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Recipes that meet the EAT-Lancet: what should we be cooking?

Christian Reynolds,

Hosted by BDA Sustainable Diets Specialist Group

7:30-9:00pm 29 June 2022

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**Centre for
Food Policy**
Shaping an effective food system

Who am I? – Christian Reynolds



Senior Lecturer at the Centre for Food Policy



Focus: healthy sustainable diets and food consumption (including waste)



Previously: Food waste politics/history, social sciences approaches

Cheeky shout out – PhD funding available

City, University of London has multiple funding streams open to Dietitians (and other healthcare professionals) to complete a PhD in food, diet and sustainability – **please do get in touch if you are interested!**

- **UK Food Systems Centre for Doctoral Training (UKFS-CDT)**

<https://foodsystems-cdt.ac.uk/>

- **HARP PhD Programme**

<https://harpphd.org/>

Health Advances in Underrepresented Populations and Diseases

- **BARTS Healthcare Professional Clinical Research Training Fellowships**

<https://www.bartscharity.org.uk/apply-for-funding/healthcare-professional-clinical-research-training-fellowships/>

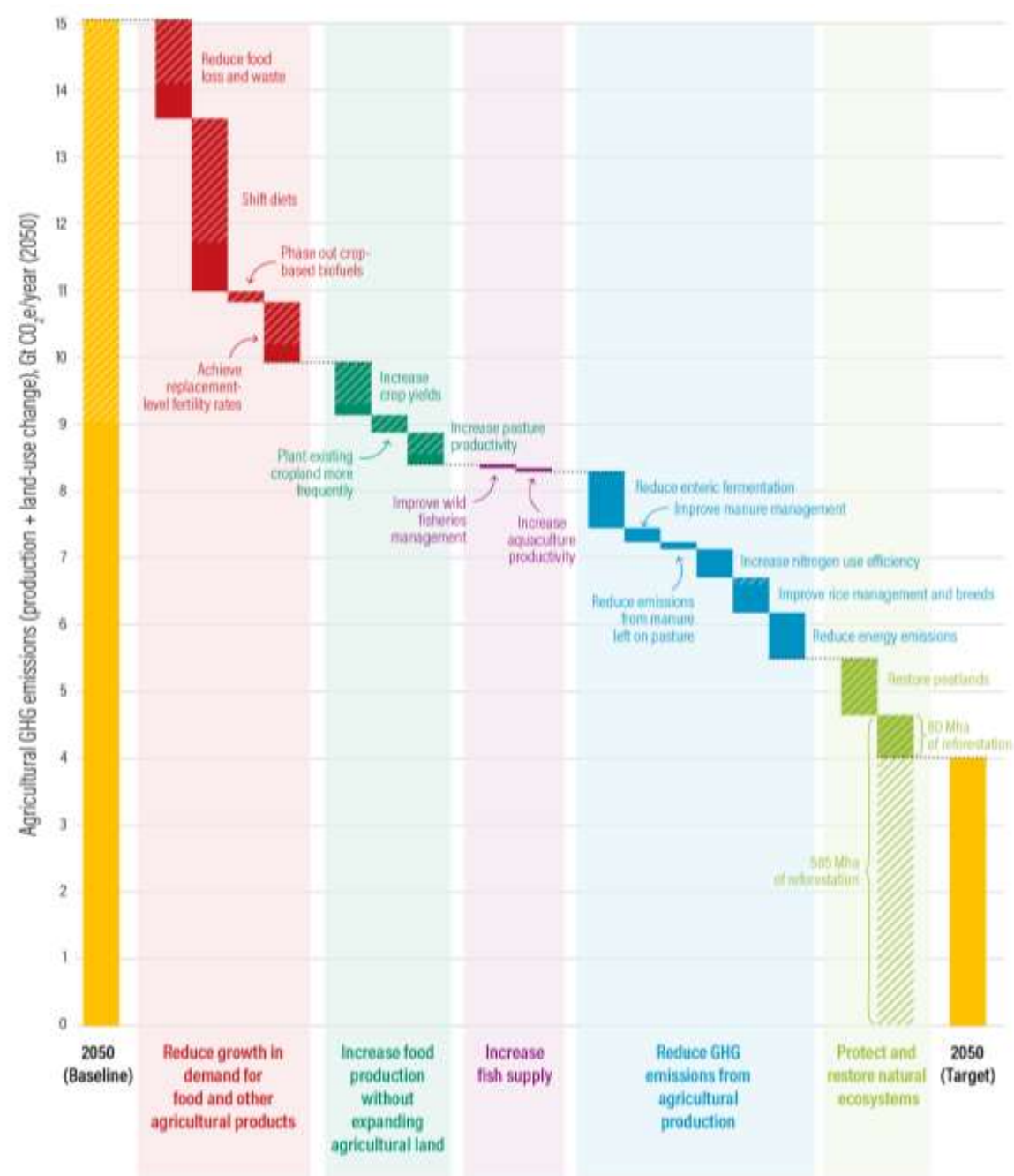
- **Internal City, University of London Scholarships**



The emissions reduction challenge – A **warming** food system

The two biggest reductions we can make to agricultural GHGE to achieve a **2°C** warming target (4 Gt/year) or **1.5°C** warming target (0 Gt/year) are through:

1. **Shifting to sustainable diets**
2. **Reducing Food Loss and Waste**



Note: Solid areas represent agricultural production emissions. Hatched areas represent emissions from land-use change.

Source: GlobAgri-WRR model.

Source WRI, [World Resources Report: Creating a Sustainable Food Future](#)



Sustainable diets and The EAT–Lancet report

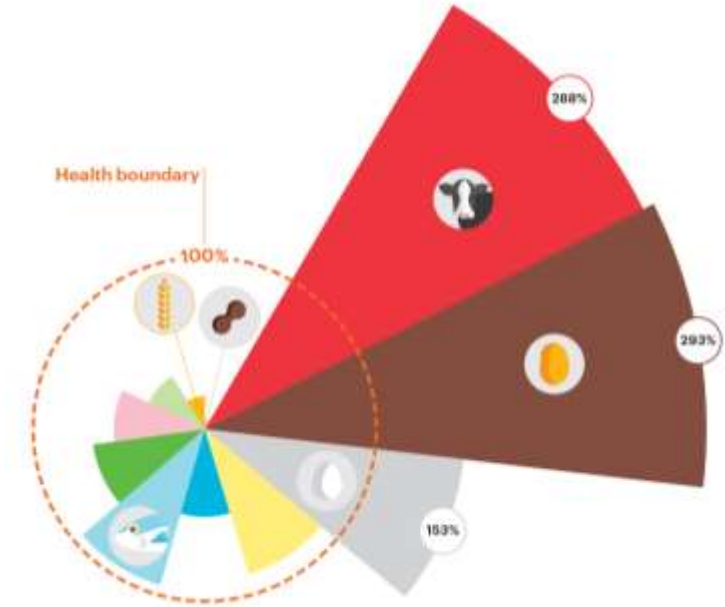
Published in 2019

Setting Scientific Targets for Healthy Diets and Sustainable Food Production

↑ consumption of fruit (100 -300g/day) & vegetables (200-600g/day)

↓ consumption of animal products

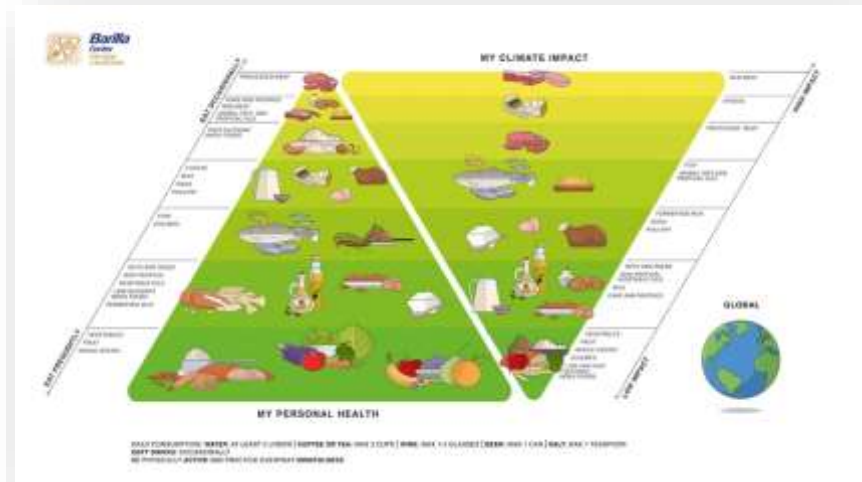
Per day requirements: 2500 kcal, and protein 56g, for a max of 1780g of CO₂e



	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
Whole grains <i>Rice, wheat, corn and other</i>	222	811
Tubers or starchy vegetables <i>Potatoes and cassava</i>	50 (0-100)	30
Vegetables <i>All vegetables</i>	300 (100-600)	78
Fruits <i>All fruits</i>	200 (100-300)	120
Dairy foods <i>Whole milk or equivalents</i>	300 (0-500)	103
Protein sources		
<i>Beef, lamb and pork</i>	14 (0-26)	30
<i>Chicken and other poultry</i>	20 (0-50)	42
<i>Eggs</i>	13 (0-25)	19
<i>Fish</i>	20 (0-100)	40
<i>Legumes</i>	75 (0-100)	284
<i>Nuts</i>	50 (0-75)	291
Added fats		
<i>Unsaturated oils</i>	40 (20-80)	354
<i>Saturated oils</i>	13.8 (0-11.8)	98
Added sugars <i>All sugars</i>	31 (0-31)	120

The EAT–Lancet report - A Critique

- Lack of consideration of local and traditional diets, food ways or systems of production.
- Limited suggestions on how to implement the ‘global healthy sustainable diet’ (only photos).
- Minimal discussion of cooking and real life examples (e.g. no recipes)
- Current sustainable dietary guidance is given as ingredients
- We have only just started to see translation into sustainable gastronomy – see Barilla foundation reports (2021)



We need sustainable recipes tools and data

- **Public engagement/communication need**

#1 ask I get is ...



