)	0·90 (0·85–0·96)	0·81 (0·76–0·87)	0·77 (0·72–0·82)	0·67 (0·63–0·71)	<0·0001
Model 2	1 (ref)	0·96 (0·91–1·03)	0·91 (0·85–0·97)	0·89 (0·84–0·95)	0·83 (0·78–0·89)	<0·0001
Coronary heart disease						
Cases	1202	1150	1152	1064	931	..
Person-years	904 998	909 139	909 919	910 989	911 064	..
Model 1	1 (ref)	0·88 (0·81–0·96)	0·84 (0·78–0·92)	0·75 (0·69–0·82)	0·63 (0·58–0·69)	<0·0001
Model 2	1 (ref)	0·95 (0·88–1·04)	0·96 (0·88–1·04)	0·89 (0·81–0·97)	0·81 (0·74–0·88)	<0·0001
Stroke						
Cases	954	970	854	914	874	..
Person-years	905 213	909 314	910 157	911 063	911 087	..
Model 1	1 (ref)	0·92 (0·85–1·01)	0·77 (0·70–0·84)	0·79 (0·72–0·87)	0·72 (0·66–0·79)	<0·0001
Model 2	1 (ref)	0·98 (0·89–1·07)	0·84 (0·77–0·93)	0·89 (0·81–0·98)	0·86 (0·78–0·95)	0·0004
Ischaemic stroke						
Cases	459	519	427	495	437	..
Person-years	905 671	909 743	910 576	911 459	911 490	..
Model 1	1 (ref)	1·02 (0·90–1·15)	0·78 (0·69–0·90)	0·87 (0·76–0·98)	0·73 (0·64–0·83)	<0·0001
Model 2	1 (ref)	1·06 (0·93–1·20)	0·85 (0·74–0·97)	0·96 (0·84–1·10)	0·86 (0·75–0·99)	0·01

Data are number of cases, number of person-years, or hazard ratios (95% CI). Model 1: inverse variance-weighted fixed effects meta-analysis of age-adjusted cohort-specific hazard ratios. Model 2: additionally adjusted for energy intake, alcohol (0, >0 to <5, 5 to <10, 10 to <15, or ≥15 g/d), multivitamin use (yes or no), aspirin use (yes or no), smoking (never smoker, past smoker, current smoker 1–14 cigarettes per day, current smoker 15–24 cigarettes per day, or current smoker ≥24 cigarettes per day), physical activity (<3, 3 to <9, 9 to <18, 18 to 27, 27 to <42, or ≥42 total metabolic equivalent of task per week), BMI (<21, 21 to <23, 23 to <25, 25 to <27, 27 to <30, 30 to <33, 33 to <35, 35 to <40, or ≥40 kg/m²), marital status (never married, married, widowed, or divorced or separated), family history of type 2 diabetes (yes or no), family history of cardiovascular disease (yes or no), postmenopausal hormone use (premenopausal, postmenopausal never used, postmenopausal currently using, or postmenopausal past use), oral contraceptive use (NHS II only; current, past, or never used), race (White or not White), hypertension (yes or no), hypercholesterolaemia (yes or no), and incident diabetes (yes or no).

Table 3: **Association between Planetary Health Diet Index and incident cardiovascular disease, coronary heart disease, and stroke in meta-analysis of the Nurses' Health Study I, Nurses' Health Study II, and Health Profssionals Follow-up Study**

Sawicki, C.M., Ramesh, G., Bui, L., Nair, N.K., Hu, F.B., Rimm, E.B., Stampfer, M.J., Willett, W.C. and Bhupathiraju, S.N., 2024. Planetary health diet and cardiovascular disease: results from three large prospective cohort studies in the USA. *The Lancet Planetary Health*, *8*(9), pp.e666-e674.



To eliminate all nutrient deficiencies

To optimize nutrient intake to minimize NCD

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Building a more sustainable diet

Environment

Health → Is it good for my health?

Accessibility → Can I buy climate-friendly food?

Acceptance → Will I like a climate-friendly diet?

Personalised to me

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SuHeGuide

Need for population change – healthy & sustainable diet – lack of data on nutritional status

Consider use of PN strategies to support behavioural change within population health

Multicentre RCT examining impact of PN strategies for healthy sustainable diets on nutrient intake and status

UCD DUBLIN

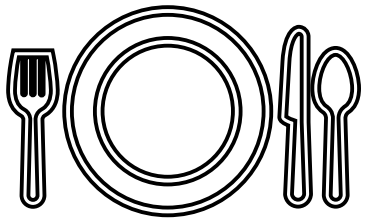
QUEEN'S UNIVERSITY BELFAST

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

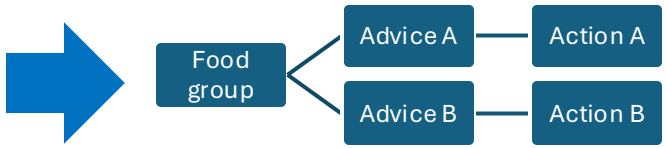
Department of Agriculture, Environment and Rural Affairs
Sustainability at the heart of a living, working, active landscape valued by everyone

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

MyPlanetDiet Dietary Intervention

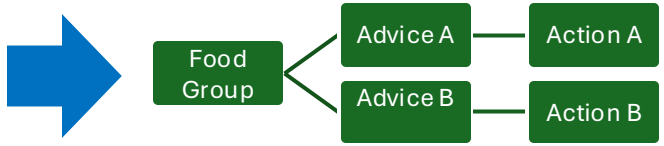


Healthy Eating Guidelines



- 2 servings per day
- “Meat, poultry, fish, eggs, beans and nuts group”
- Meat serving = 50-75g
- No more than one red meat per day

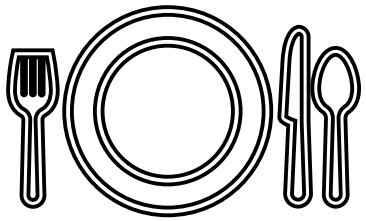
Sustainable Healthy Diet



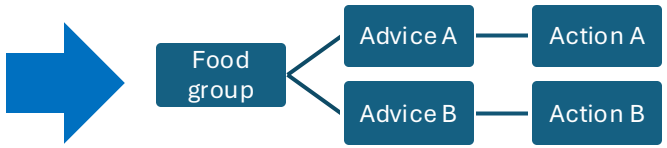
- 3 servings meat per week
- Meat serving = 140g
- No more than 1 red meat/week
- 1 serving plant protein per day
- 1 serving nuts and seeds

Davies KP, Gibney ER, O'Sullivan AM. Moving towards more sustainable diets: Is there potential for a personalised approach in practice? J Hum Nutr Diet. 2023 Dec;36(6):2256-2267.
Davies KP, Gibney ER, Leonard UM, Lindberg L, Woodside JV, Kiely ME, Nugent AP, Arranz E, Conway MC, McCarthy SN, O'Sullivan AM. Developing and testing personalised nutrition feedback for more sustainable healthy diets: the MyPlanetDiet randomised controlled trial protocol. Eur J Nutr. 2024

MyPlanetDiet Dietary Intervention

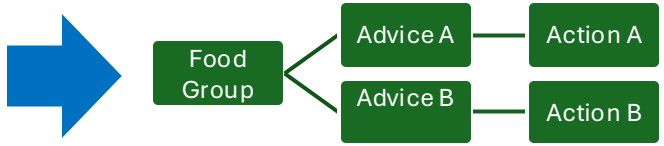


Healthy Eating Guidelines



- 2 servings per day
- [illegible]
- Adherence = ~60%
- lower GHGE
- No more than one red meat per day

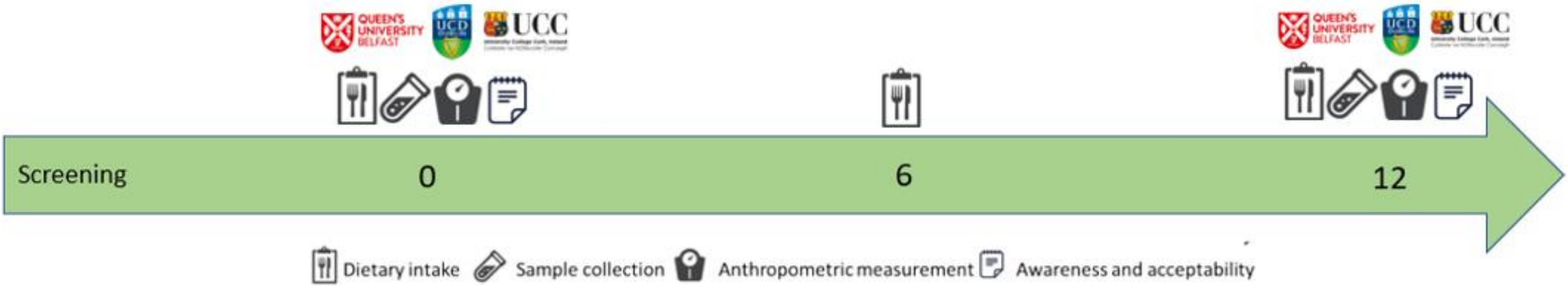
Sustainable Healthy Diet



- 3 servings meat per week
- Adherence = ~80%
- lower GHGE
- 1 serving plant protein per day
- 1 serving nuts and seeds

Davies KP, Gibney ER, O'Sullivan AM. Moving towards more sustainable diets: Is there potential for a personalised approach in practice? J Hum Nutr Diet. 2023 Dec;36(6):2256-2267.
Davies KP, Gibney ER, Leonard UM, Lindberg L, Woodside JV, Kiely ME, Nugent AP, Arranz E, Conway MC, McCarthy SN, O'Sullivan AM. Developing and testing personalised nutrition feedback for more sustainable healthy diets: the MyPlanetDiet randomised controlled trial protocol. Eur J Nutr. 2024

