

Les conditions de la prochaine transition alimentaire

Adam Drewnowski, PhD

Director, Center for Public Health Nutrition

Director, Nutritional Sciences Program

Professor of Epidemiology, School of Public Health

University of Washington, Seattle, WA 98195



Changement climatique et alimentation
Séance du mercredi 7 avril 2021



Le bilan végétal de EAT-Lancet

The Planetary Health Diet

The Planetary Health Plate



Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail

Marco Springmann, Keith Wiebe, Daniel Mason-D'Croz, Timothy B. Sulzer, Mike Rayner, Peter Scarborough



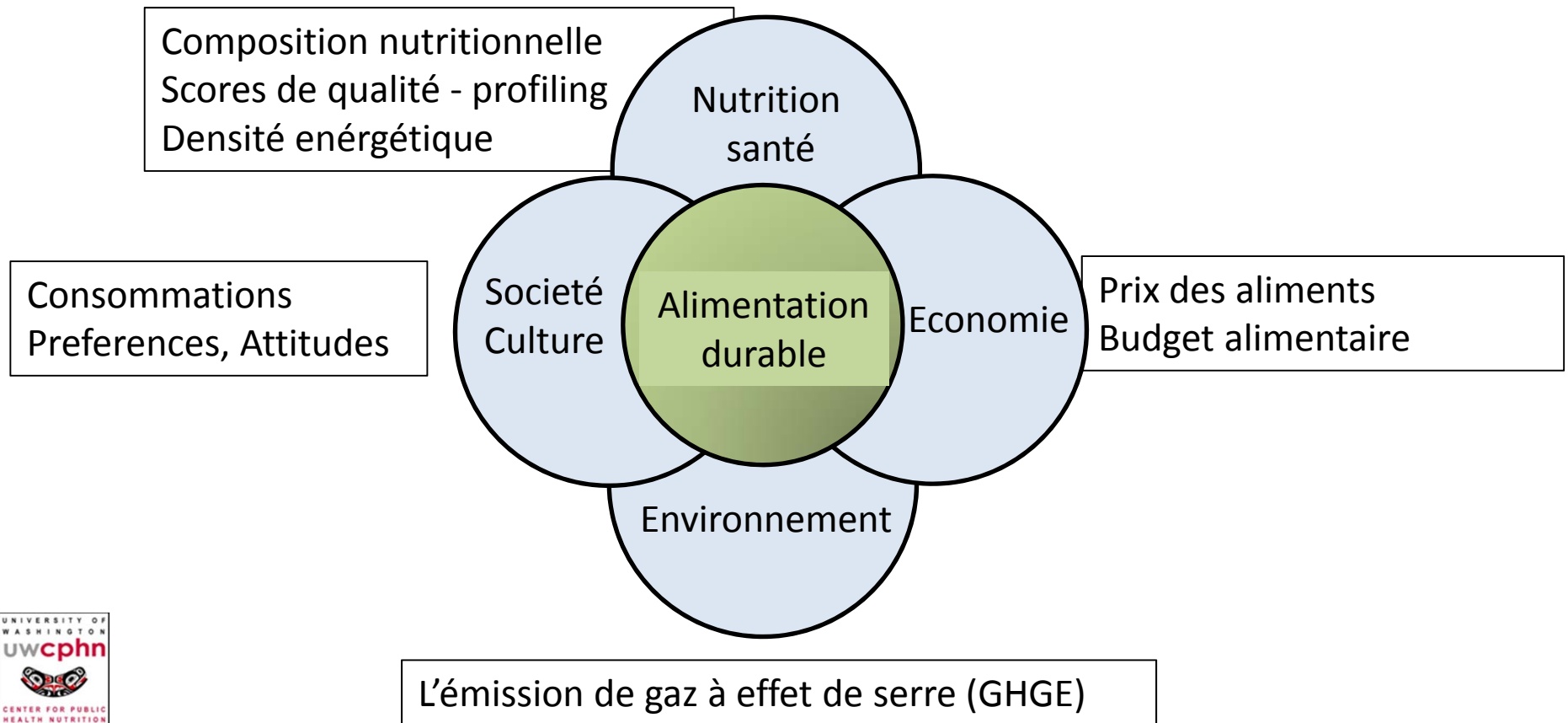
	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
Whole grains Rice, wheat, corn and other	232	811
Tubers or starchy vegetables Potatoes and cassava	50 (0-100)	39
Vegetables All vegetables	300 (200-600)	78
Fruits All fruits	200 (100-300)	126
Dairy foods Whole milk or equivalents	250 (0-500)	153
Protein sources		
Beef, lamb and pork	14 (0-28)	30
Chicken and other poultry	29 (0-58)	62
Eggs	13 (0-25)	19
Fish	28 (0-100)	40
Legumes	75 (0-100)	284
Nuts	50 (0-75)	291
Added fats		
Unsaturated oils	40 (20-80)	354
Saturated oils	11.8 (0-11.8)	96
Added sugars		
All sugars	31 (0-31)	120