“how/what can I cook sustainably this at home?”

“what are the impacts of this recipe?”

We need this information to empower citizens!

People do not think in **ingredients**, they think in **recipes**

- **Industry need**

Need for communication around sustainable menu development and recipe design.

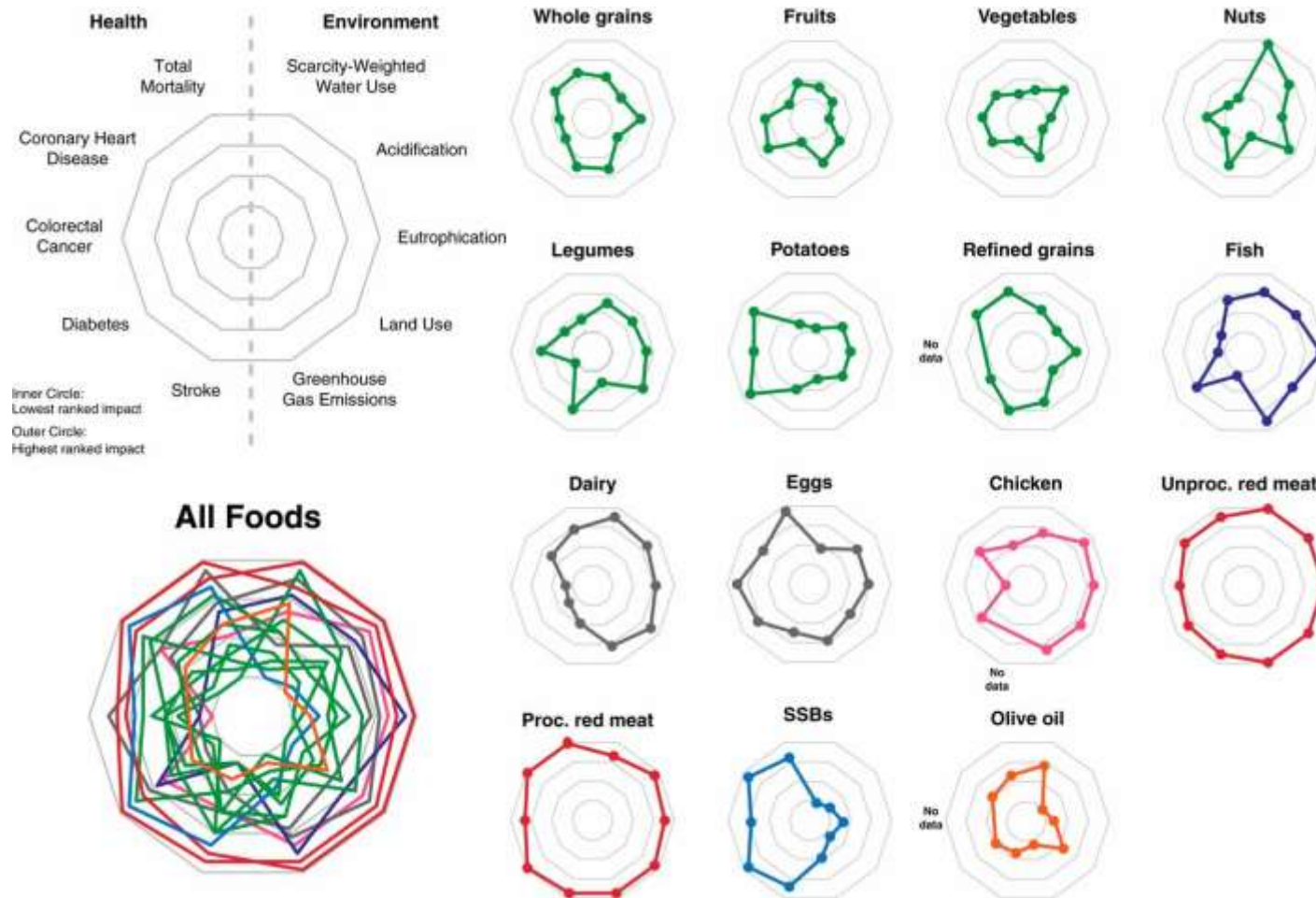
- **Policy need**

Need for data / visualisations of nutrition and food education, pack and portion advice etc.

Are there recipes that meet or are within the **Eat-Lancet** ?



Each ingredient has different health and environmental impacts – so what about recipes (and complex ingredients)?



Do other studies have EAT-Lancet compatible meals ?

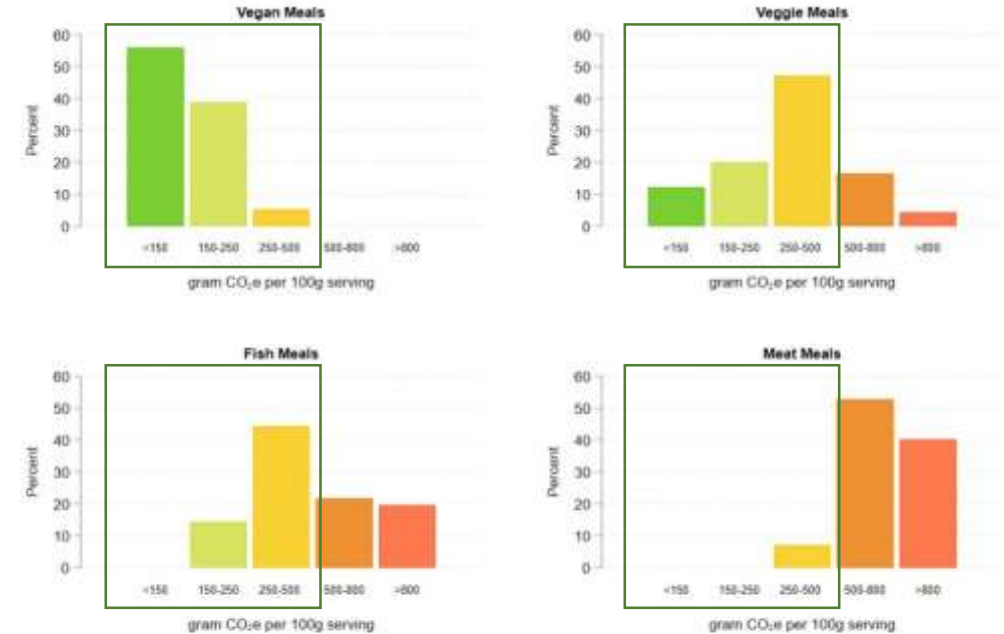
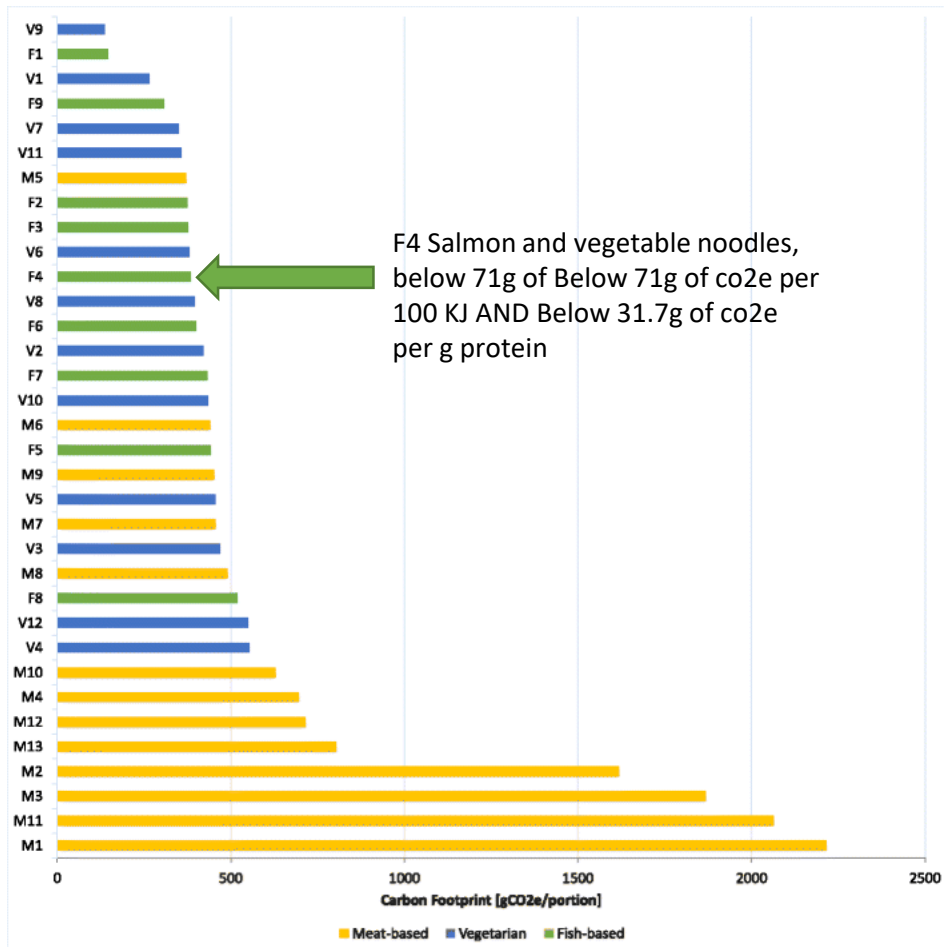