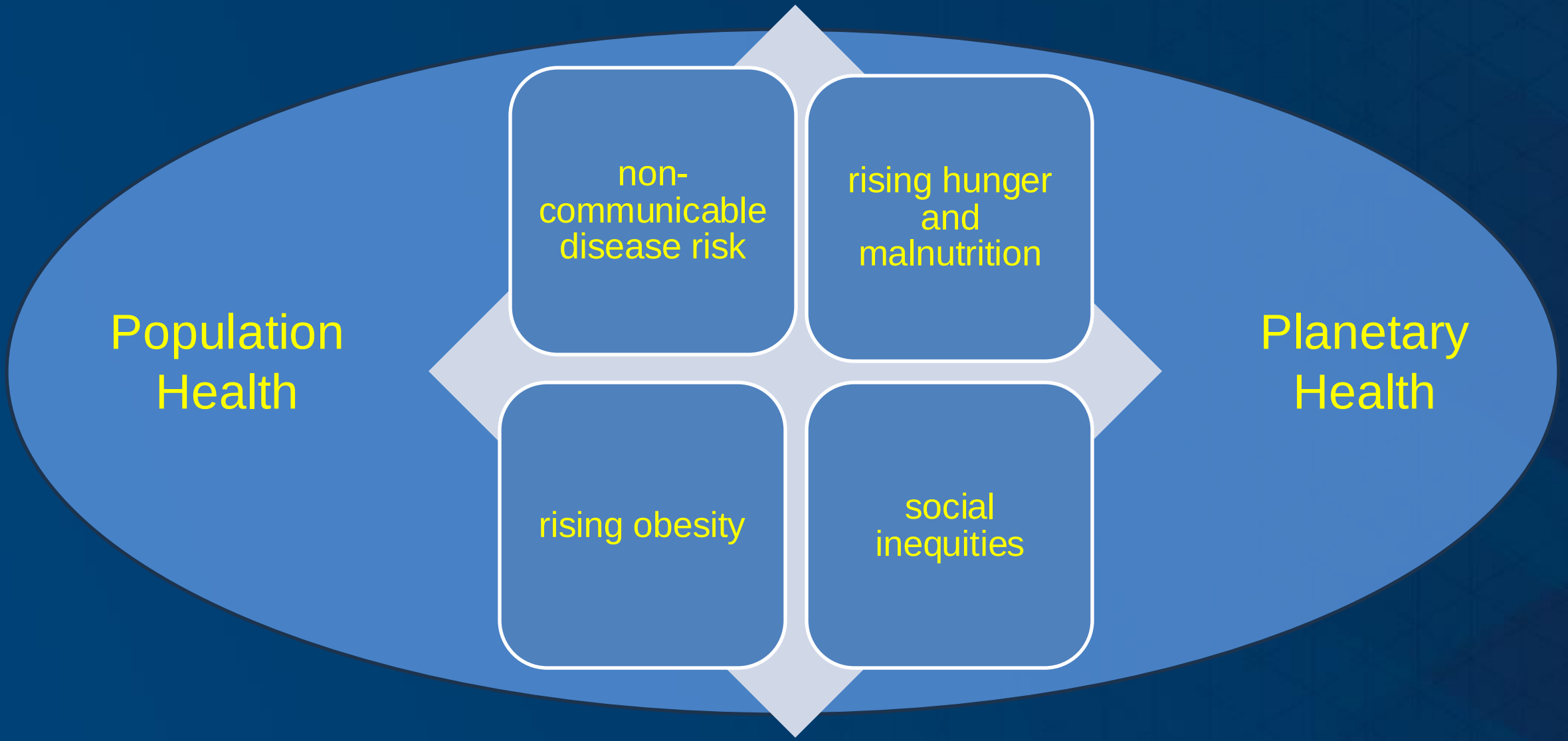
SuHE RCT



- Personalised General Healthy v Sustainable Healthy Eating advice
- n=360, 18-65 males/females
- 12 week HEG v SHD
- 1’ outcome - Dietary intake, GHGEs
- Nutrient status, Health biomarkers

Davies KP, Gibney ER, O'Sullivan AM. Moving towards more sustainable diets: Is there potential for a personalised approach in practice? J Hum Nutr Diet. 2023 Dec;36(6):2256-2267.
Davies KP, Gibney ER, Leonard UM, Lindberg L, Woodside JV, Kiely ME, Nugent AP, Arranz E, Conway MC, McCarthy SN, O'Sullivan AM. Developing and testing personalised nutrition feedback for more sustainable healthy diets: the MyPlanetDiet randomised controlled trial protocol. Eur J Nutr. 2024

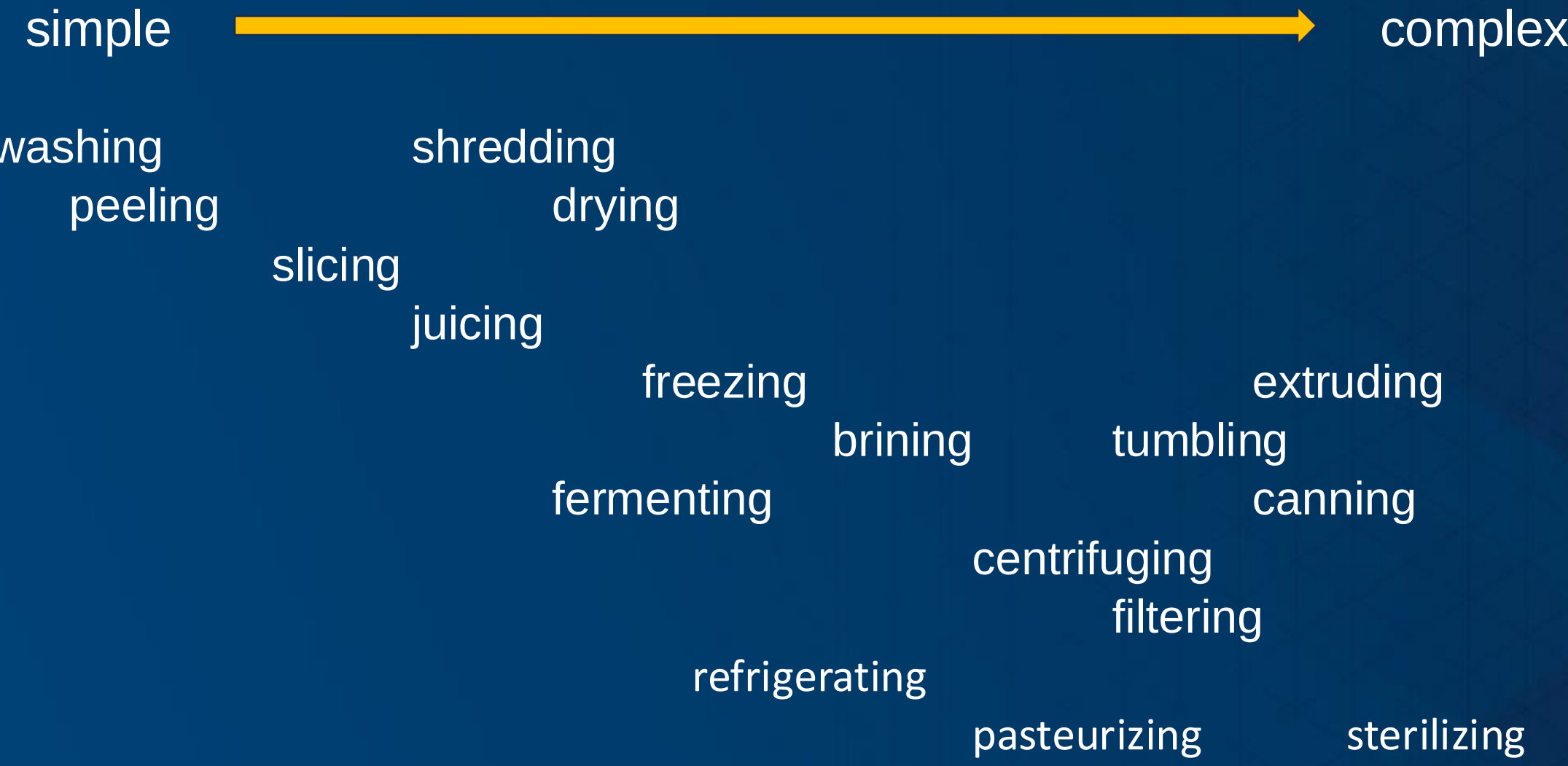
WHAT CHALLENGES DO OUR FOOD SYSTEMS FACE?



- What do we mean by processed foods?

  What is food processing?
  Link to sustainability and disease risk?

What is food processing?



Why? …. Positive effects…..

Increased food availability	**Convenience**	**Variety (special requirements – gluten free, low sugar)**	**Safety**
Palatable	**Increasing nutritional quality**	**Fortification**	**Affordability**

Food processing Classification Systems

Article

Food Processing: Comparison of Different Food Classification Systems

Taissa Pereira de Araújo [1,2,*], Milena Miranda de Moraes [1,2], Cláudia Afonso [1,2], Cristina Santos [1,3] and Sara S. P. Rodrigues [1,2]

Classification Systems	Degree of Processing Groups			
	1	2	3	4
IARC—Europe (2009)	Non Processed Food		Moderately PF	Highly PF
NOVA—Brazil (2010, 2016)	Unprocessed food or Minimally PF	Processed culinary ingredients	Processed food	Ultra-processed food
IFPRI—Guatemala (2011)	Unprocessed Food	Primary PF		Highly PF
IFIC—USA (2012)	Minimally PF		FP for preser-vation	Prepared foods/meals
			Mixtures of combined ingredients	Ready-to-eat processed
UNC—USA (2016)	Unprocessed food	Basic PF	Moderately PF	Highly PF

de Araújo TP, de Moraes MM, Afonso C, Santos C, Rodrigues SSP. Food Processing: Comparison of Different Food Classification Systems. *Nutrients*. 2022; 14(4):729. https://doi.org/10.3390/nu14040729

Article

Food Processing: Comparison of Different Food Classification Systems

Taissa Pereira de Araújo [1,2,*], Milena Miranda de Moraes [1,2], Cláudia Afonso [1,2], Cristina Santos [1,3] and Sara S. P. Rodrigues [1,2]

NOVA. IARC, IFPRI and UNC food classification systems (556 foods)

Discrepancy Range % of UPF Classification (DR)

Classification Systems	Degree of Processing Groups			
	1	2	3	4
IARC—Europe (2009)	Non Processed Food		Moderately PF	Highly PF
NOVA—Brazil (2010, 2016)	Unprocessed food or Minimally PF	Processed culinary ingredients	Processed food	Ultra-processed food
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			Mixtures of combined ingredients	Ready-to-eat processed
UNC—USA (2016)	Unprocessed food	Basic PF	Moderately PF	Highly PF