Rice
Wheat
Corn
Potatoes
Cassava
Vegetables, Fruits
Legumes,
Nuts
Dairy
Vegetable oils

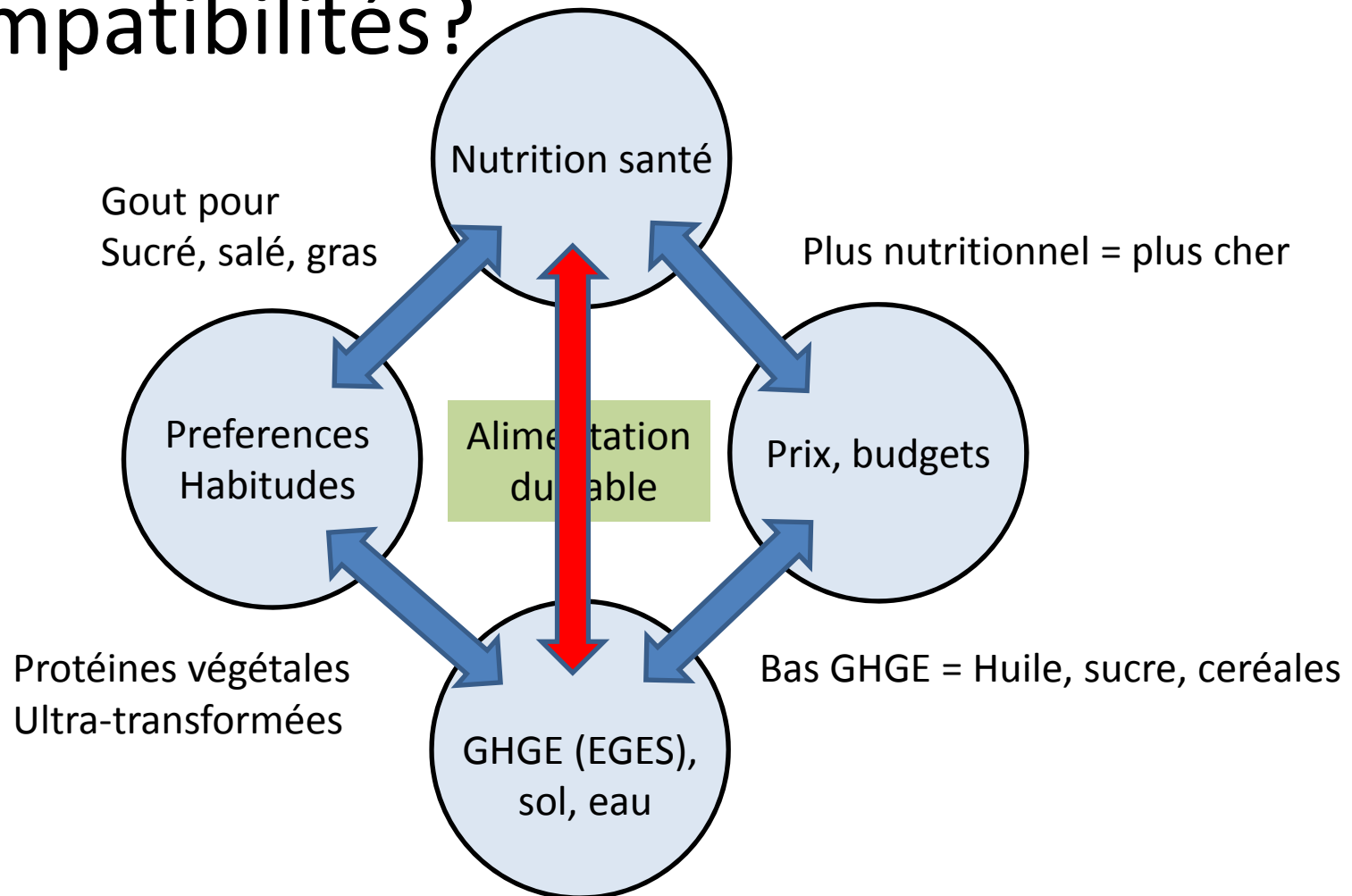