Figure A2: Frequency distribution of vegan, vegetarian, fish and meat meals across label categories

Note: Vegan N = 152, Veggie N = 140, Fish N = 84, Meat N = 199

De Laurentiis et al (2018) n=34 recipes total
 Below 31.7g of CO₂e per g protein n=24 recipe
 Below 71g of CO₂e per 100 KJ n= 1 recipe

<https://doi.org/10.1007/s11367-018-1460-x>

Lohmann et al (2022) n=575 recipes total
 Below ~390g of CO₂e per 100g. 20 meat ,and 45 fish, 136 vegan
 and 110 vegetarian

<https://doi.org/10.1016/j.jeem.2022.102693>

There are (now) many Tools and Apps



Generic Meals and carbon labels

Edamam, a provider of nutrition data and semantic solutions for businesses in the food, health, and wellness sectors (<https://developer.edamam.com>)

- Integrated a food environmental impact database of 2,842 ingredients (using the classification system of the USDA Nutrient Database for Standard Reference, Release 24). This food environmental impact database was based on environmental data from Poore and Nemecek (2018) and was supplied by City.
- For some items which are not part of USDA food list Edamam used in-house nutrition experts to map them to USDA items.
- Edamam has labeled about **5 million recipes in the English language web** with CO2 labels ranking from A+ (best) to G (worst) and is making those searchable via its Recipe Search API.

Edamam's Generic meals are a database of 180,000+ recipes that encompass more than 90% of what restaurants offer/commonly cooked at home.

- Similar recipes are clustered based on titles after removing certain non essential words from the title. These recipes represent the initial generic meal set.
- Compare recipes based on nutrition and content and remove any outliers. From the rest of the recipes Edamam build a combined recipes for which they also create a distribution of labels and nutrition among the recipe population. CO2e is one of the values which is part of this calculation.
- Edamam matched the CO2e data and carbon labels to the Generic meals database.



Edamam Partners with City University of London to Provide CO2 Imprint of Recipes and Meals

Edamam leverages research by City University and its proprietary algorithms to calculate CO2 impact of 5 million recipes and 70,000 most commonly eaten meals.



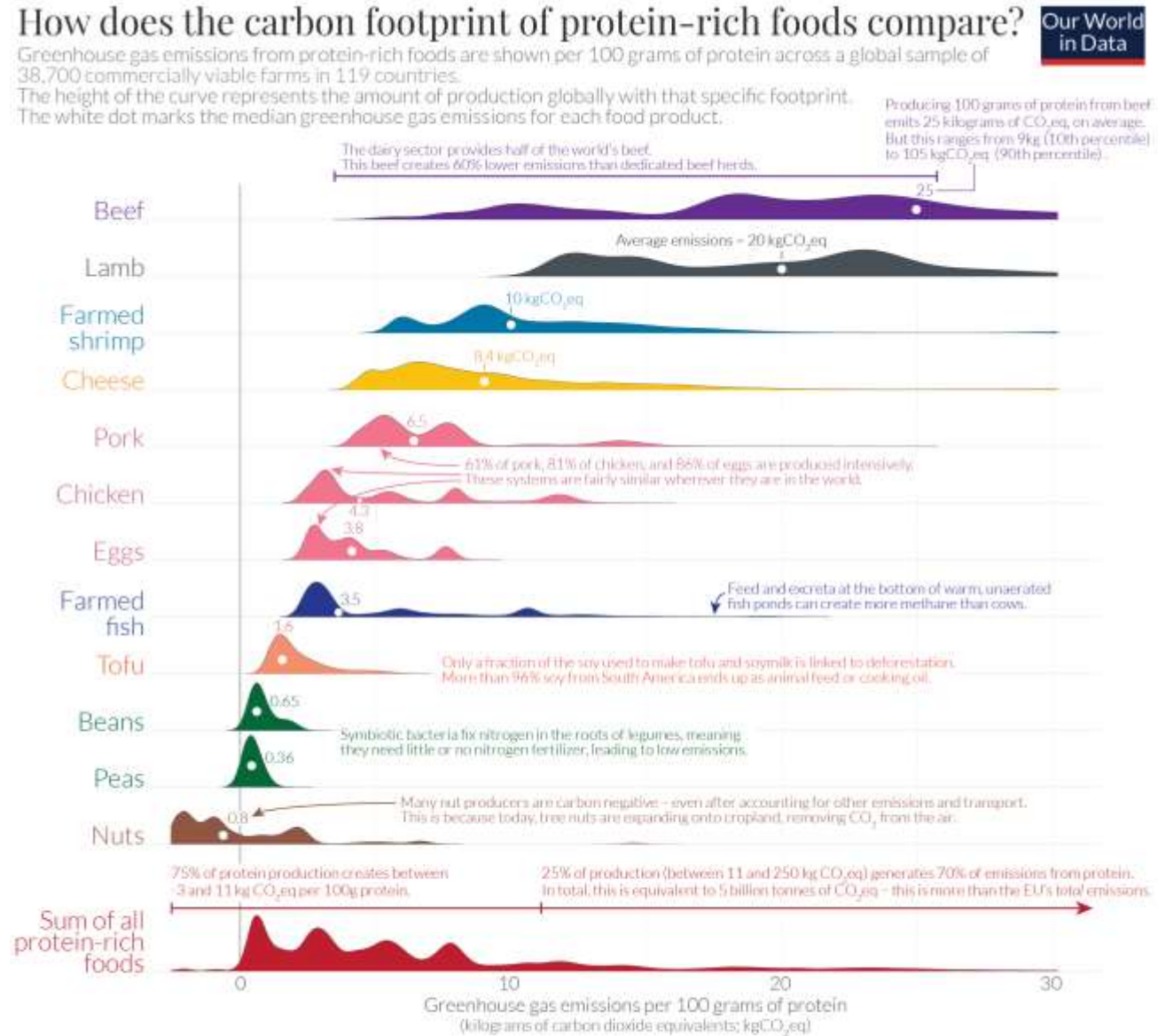
The advantage of Poore and Nemecek (2018)

The Poore and Nemecek (2018) database provides 5% and 95% confidence intervals as well as **mean global impacts**

43 food categories meta-analysis comparing various types of food production systems.

Impact can vary 50-fold among producers of the same product, creating substantial mitigation opportunities

*Note EAT-Lancet requires 56g of Protein for 1780 g CO₂e / person / day
So ~0.31 g CO₂e per 100g of Protein on average.*



Note: Data refer to the greenhouse gas emissions of food products across a global sample of 38,700 commercially viable farms in 119 countries. Emissions are measured across the full supply chain, from land-use changes through to the retailer, and includes on-farm, processing, transport, packaging and retail emissions. Data source: Joseph Poore and Thomas Nemecek (2018), Reducing food's environmental impacts through producers and consumers, Science. OurWorldinData.org - Research and data to make progress against the world's largest problems. Licensed under CC-BY by the authors, Joseph Poore & Hannah Ritchie.

Matching P&N (2018) to FoodEx2/USDA

43 food categories matched to 4558 FoodEx2 code (Kg of Co2e per 100g)

All products were matched by hand, using the closest raw product; if it was a product with multiple ingredients, we took the largest ingredient by weight. GHGE Values corrected for hydration and processing.