IARC - 47.4%

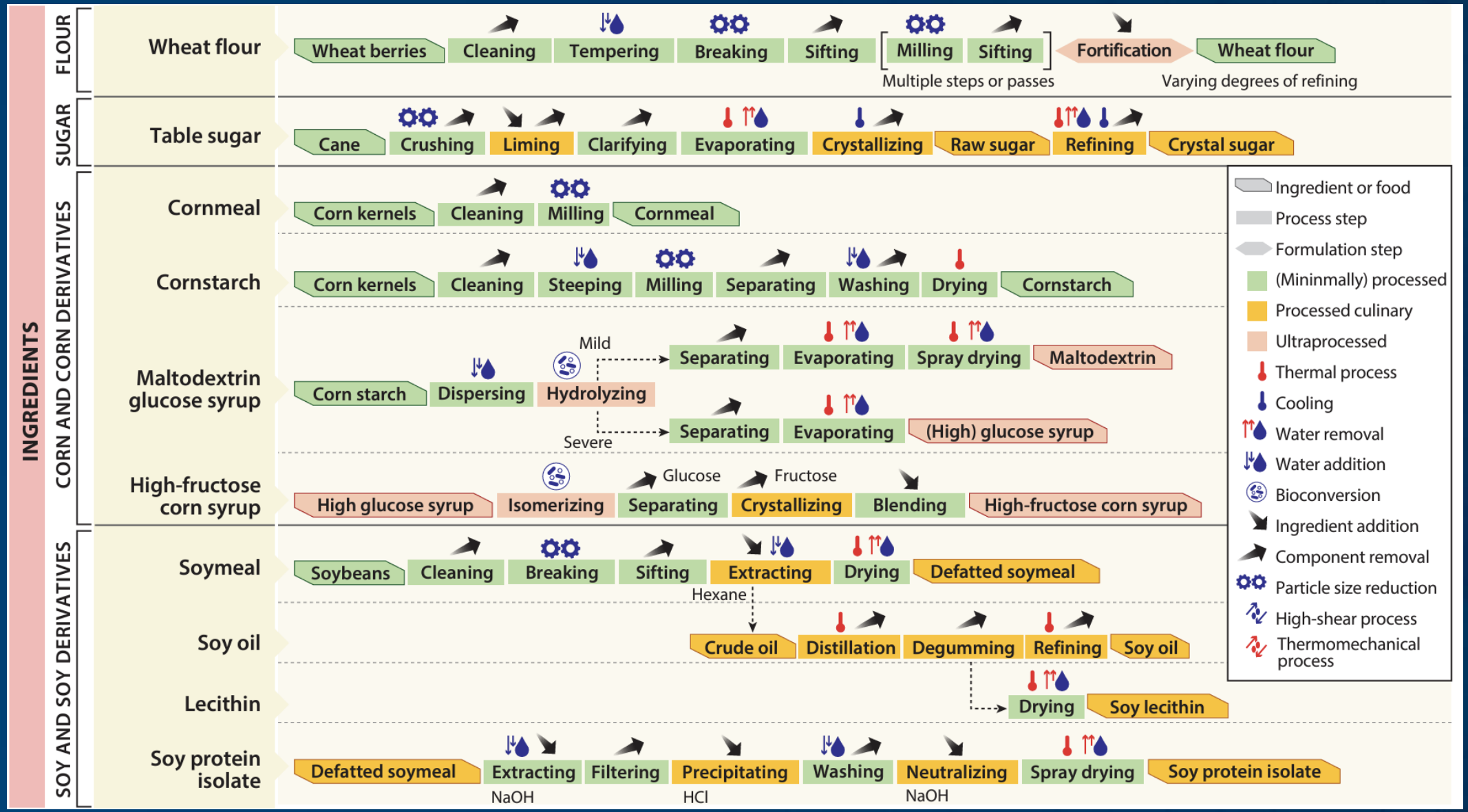
NOVA - 10.2%

IFPRI - 16.7%

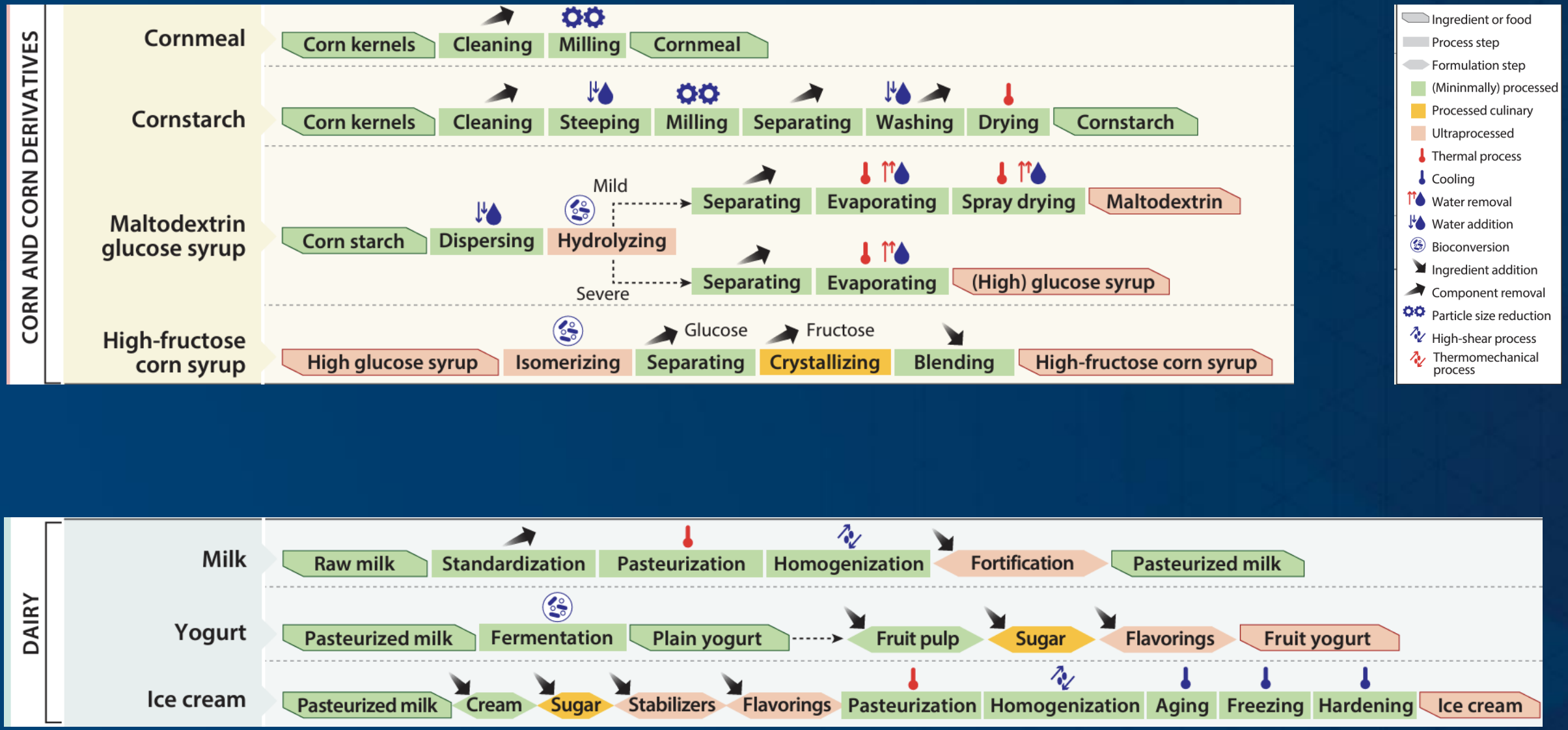
IFIC - 17.7%

UNC - 15.2%

de Araújo TP, de Moraes MM, Afonso C, Santos C, Rodrigues SSP. Food Processing: Comparison of Different Food Classification Systems. *Nutrients*. 2022; 14(4):729. https://doi.org/10.3390/nu14040729



Ubbink J, Levine AS. From Processed Foods to Ultraprocessed Foods: Evolution of an Industry Model and Impact on Dietary Quality, Health, and Society. Annu Rev Food Sci Technol. 2024 Nov 13. doi: 10.1146/annurev-food-111523-122028. Epub ahead of print. PMID: 39536090.xc



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Consumption of ultra-processed foods and risk of multimorbidity of cancer and cardiometabolic diseases: a multinational cohort study

Reynalda Cordova • Vivian Viallon • Emma Fontvieille • Laia Peruchet-Noray • Anna Jansana • Karl-Heinz Wagner • et al. Show all authors

Open Access • Published: November 13, 2023 • DOI: https://doi.org/10.1016/j.lanepe.2023.100771

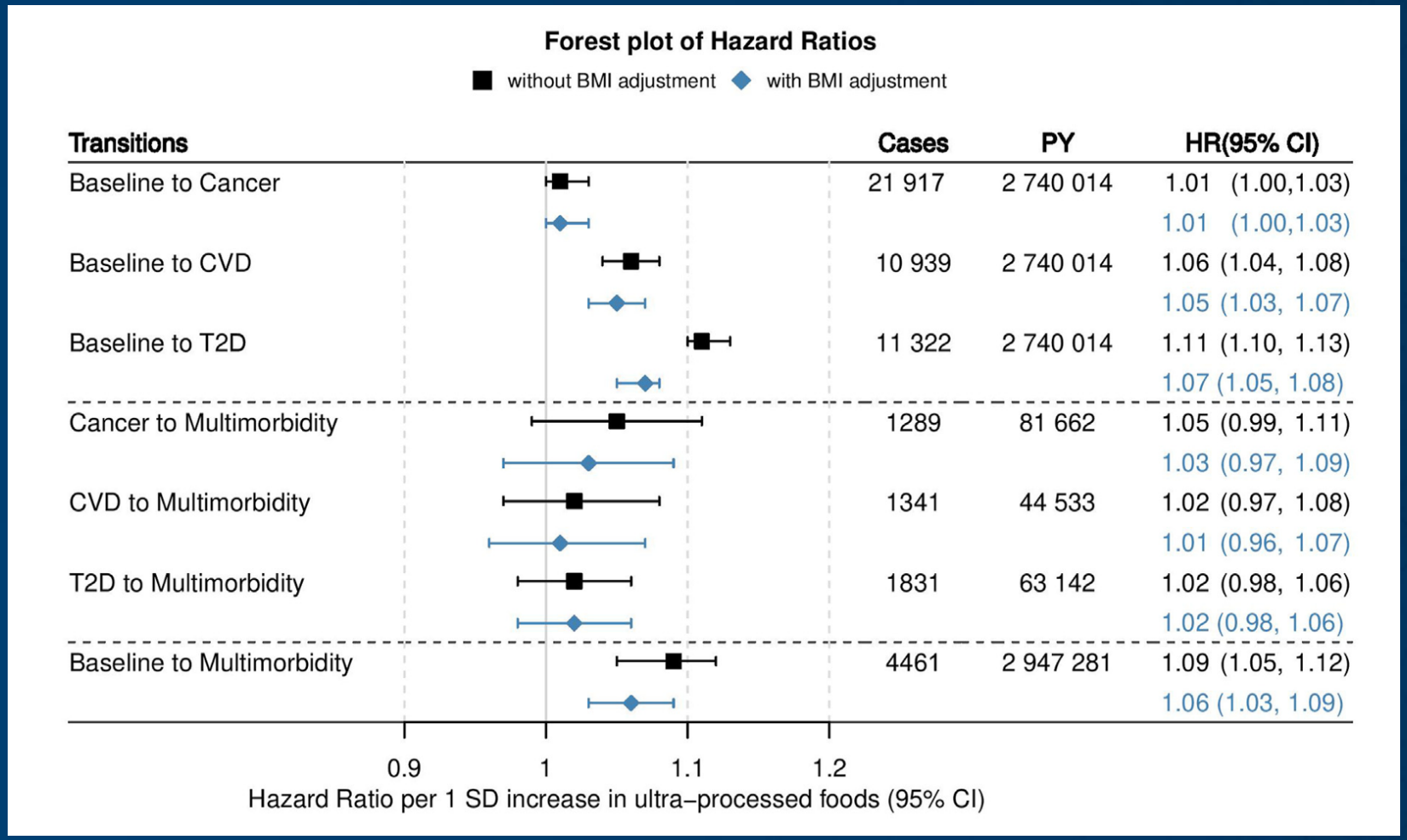
The Lancet Regional Health - Europe 2023;■: 100771