N	O	P	Q
L7_Food	L7_FoodEx2_desc	level	Category
A000J	Grains and grain-based products	1	Wheat & Rye (Bread)
A000K	Cereals and cereal primary derivatives	2	Wheat & Rye (Bread)
A000L	Cereal grains (and cereal-like grains)	3	Wheat & Rye (Bread)
A001X	Mixture of grains	4	Wheat & Rye (Bread)
A0D9Y	Barley and similar-	4	Barley (Beer)
A000P	Barley grains	5	Barley (Beer)
A002K	Barley grain, pearled	6	Barley (Beer)

N	O	P	Q
L7_Food	L7_FoodEx2_desc	level	Category
A000P	Potatoes and similar-	3	Potatoes
A002T	Potatoes	4	Potatoes
A011P	Potato boiled	5	Potatoes
A011R	Potato baked	5	Potatoes
A002X	Main-crop potatoes	5	Potatoes
A002V	New potatoes	5	Potatoes
A0DPM	Andigena	4	Potatoes
A002Y	Tropical root and tuber vegetables	3	Cassava
A04JX	Cassava roots and similar-	4	Cassava
A002Z	Cassava roots	5	Cassava

Results: YES! Eat-Lancet compatible recipes!

196,005 recipes with 100% ingredients matched to CO2e data. Mean 2101.45g of CO2e per portion, (SD 3472.02g)

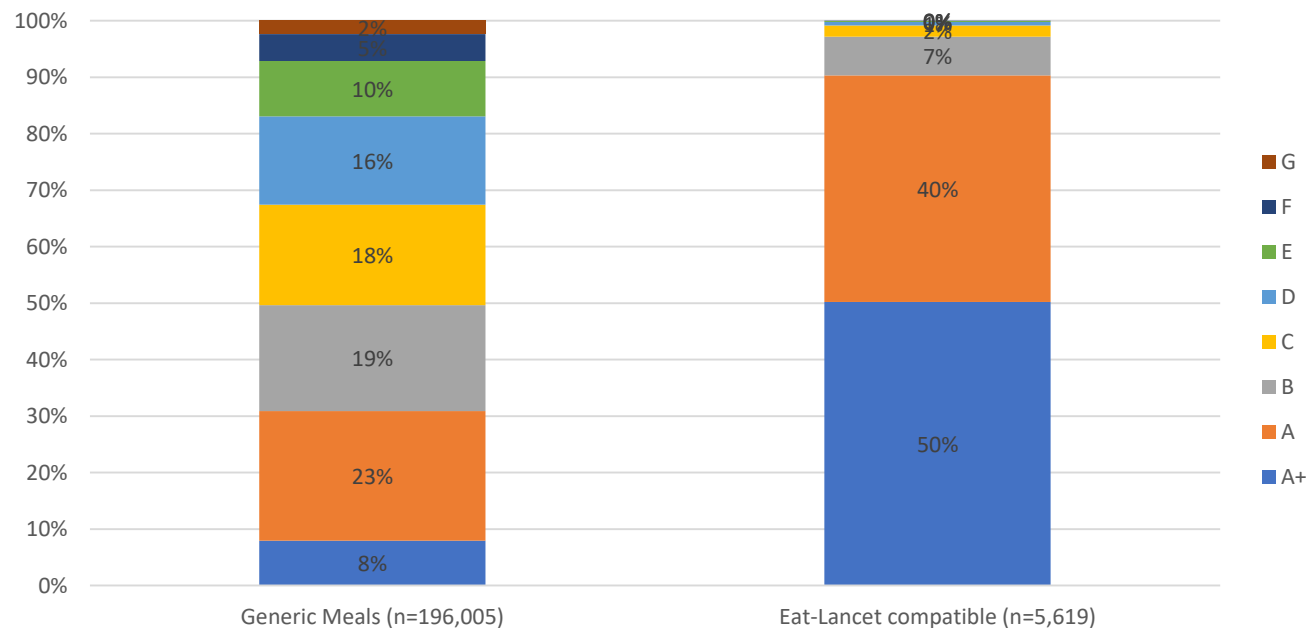
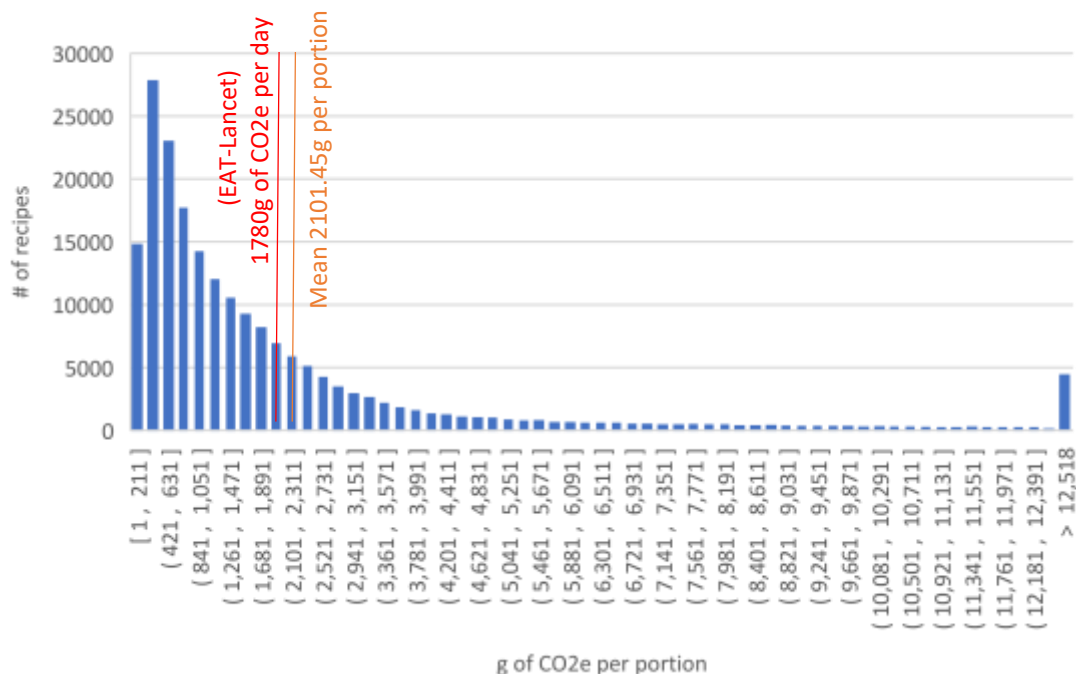
Information provided in grams of CO2e per **portion**, per **Kcal**, per g of **protein**

Eat-Lancet recipes: Assume consumption of this recipe is scaled to meet 2500 kcal, and protein 56g, is the scaled recipe below 1780g of CO2e.

Below 31.7g of co2e per g protein n=10,434

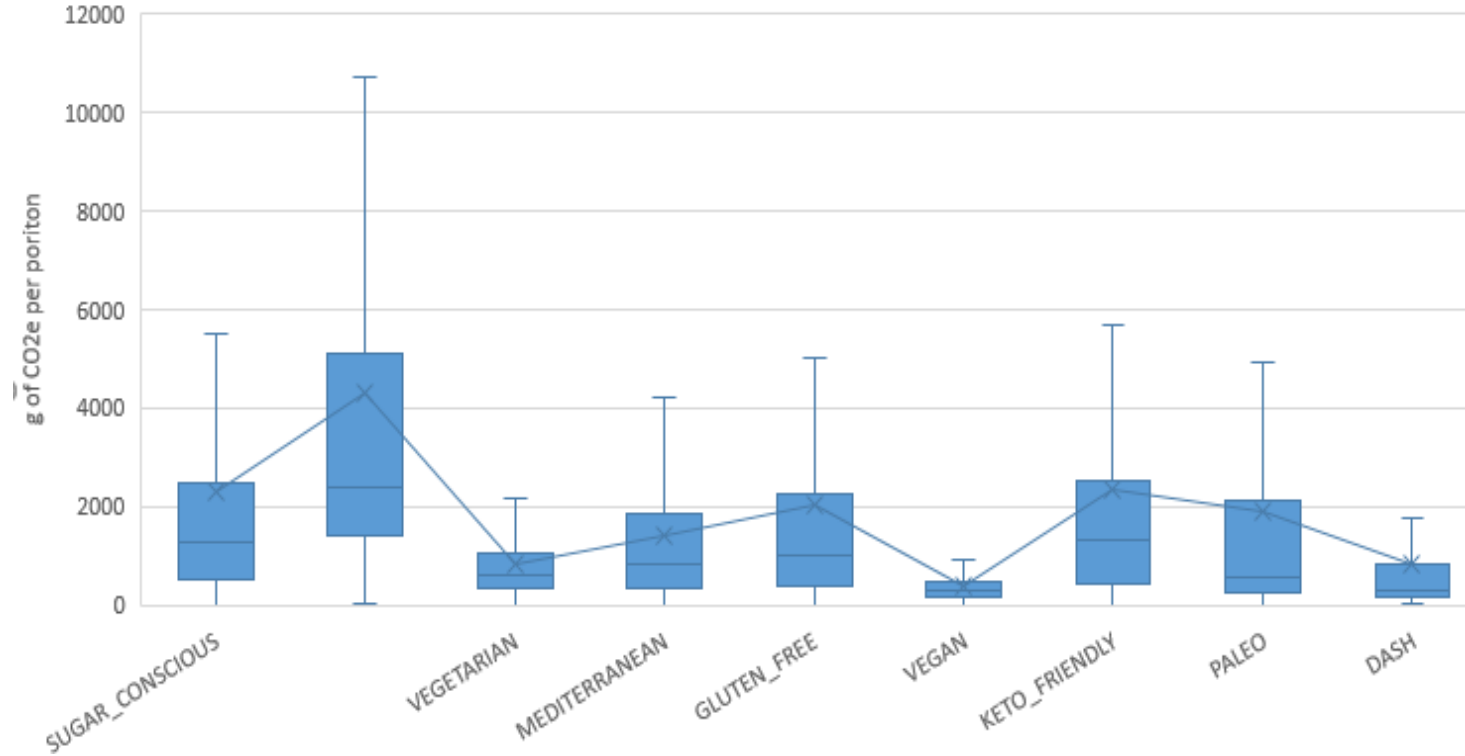
Below 71g of co2e per 100 KJ =8,015

5,619 recipes met both criteria! (2.8%) Mean 180.87g of CO2e per portion, (SD 117.20g, max 1240g of CO2e per portion)



Different ways to cut the data... Health/Diet

Metadata presented for Meal type, **Health/Diet** type, Cuisine type, Dish type, and Ingredients per recipe



Different carbon impact spreads across Diet choice types, but also the number of recipes matters!

DASH, Vegan, and Vegetarian recipes had the lowest mean, median and IQR of any specific health/diet type.

DASH= Dietary Approaches to Stop Hypertension, includes foods that are rich in potassium, calcium and magnesium. Limits foods that are high in sodium, saturated fat and added sugars.

	SUGAR CONSCIOUS	No Classification	VEGETARIAN	MEDITERRANEAN	GLUTEN_FREE	VEGAN	KETO FRIENDLY	PALEO	DASH
Count	49,690	29,031	111,263	37,869	81,000	24,651	22,372	11,270	7,086
Avg. g CO2e per portion	2,313.34	4,320.09	833.55	1,417.64	2,013.42	402.28	2,349.80	1,881.94	816.31

Examples of DASH, Vegan, and Vegetarian recipes that meet Eat-Lancet

Sweet Potato Flat Breads (44g of Co2e per portion)

Curly Kale With Caramelized Onions (46g of Co2e per portion)

Alfresco Friday Hummus (49g of Co2e per portion)

Oatmeal Raisin Cookie Larabars (69g of Co2e per portion)

Pasta With Lentil Soup Sauce (137g of Co2e per portion)

Lentil And Spinach Salad With Onion, Cumin And Garlic (145g of Co2e per portion)

Falafel Veggie Burgers (173g of Co2e per portion)

Farro Salad With Winter Fruit, Pistachios And Ginger (175g of Co2e per portion)

Kale, Quinoa And Roasted Pumpkin Pilaf (226g of Co2e per portion)

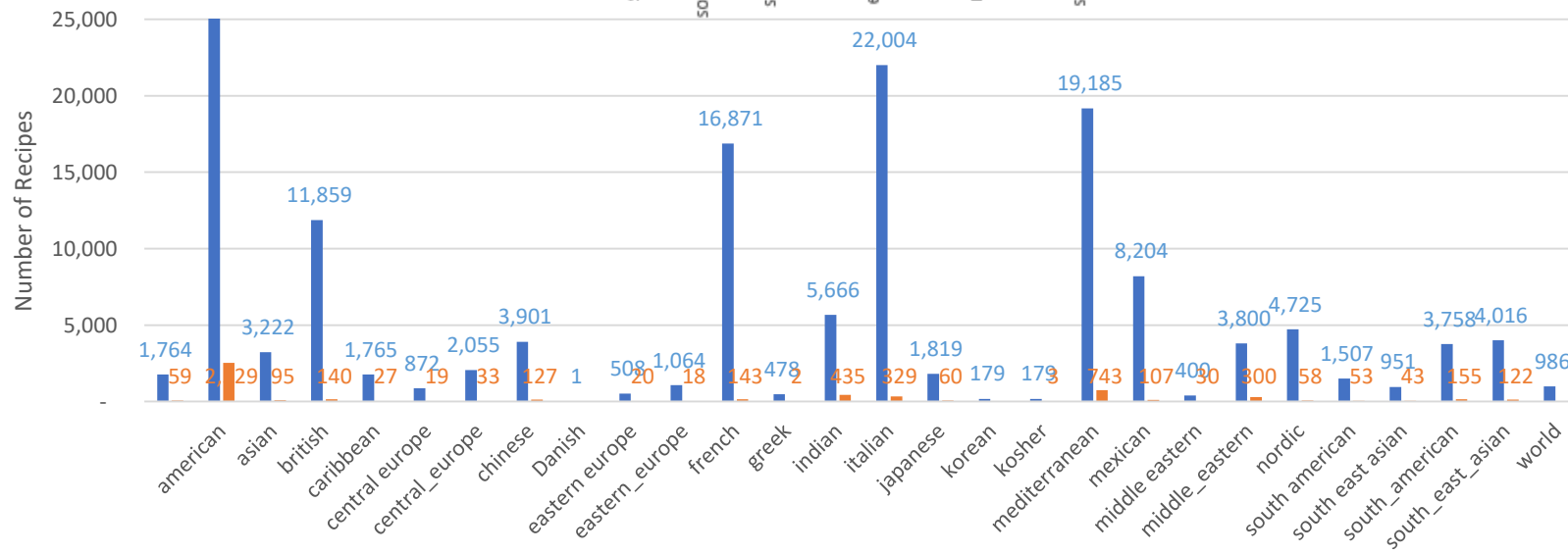
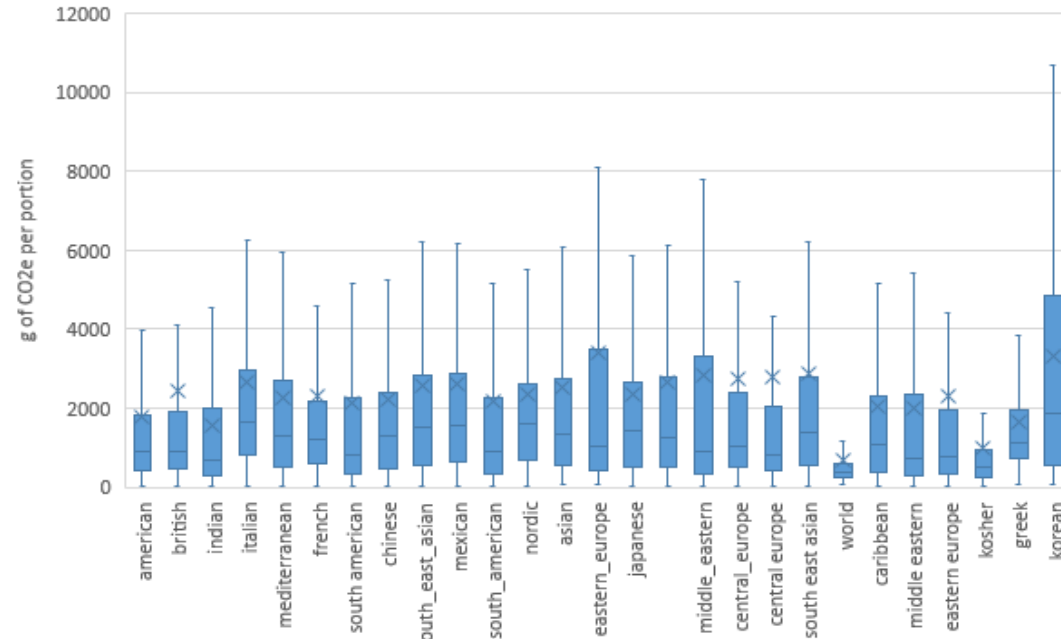
Spicy Portabella Couscous (237g of Co2e per portion)

...

Cumin And Coriander Chickpea Salad (568g of Co2e per portion) etc.