Published Online XXX https://doi.org/10.1016/j.lanepe.2023.100771

Prospective cohort study
N= 266,666 participants (60% women) free of cancer, cardiovascular disease, and type 2 diabetes at recruitment fr
N=7 European countries in the EPIC study.
Foods and drinks consumed in previous 12 months assessed at baseline by FFQ
Classified according to their degree of processing using Nova classification.

Multistate modelling based on Cox regression to estimate cause-specific hazard ratios (HR) and their 95% confidence intervals (CI) for associations of **total and subgroups of UPFs with the risk of multimorbidity of cancer and cardiometabolic diseases.**

NOVA—Brazil (2010, 2016)	Unprocessed food or Minimally PF	Processed culinary ingredients	Processed food	Ultra-processed food



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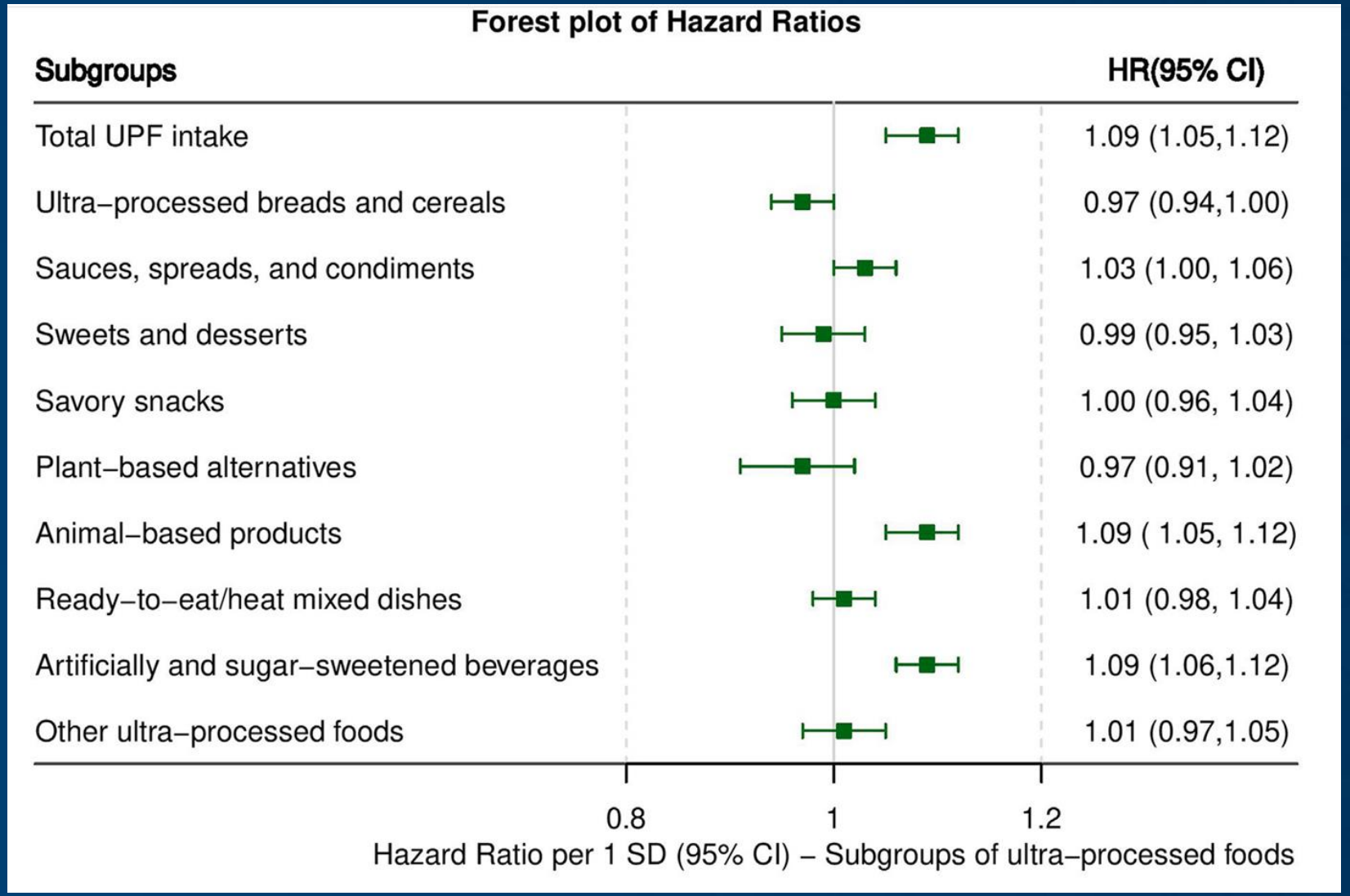

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Impact of processing on environment and disease risk….

Different levels of ultra-processed food and beverage consumption and associations with environmental sustainability and **all-cause mortality** in EPIC-NL

UPFD: Ultra-processed food & drink, UPF: Ultra-processed food, UPD: Ultra-processed drink

	Relative risk of all cause mortality			
	Q1 (low)	Q2	Q3	Q4 (High)
UPFD	1.00	0.97	0.99	1.17
UPF	1.00	0.93	0.91	1.06
UPD	1.00	0.98	1.00	1.16

Vellinga RE, van den Boomgaard I, M A Boer J, van der Schouw YT, Harbers MC, Verschuren WMM, van 't Veer P, H M Temme E, Biesbroek S. Different Levels of Ultraprocessed Food and Beverage Consumption and Associations with Environmental Sustainability and All-cause Mortality in EPIC-NL. Am J Clin Nutr. 2023 Jul;118(1):103-113. doi: 10.1016/j.ajcnut.2023.05.021. Epub 2023 May 18. PMID: 37207984.

Different levels of ultra-processed food and beverage consumption and associations with environmental sustainability and **all-cause mortality** in EPIC-NL

	% difference Q1 to Q4 of consumption		
	UPFD	**UPF**	**UPD**
GHG emission	**+1.9**	**-7.7**	**+5.8**
Blue water consumption	**-4.0**	**-13.6**	**+3.2**
Land use	**-0.9**	**-3.0**	**+0.4**
Terrestrial acidification	**-0.9**	**-7.2**	**+2.9**
Fresh water eutrophication	**+2.6**	**-5.3**	**+5.0**
Marine water eutrophication	**-1.5**	**-5.4**	**+1.2**

Vellinga RE, van den Boomgaard I, M A Boer J, van der Schouw YT, Harbers MC, Verschuren WMM, van 't Veer P, H M Temme E, Biesbroek S. Different Levels of Ultraprocessed Food and Beverage Consumption and Associations with Environmental Sustainability and All-cause Mortality in EPIC-NL. Am J Clin Nutr. 2023 Jul;118(1):103-113. doi: 10.1016/j.ajcnut.2023.05.021. Epub 2023 May 18. PMID: 37207984.


Current Research in Food Science 7 (2023) 100627

Contents lists available at ScienceDirect

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Examination of the interrelationships between nutrition, environmental sustainability and food-processing: A concept study using model diets

Steven L. Mulrooney, James G. Lyng, Cathal O'Hara, Aifric O'Sullivan, E. Dolores O'Riordan, Eileen R. Gibney*

Institute of Food and Health, University College Dublin, Ireland

Examination of the interrelationships between nutrition, environmental sustainability and food-processing: A concept study using model diets. Steven L Mulrooney, James G Lyng, Cathal O'Hara, Aifric O'Sullivan, E Dolores O'Riordan, Eileen R Gibney- Current Research in Food Science, 2023

	Healthy	Unhealthy (processed)	Healthy (plant-based - processed)	Healthy (plant-based)
AHEI Score	62	16	70	79
Processing specific energy (MJ/day)	5	8	17	5
Total # processes in diet per day	86	131	86	87
Average # processes / food item	4	6	5	4
Greenhouse Gas Emissions (kg/day)	5	5	3	3
Blue Water Footprint (m^3/day)	0.3	0.2	0.2	0.2
Cropland Use (m^2/day)	6	5	11	14

Examination of the interrelationships between nutrition, environmental sustainability and food-processing: A concept study using model diets. SL Mulrooney, JG Lyng, C O'Hara, A O'Sullivan… - Current Research in Food Science, 2023

European Journal of Nutrition (2024) 63:2957–2973
https://doi.org/10.1007/s00394-024-03477-w

ORIGINAL CONTRIBUTION

Check for updates

The role of ultra-processed foods in plant-based diets: associations with human health and environmental sustainability

Merel C. Daas[1] · Reina E. Vellinga[1,2] · Maria Gabriela M. Pinho[3] · Jolanda M. A. Boer[2] · W. M. Monique Verschuren[2,4] · Yvonne T. van der Schouw[4] · Pieter van't Veer[1] · Sander Biesbroek[1]

- Associations of UPF in healthful (hPDI) & unhealthful (uPDI) plant-based diets
- All-cause mortality, greenhouse gas emissions (GHGE), and blue water consumption (BWC).
- 35,030 participants (20–70 years; 74% females) EPIC-NL cohort, 1993 to 1997 through 2014.
- Cox proportional hazard and multiple linear regression models to estimate associations between quartiles of the PDI indices and UPF consumption.