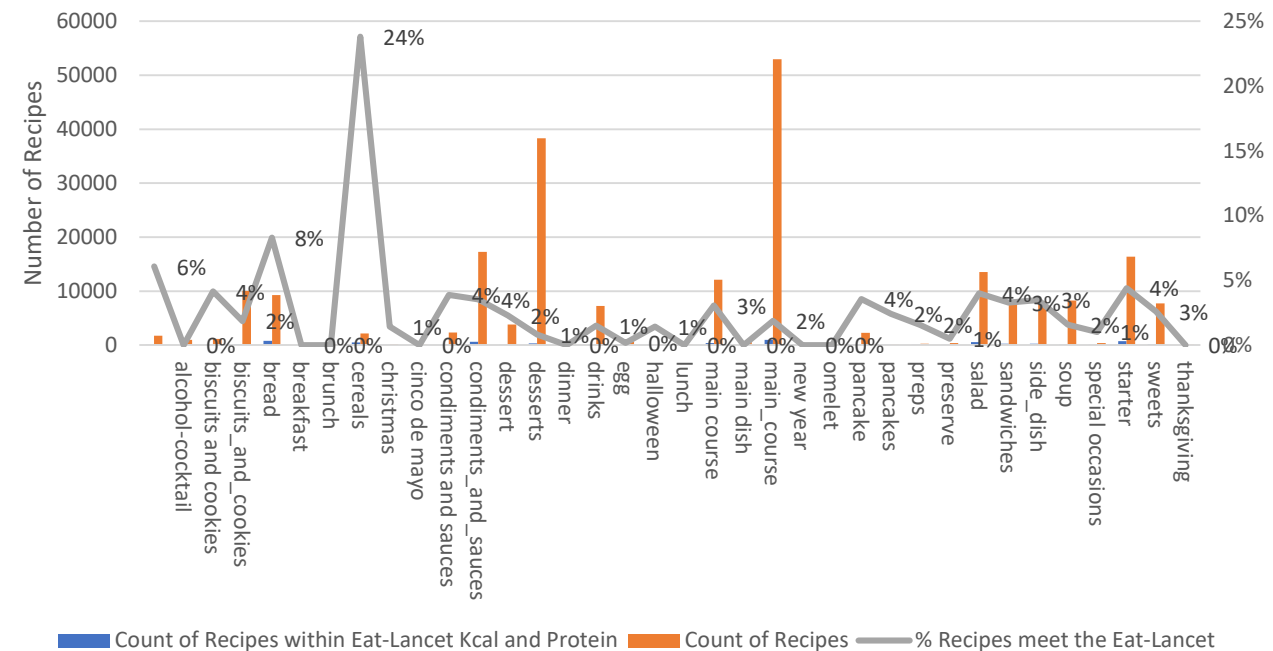
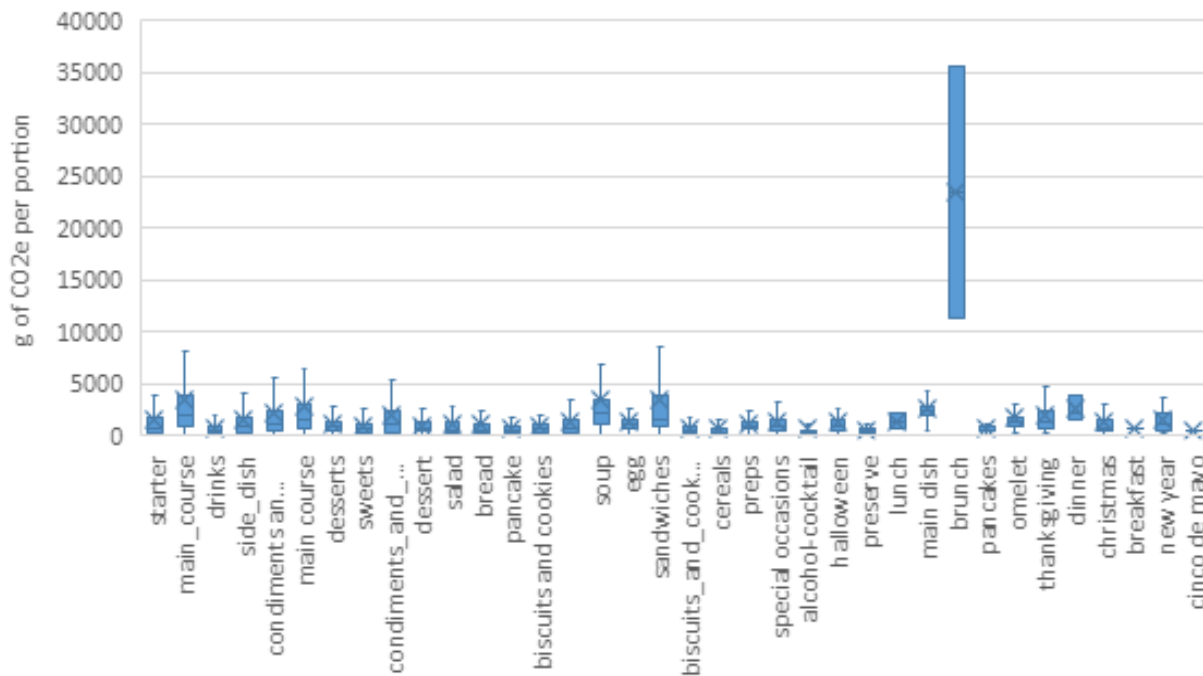
(note to self at least 100 variant recipes for hummus)

Different ways to cut the data... Cuisine type



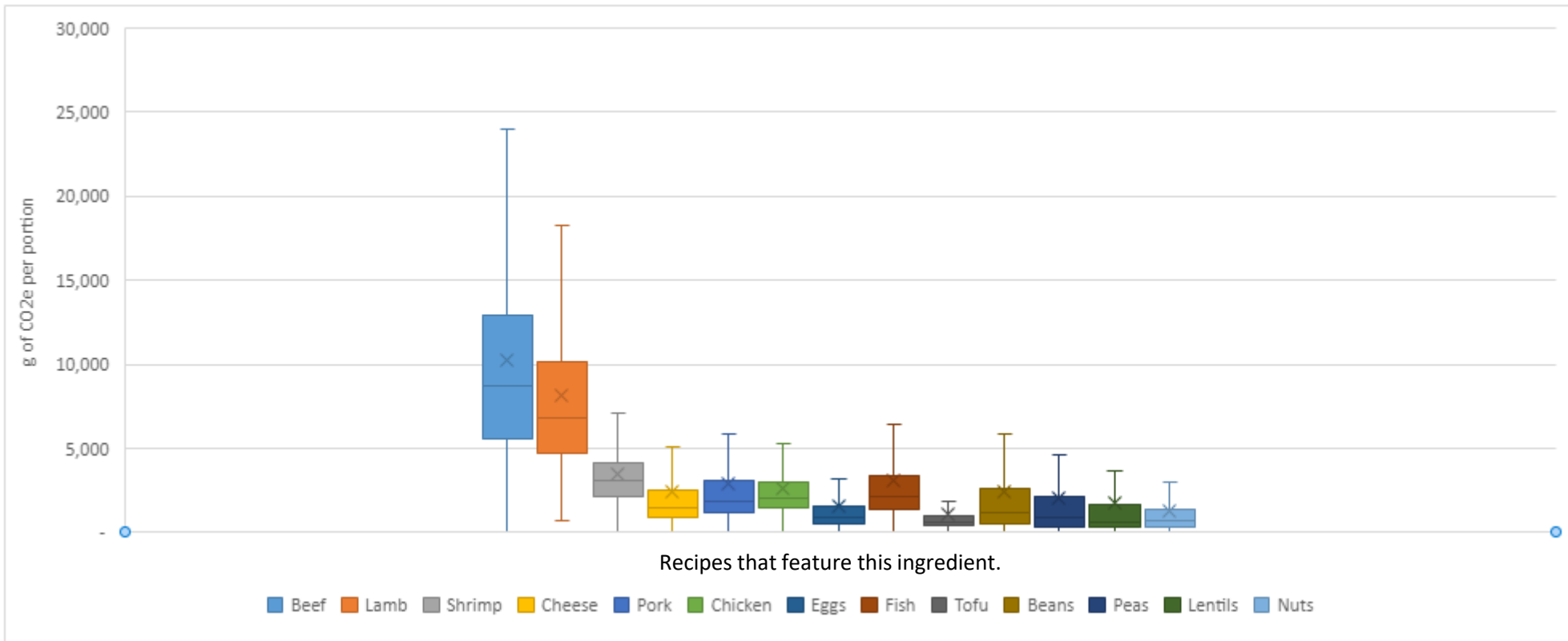
There are a % of recipes in most cuisines that meet the Eat-Lancet

Different ways to cut the data... Dish type



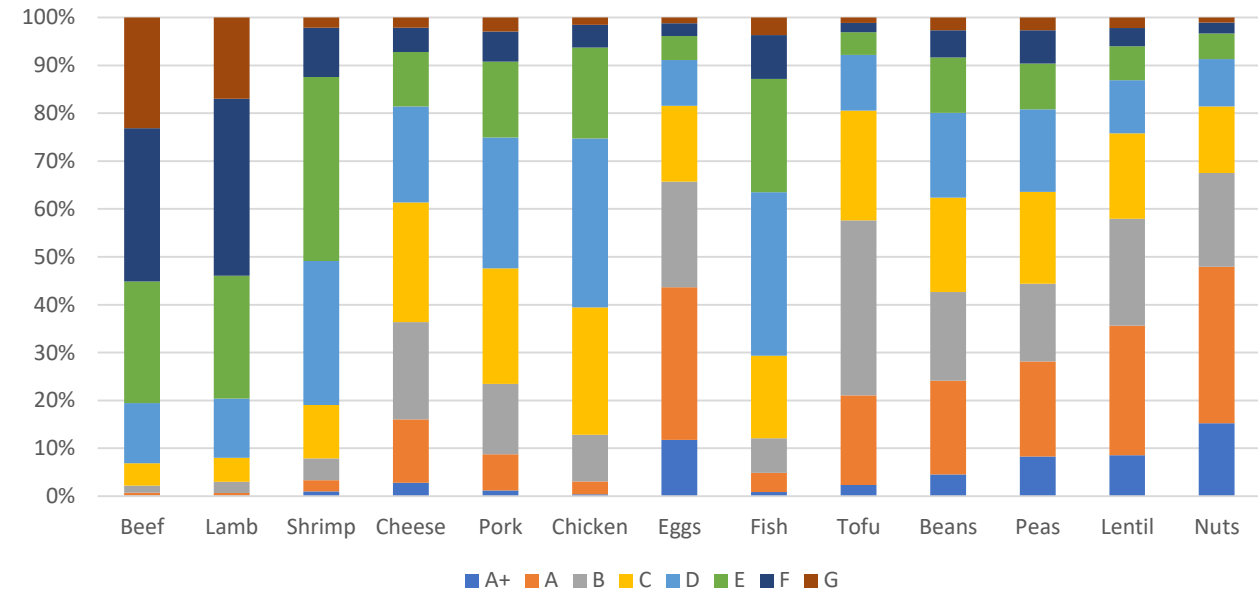
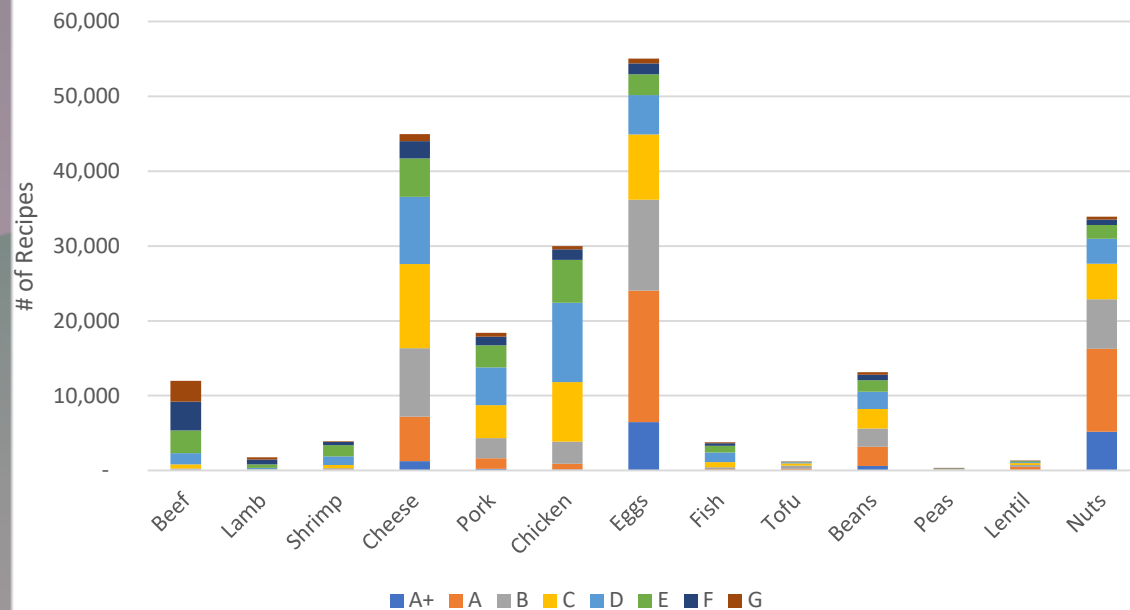
There are a % of recipes that meet the Eat-Lancet – Dish types vary in footprint, but a problem with sample size/tagging

Different ways to cut the data... Ingredients



	Beef	Lamb	Shrimp	Cheese	Pork	Chicken	Eggs	Fish	Tofu	Beans	Peas	Lentil	Nuts
Mean g of CO ₂ e per portion	10,265.96	8,139.05	3,448.71	2,388.032	2,890.13	2890.13	1,552.63	3,086.02	1,054.26	2,473.38	2,057.60	1,742.12	1,289.52
Count	11,984	1,776	3,890	44,959	18,411	18,411	55,074	3,795	1,168	13,157	302	1,312	33,835
# of Eat-Lancet	0	0	4	48	17	14	542	8	12	608	31	206	1802
% Eat-Lancet	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	1.0%	0.2%	1.0%	4.6%	10.3%	15.7%	5.3%

Different ways to cut the data... Ingredients



Different carbon label spreads across ingredient types, but also the number of recipes matters!

This means there are some border line recipes in all cases.

To consider... the underlying GHGE data

***may* not be accurate**

Multiple Greenhouse Gas Emissions (GHGE) databases exist (Each describes the impacts of different agricultural production systems around the world).

Our use of Poore and Nemeck (2018) is not the only ingredient level data out there.

Each database makes assumptions.

To validate our results we compared Poore and Nemeck (2018) to other databases all matched to FoodEx2 classification system.

For SHARP (n=945)
44% (n=206) within p5 and p95
confidence interval values of City
31% (n=144) lower than the p5
confidence interval values of City
25% (n= 119) higher than p95
confidence interval values of City.

Database	n	Spearman correlation	p-value
Sharp https://doi.org/10.1016/j.dib.2019.104617	945	0.699	< 0.001
Rose/Heller https://doi.org/10.1093/ajcn/nqy327	608	0.572	< 0.001
Garzillo https://doi.org/10.11606/9788588848405	329	0.610	< 0.001

So what does this mean practically?

ingredient, dish, keyword...

Recipes ▾ How to ▾ Health ▾ Inspiration ▾ Reviews ▾ Healthy Diet Plan ▾ Subscribe now

Home ▾ Recipes ▾ Beef bourguignon

Beef bourguignon

By Barry Deane

★★★★★ 62 ratings Rate 87 comments

Massive subscription - your first 8 issues for only £5!

Prep: 45 mins Cook: 3 hrs and 30 mins plus overnight marinating

Easy Serves 6

The secret to this rich beef casserole is to use all wine and no stock. Our ultimate beef bourguignon recipe is an instant comforting classic, full of satisfying flavours.

SHARP 62.76kg of Co2e (Beef is 87% of the footprint)
City 166.58kg of Co2e (Beef is 95% of the footprint)

ingredient, dish, keyword...

Recipes ▾ How to ▾ Health ▾ Inspiration ▾ Reviews ▾ Healthy Diet Plan ▾ Subscribe now

Home ▾ Recipes ▾ Bangers and mash with onion gravy

Bangers and mash with onion gravy

By Barry Deane

★★★★★ 17 ratings Rate 2 comments

Massive subscription - your first 8 issues for only £5!

Prep: 20 mins Cook: 50 mins

More effort Serves 4

Make sausages and mash with love and you're in for a real treat. We've perfected this recipe to make it the very best it can be.

Facebook Twitter Pinterest Instagram YouTube

Nutrition Per serving

SHARP 8.77kg of Co2e (Sausages is 62% of the footprint)
City 7.11kg of Co2e (Sausages is 77% of the footprint)

ingredient, dish, keyword...

Recipes ▾ How to ▾ Health ▾ Inspiration ▾ Reviews ▾ Healthy Diet Plan ▾ Subscribe now

Home ▾ Recipes ▾ Broccoli salad

Broccoli salad

By Liberty Mendez

★★★★★ 17 ratings Rate 9 comments

Massive subscription - your first 8 issues for only £5!

Prep: 10 mins Cook: 3 mins plus cooling

Easy Serves 2

Enjoy this crunchy, vegan broccoli salad for lunch or as a side. It's sweet, sharp and full of different textures and colours.

SHARP 0.95kg of Co2e (Broccoli is 30% of the footprint)
City 1.07kg of Co2e (Broccoli is 14% of the footprint)

ingredient, dish, keyword...

Recipes ▾ How to ▾ Health ▾ Inspiration ▾ Reviews ▾ Healthy Diet Plan ▾ Subscribe now

Home ▾ Recipes ▾ Classic Victoria sandwich recipe

Classic Victoria sandwich recipe

By Barry Deane

★★★★★ 995 ratings Rate 882 comments

Massive subscription - your first 8 issues for only £5!