	GHGE (Green House Gas Emissions)	BWC (Blue Water Consumption)
Lower UPF	1.4%	1.6
Higher Healthy Plant Diet Index	-7.4%	-9.6%
Lower UPF & Lower hPDI	-6.8%	-13.1%

	All-cause mortality (risk estimate)	
Lower UPF	0.98	-0.2%
Higher Healthy Plant Diet Index	0.86	-14%
Lower UPF & Lower hPDI	0.78	-22%

European Journal of Nutrition (2024) 63:2957–2973
https://doi.org/10.1007/s00394-024-03477-w

ORIGINAL CONTRIBUTION

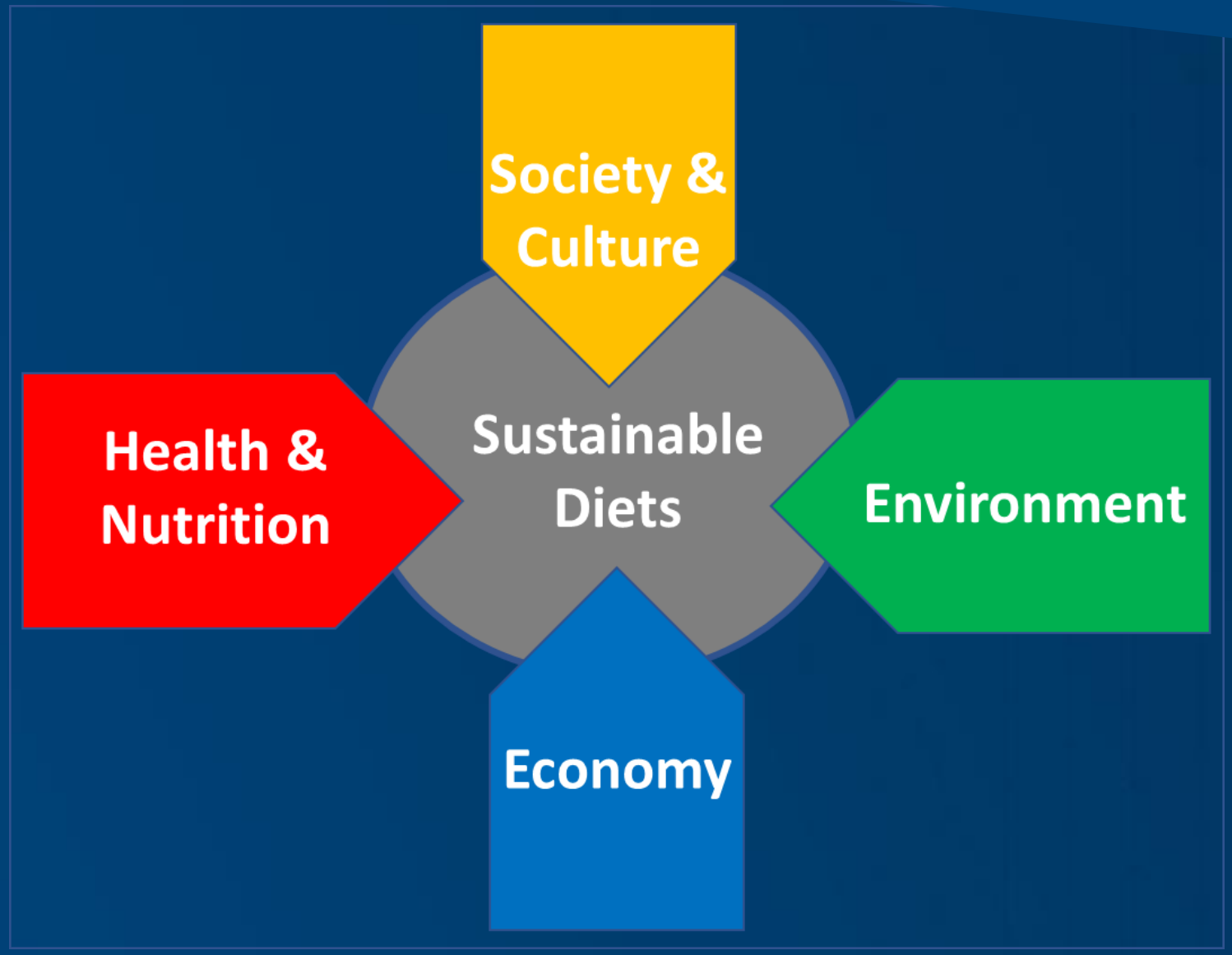
The role of ultra-processed foods in plant-based diets: associations with human health and environmental sustainability

Merel C. Daas[1] · Reina E. Vellinga[1,2] · Maria Gabriela M. Pinho[3] · Jolanda M. A. Boer[2] · W. M. Monique Verschuren[2,4] · Yvonne T. van der Schouw[4] · Pieter van't Veer[1] · Sander Biesbroek[1]

- Mortality risk and environmental impacts were mostly associated with the amount of plant-based foods and to a lesser extent UPF in the diet.

- Shifting to a more healthful plant-based diet could improve human health and reduce most aspects of environmental impact (GHGE, but not BWC) irrespective of UPF consumption.

- Results for unhealthy plant diet were inconclusive



UN FAO

- *low environmental impacts*
- *nutrition security and to healthy life*
- *culturally acceptable, accessible*
- *economically fair and affordable*

FAO, 2010, Sustainable Diets and Biodiversity.

Affordable Nutrient Density in Brazil: Nutrient Profiling in Relation to Food Cost and NOVA Category Assignments

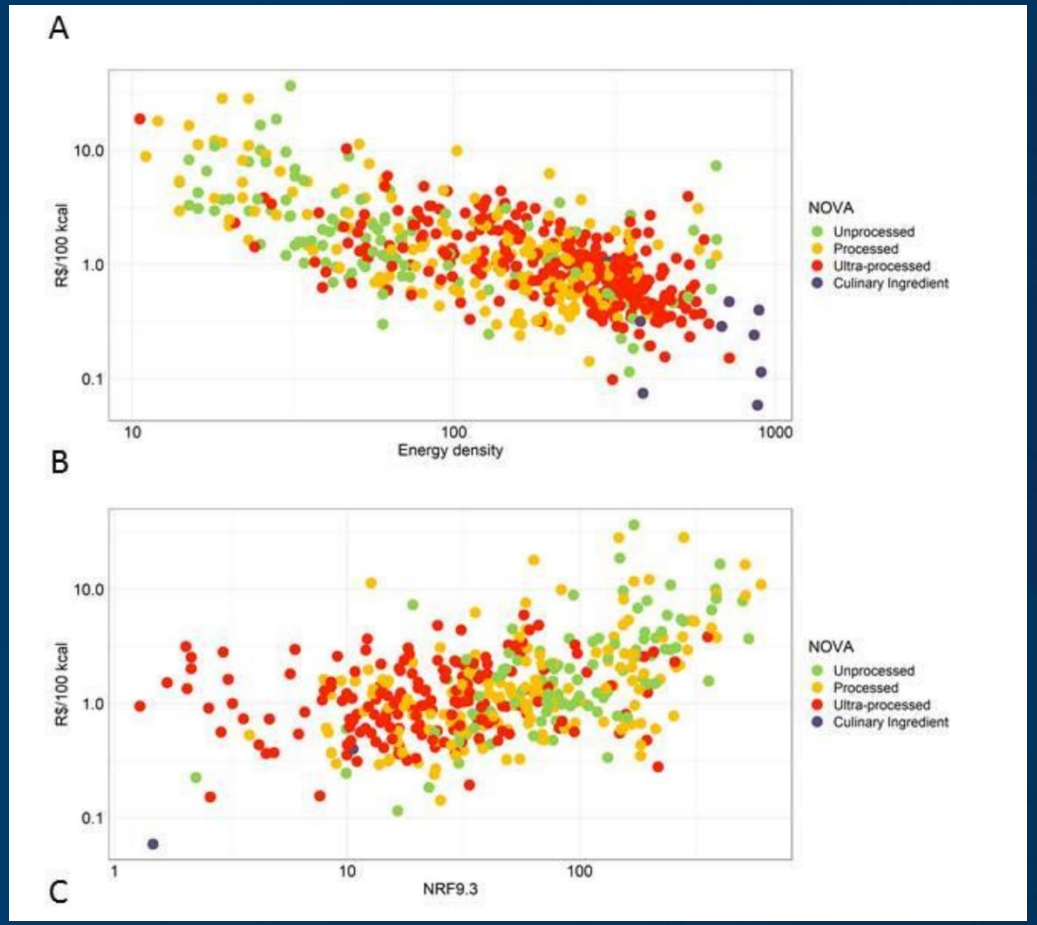
by Alfonso Mendoza-Velázquez [1,2], Jonathan Lara-Arévalo [1,*], Kennya Beatriz Siqueira [3], Mariano Guzmán-Rodríguez [2] and Adam Drewnowski [1]

Affordable nutrient density - low-cost and nutrient-rich foods.

n = 591 Foods in Brazil

- Nutrient Rich Food Index (NRF9.3)
- Affordability
- NOVA category

- Affordable Nutrient-rich foods included MPF processed foods (PF) and UPF.



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Making Healthy, Sustainable Diets Accessible and Achievable: A New Framework for Assessing the Nutrition, Environmental, and Equity Impacts of Packaged Foods

David I Gustafson,[1] Eric A Decker,[2] Adam Drewnowski,[3] Michael W Hamm,[4] Jane Hwang,[5] and Kathleen A Merrigan[6]

[1]Adjunct Research Faculty, Biological Systems Engineering, Washington State University, Pullman, WA, USA; [2]Department of Food Science, University of Massachusetts, Amherst, MA, USA; [3]Center for Public Health Nutrition, University of Washington, Seattle, WA; USA; [4]Department of Community Sustainability, Michigan State University, Lansing, MI, USA; [5]Social Accountability International, New York, NY, USA; and [6]Swette Center for Sustainable Food Systems, Arizona State University, Tempe, AZ, USA

SUSTAINABLE, NUTRITIOUS PACKAGED FOODS:
GUIDING PRINCIPLES

Potential Indicators

Nutrition*

- **Contributes positive food group(s)**
  - ***FOR SNACKS:*** *8g whole grains; ¼ cup equivalent of fruits, vegetables or dairy; ¼ oz of nuts*
- **Contributes under-consumed nutrient(s)**
  - ***FOR SNACKS:*** *10% DV potassium, fiber, vitamin D, calcium, iron, vitamin E, magnesium, etc.*
- **Includes whole food ingredients**
  - ***FOR SNACKS:***
    - *First ingredient is a whole food AND*
    - *Most ingredients (>50% by wt.) are whole foods*
- **Limits total and added sugar**
  - ***FOR SNACKS:*** *Meets NSSRI targets (by category)*
- **Limits saturated fat**
  - ***FOR SNACKS:*** *<10% of calories*
- **Limits sodium**
  - ***FOR SNACKS:*** *Meets FDA voluntary sodium reduction targets (by category)*

Environment

SOURCING

- **Is "made with organic" or contains ingredients sourced in a way that …**
  - Limits GHG emissions, moving to net zero
  - Limits synthetic chemicals/pesticides
  - Supports downstream water quality
  - Supports soil quality
  - Promotes biodiversity

MANUFACTURING

- **Leverages zero waste practices**
  - Made in a facility following zero waste standards
- **Uses eco-friendly packaging**
  - Packaging is recyclable, reusable or compostable
  - It's accompanied by simple/visible consumer education
- **Limits GHG emissions**
  - Made using renewable energy

Equity

MANUFACTURING/SOURCING

- **Is made while ensuring fair and healthy working conditions across the supply chain:**
  - Living wage and income
  - Safe working environment
  - No forced or child labor
  - Freedom of association

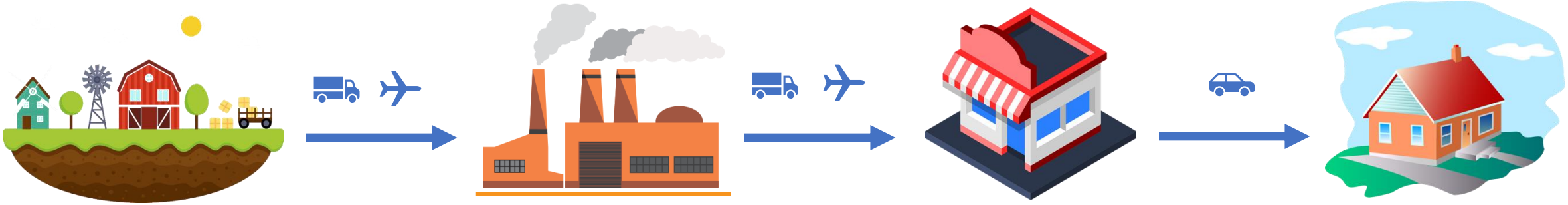
PRODUCT/PROMOTION

- **Delivers consumer-relevant value**
- **Has a desirable taste, texture and appearance**
- **Meets consumers' diverse lifestyle demands**
  - Examples: portable, time saving, easy to prepare at all skill levels to help make healthy, sustainable eating achievable
- **Clearly conveys product attributes and benefits with accessible marketing and labeling**