Prep: 40 mins Cook: 20 mins plus cooling

Easy Cuts into 10 slices

The perfect party cake, a Victoria sponge is a traditional fave everyone will love. Makes an easy wedding cake, too.

SHARP 11.34kg of Co2e (Butter is 88% of the footprint)
City 3.77kg of Co2e (Butter is 24% of the footprint)

How recipes could be changed to reduce their environmental impacts

Modifying fruit, vegetable, fat and animal protein contents.

Option 1

Halve the amounts of animal protein and fat (and or switch to plant based)

– the biggest difference we found was a ~50% **decrease** in footprint

Option 2

Double the amount of fruits and vegetables

– the biggest difference we found was a ~25% **increase** in footprint



The screenshot shows the BBC Good Food website interface. At the top, there is a search bar with the text "ingredient, dish, keyword..." and a magnifying glass icon. Below the search bar, there are navigation links: "Recipes", "How to", "Health", "Inspiration", "Reviews", "Healthy Diet Plan", and "Subscribe now". The main content area features a recipe for "Beef bourguignon" by Barry Coustary. The recipe includes a photo of the dish, a 5-star rating with 62 ratings, and a link to "Rate". It also mentions "47 comments" and a "Magazine subscription" offer. The recipe details are: Prep: 45 mins, Cook: 3 hrs and 30 mins, Plus overnight marinating. The difficulty is "Easy" and it serves 6. A short description reads: "The secret to this rich beef casserole is to use all wine and no stock. Our ultimate beef bourguignon recipe is an instant comforting classic, full of satisfying flavours."

SHARP 62.76kg of Co₂e (Beef is 87% of the footprint)
City 166.58kg of Co₂e (Beef is 95% of the footprint)

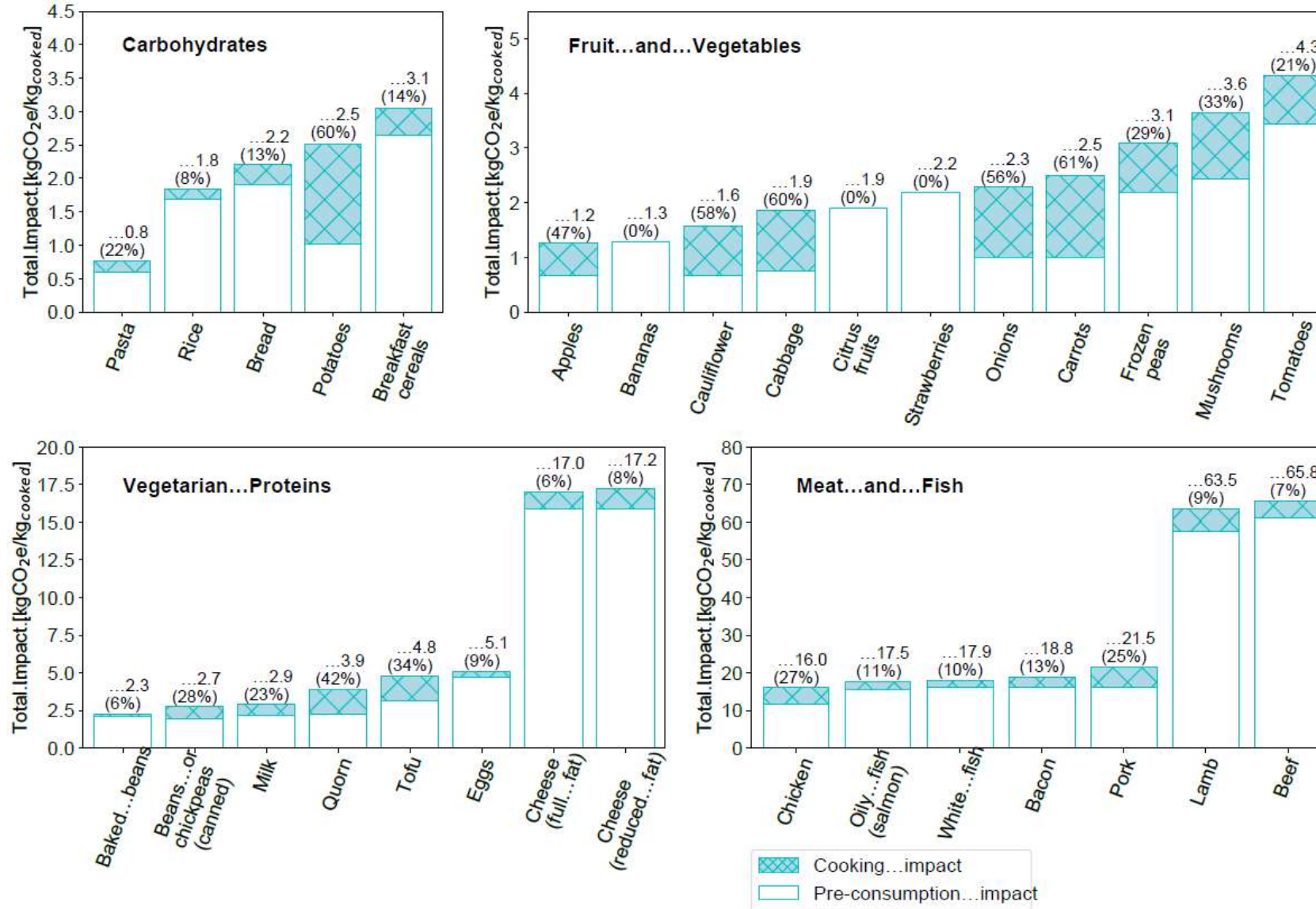


The screenshot shows the BBC Good Food website interface. At the top, there is a search bar with the text "ingredient, dish, keyword..." and a magnifying glass icon. Below the search bar, there are navigation links: "Recipes", "How to", "Health", "Inspiration", "Reviews", "Healthy Diet Plan", and "Subscribe now". The main content area features a recipe for "Broccoli salad" by Liberty Mendez. The recipe includes a photo of the salad, a 5-star rating with 17 ratings, and a link to "Rate". It also mentions "3 comments" and a "Magazine subscription" offer. The recipe details are: Prep: 10 mins, Cook: 3 mins, plus cooling. The difficulty is "Easy" and it serves 2. A short description reads: "Enjoy this crunchy, vegan broccoli salad for lunch or as a side. It's sweet, sharp and full of different textures and colours."

SHARP 0.95kg of Co₂e (Broccoli is 30% of the footprint)
City 1.07kg of Co₂e (Broccoli is 14% of the footprint)

Final thought - How we cook matters!

Up to 61% of GHGE impacts



Key take-away's

- We have a database for CO₂e of ~200,000 commonly cooked recipes in the English language (web)
 - Information provided in grams of CO₂e per **portion**, per **Kcal**, per g of **protein** and **carbon labels**
 - This database, and API can easily be used on menus, cookbooks etc.
- Recipes from different cuisines, dishes, health/diets, and protein sources all can **NOW** be cooked to meet the Kcal and Protein requirements set out by the EAT-Lancet.
- DASH, Vegan, and Vegetarian recipes had the lowest mean, median and IQR of any specific health/diet type.
- We need to think about how carbon/eco labels convey complexity when compared to specific diet requirements (e.g Eat-Lancet).
- Halving animal protein and fat and **double** the amount of fruits and vegetables – both strategies that can work

- This is all very much a work in progress, I would love to hear your thoughts and feedback.

Many thanks to all my collaborators and funders

Dr Christian Reynolds

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The Centre for Food Policy, City, University of London offers the following courses

- **Nutrition and Food Policy BSc (Hons)**

Undergraduate degree

- **Food Policy MSc/PGDip/PGCert/MSc Distance Learning**

Postgraduate taught degree

- **PhD/MPhil Food Policy**

Postgraduate research degree

<https://www.city.ac.uk/prospective-students/courses/postgraduate/food-policy>

Thank you again to all my numerous collaborators and Edamam!

Parts of this research and the GATE NLP tool have been developed with a [research grant](#) from the [alpro foundation](#)
Parts of this work have been funded by internal impact funding from City, University of London.



Aprifel – French Recipes



Looking at French Recipes and environmental impacts.

Scrape of the CuisineAZ website.

Selected 50 recipes to compare “by hand” calculation and using NLP tools.

- Beef (and other animal products) biggest impacts in recipes that use this (90% of carbon footprint)
- For some vegetarian recipes the biggest impacts are from Butter, Cheese or eggs (60%+ for one ingredients) (Butter can be less than 5% of weight but 60%+ of impacts)
- A recipe mostly composed by plant-based product, CO2 emissions of the ingredients are quite balanced (max 15% per ingredient)

How do we communicate this complexity with the French public, chefs etc?