*Performance foods are exempt

Food Systems

UCD Institute of Food and Health



Food Systems @ UCD

UCD Institute of Food and Health

CAMEO

Multi-species Sward

SuHe Sustainable Healthy Eating

Farm Zero C

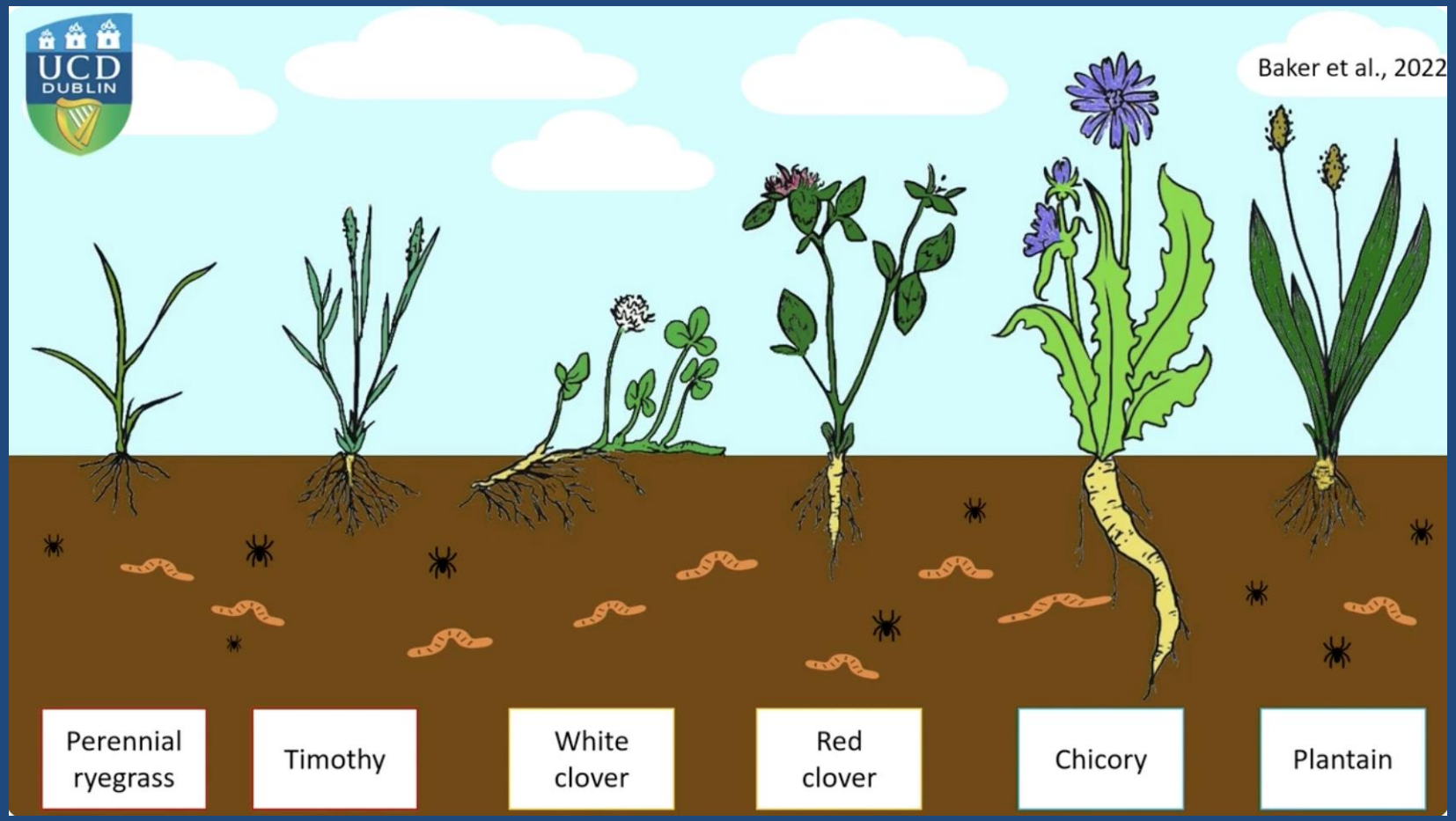
Food for Health Ireland

Biorbic

Co-Centre for Sustainable Food Systems

UCD Lyons Farm

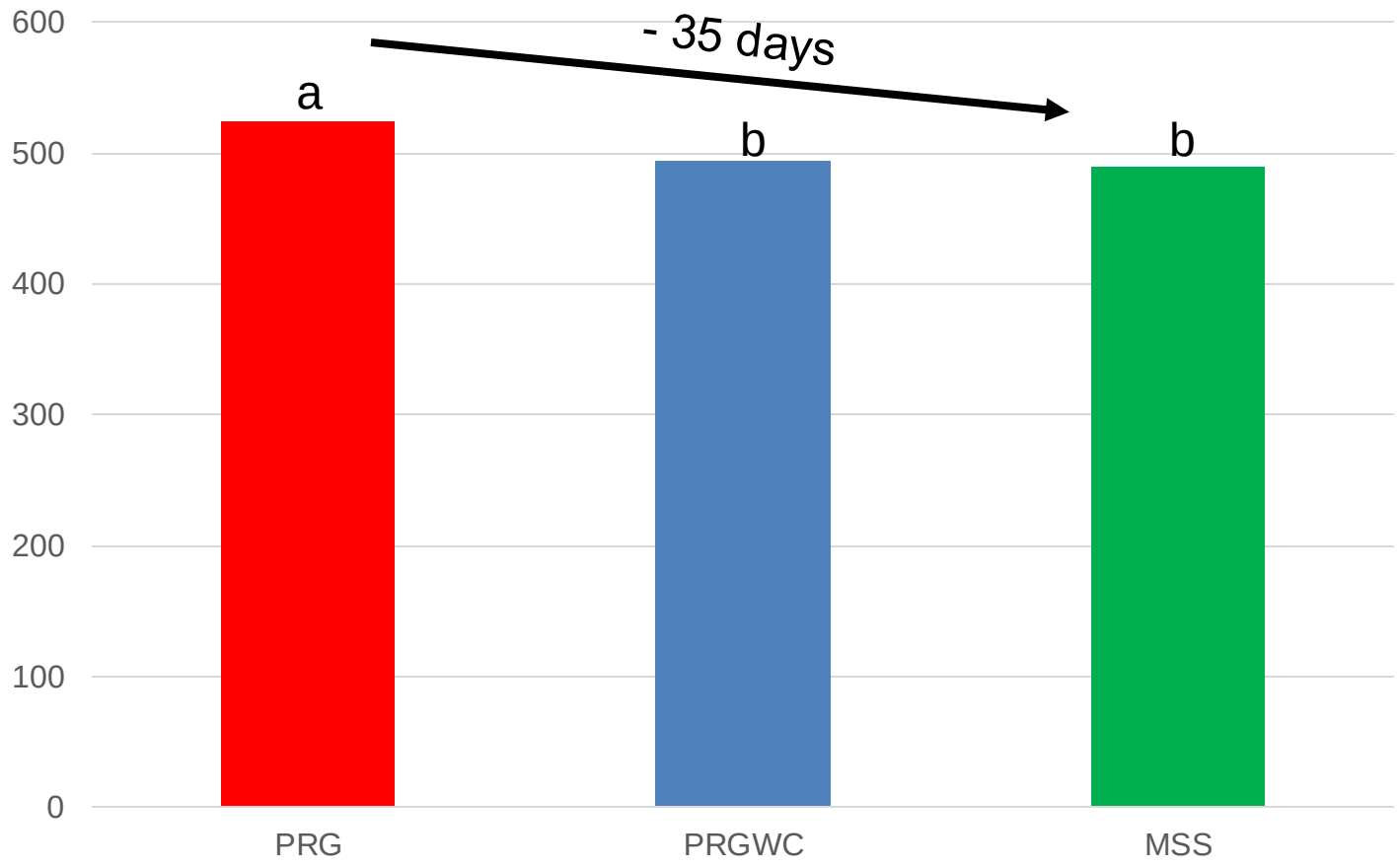
Multi-species sward



Helen Sheridan

Tommy Boland

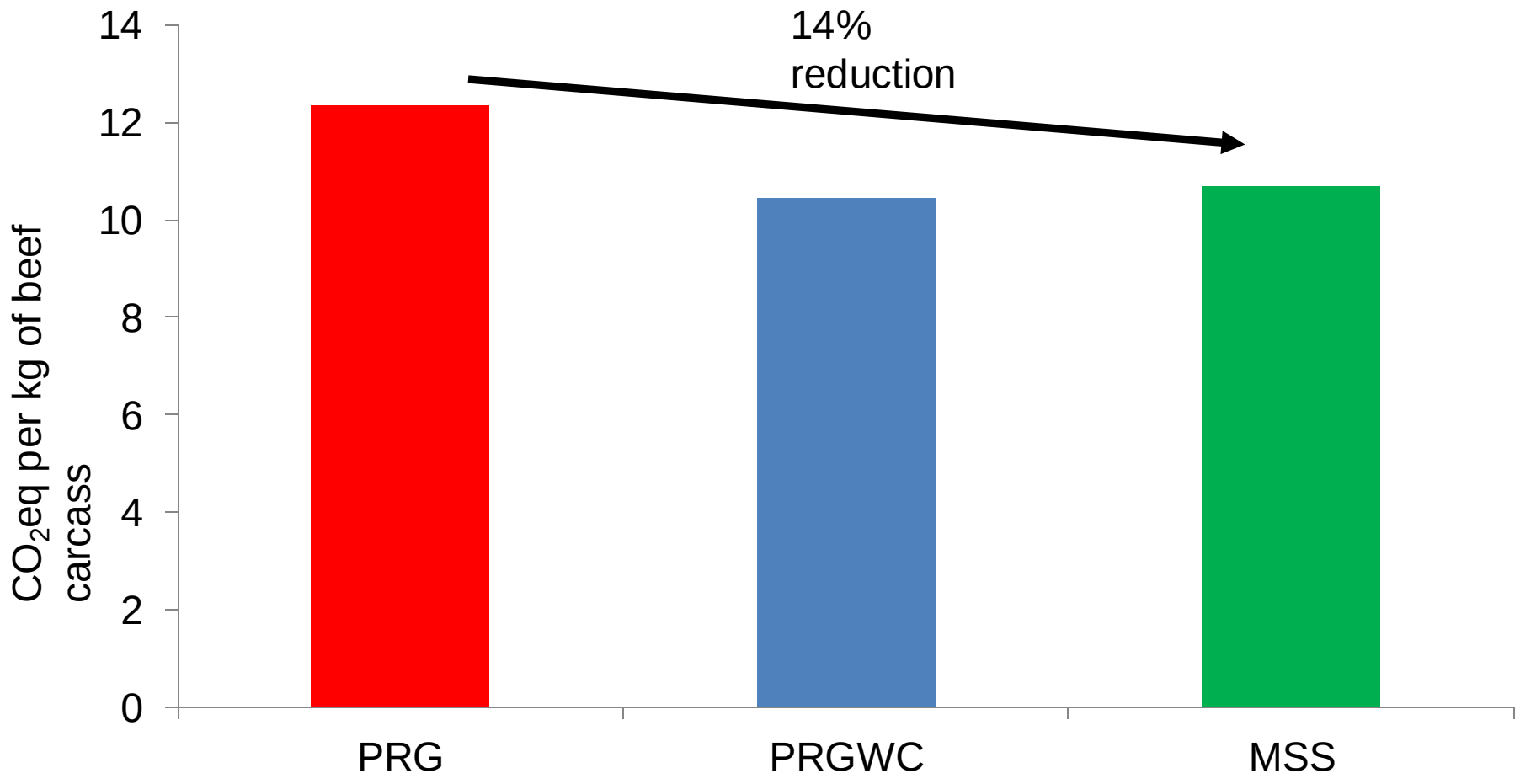
The impact of sward type on days required to reach target slaughter weight



Kelly et al., under review

P < 0.05

The effect of sward type on CO_2eq per kg of beef carcass

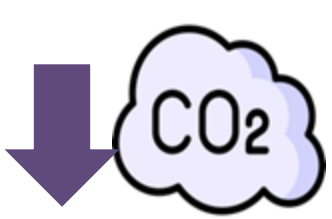


Kelly et al., under review

BiOrbic and Food Research

Kevin O'Connor

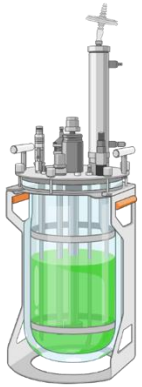
Sustainable food production



Climate neutral Nature positive

Climate neutral operational systems

Biomanufacturing Biotechnology Precision fermentation



- Food and feed ingredients
- Alternative proteins
- Amino acids
- Bioactives

Food waste

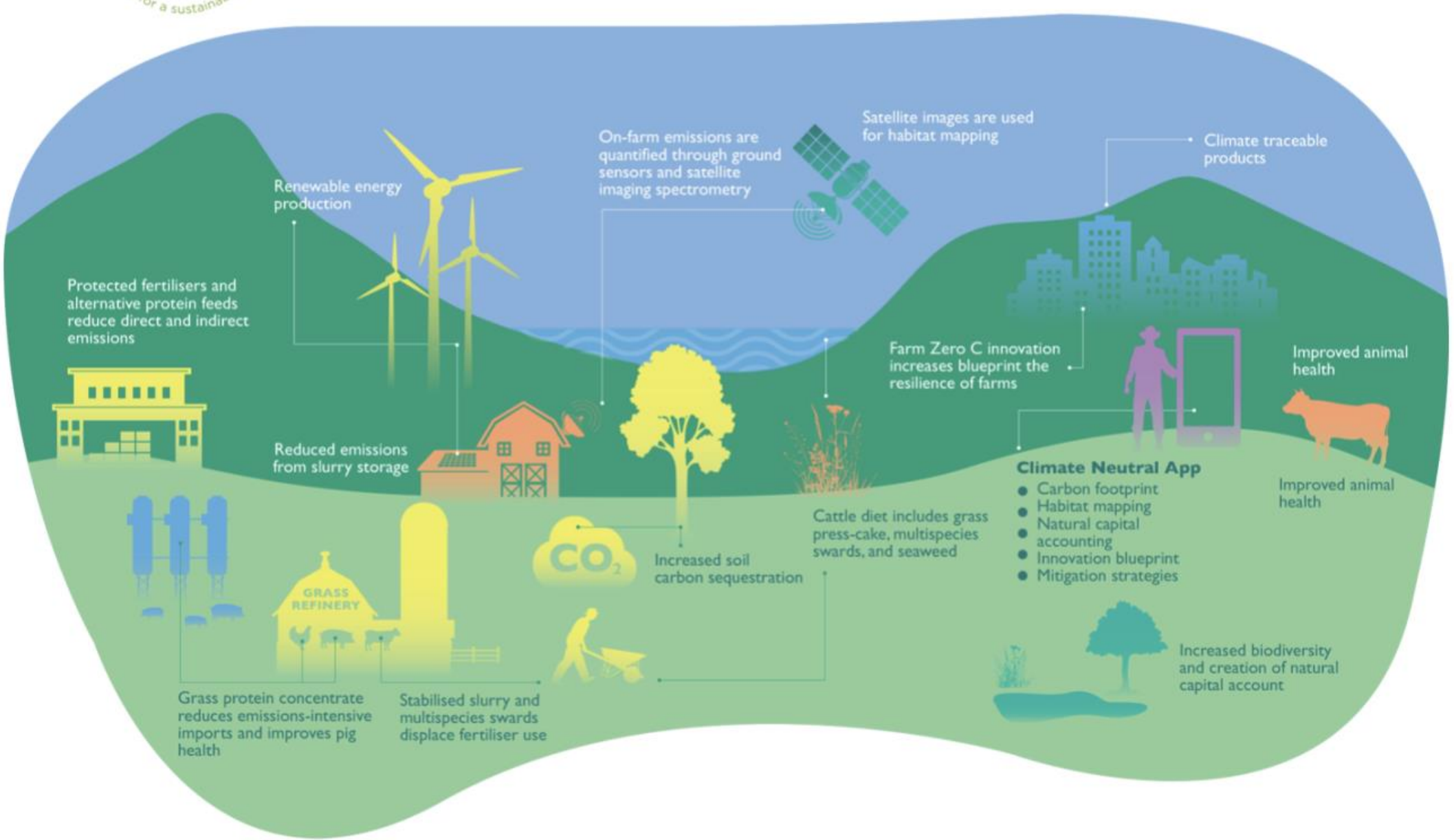
Food waste Prevention

Food waste Valorisation

Sustainable food packaging

Our holistic approach

Kevin O'Connor



Farm Zero C Key Focus Areas

Life Cycle Assessment

Animal Emissions

Breeding and Animal Health

Soil and Grassland

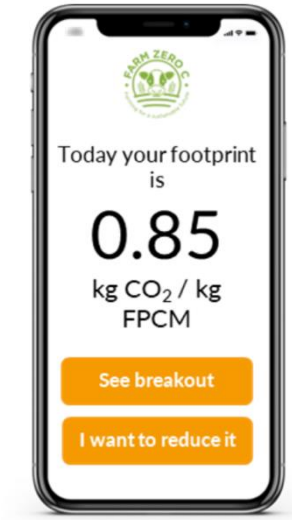
Renewable Energy

Green Biorefinery and Anaerobic Digestion

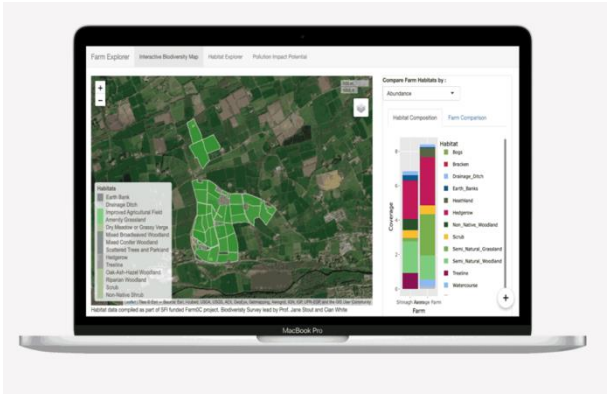
Biodiversity and Natural Capital Accounting

Water and Air Quality

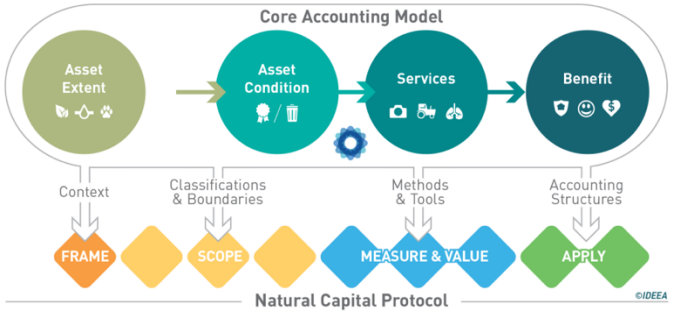
Kevin O’Connor



Life Cycle Assessment



Habitat Mapping Tool



Natural Capital Accounting

CCCENTRE Sustainable Food Systems

Taighde Éireann Research Ireland

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

UK Research and Innovation

OUR AMBITION

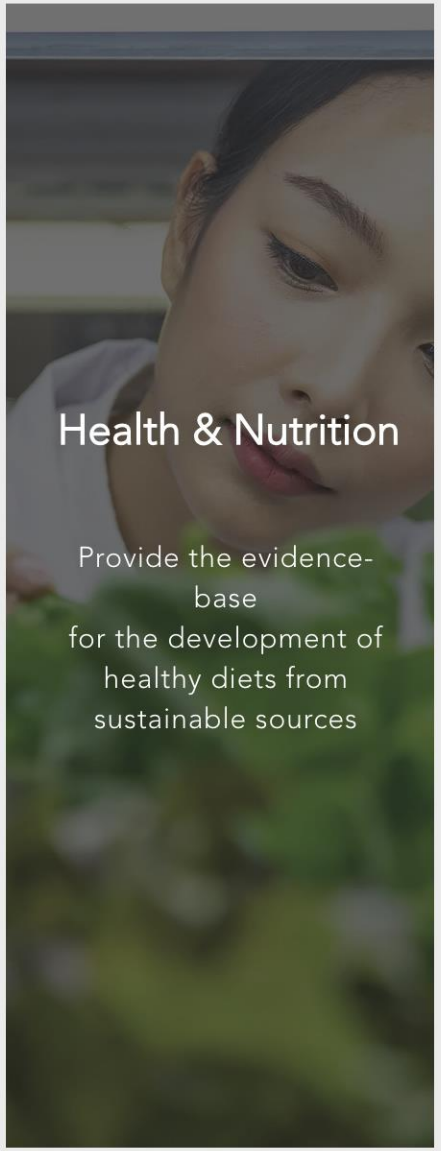
- Develop innovative and transformative solutions for IOI
- Position IOI as a global leader in research and innovation for positive and sustainable change in the transition to climate-neutrality by 2050
- Place IOI as world leaders in food systems transformation, providing a model system with global reach

Food Safety

Develop novel technologies & approaches to enhance food safety and protect against emerging challenges

Sustainable Foods

Develop novel technologies & approaches to enhance food safety and protect against emerging challenges



Health & Nutrition

Provide the evidence-base for the development of healthy diets from sustainable sources

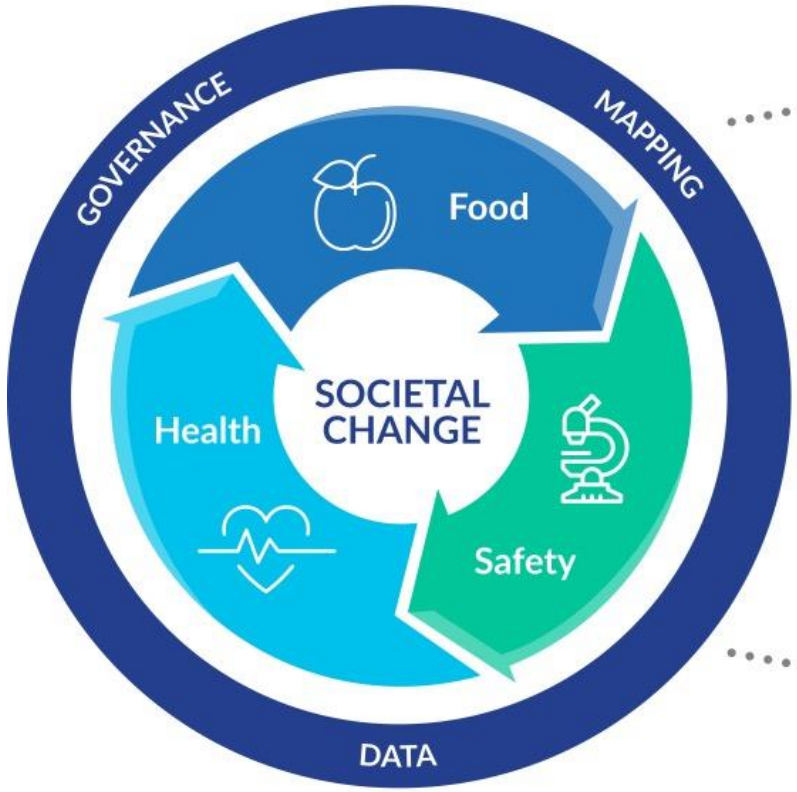
Data Modelling

Develop a framework to support federation, mapping and analysis of food system data

Trust in Food Systems

Integration of data to map the food system and undertake scenario modelling to realise improvements in food production, processing and consumption.

Co-Centre Structure



CORE RESEARCH PLATFORMS

Informed by industry/policy

- Enhancing sustainability in animal production systems
- Data driven low-carbon farming
- Transitioning to HDSS

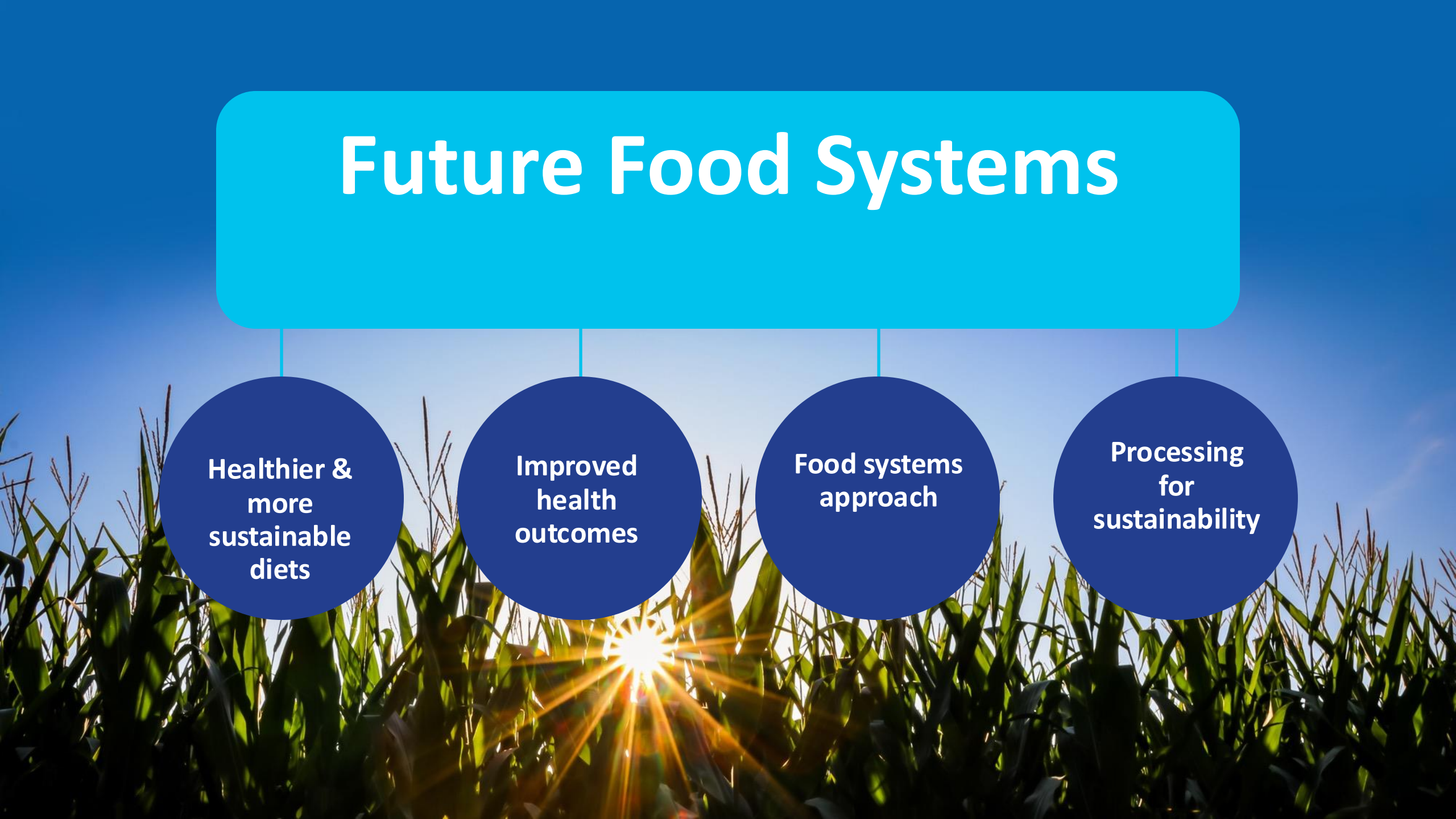
DEMONSTRATOR PROJECTS

- Sustainable food production
- Sustainable food processing
- Sustainable integrity & the circular economy
- Precision nutrition
- Trust in food systems & the regulatory context

SPOKES

Co-designed with industry/policy

Future Food Systems



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THANK YOU

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