Animal protein



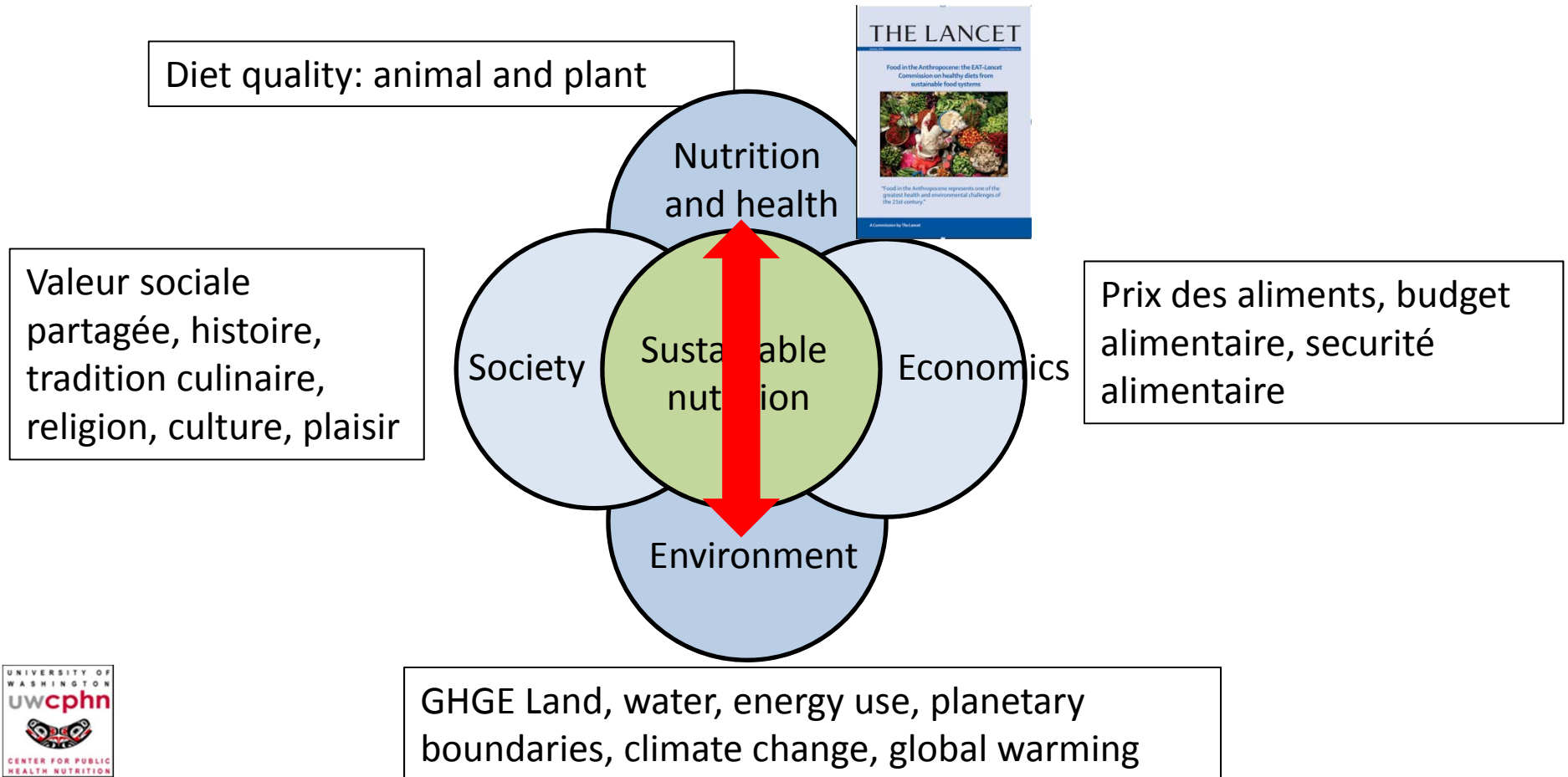
Les 4 domaines de l'alimentation durable



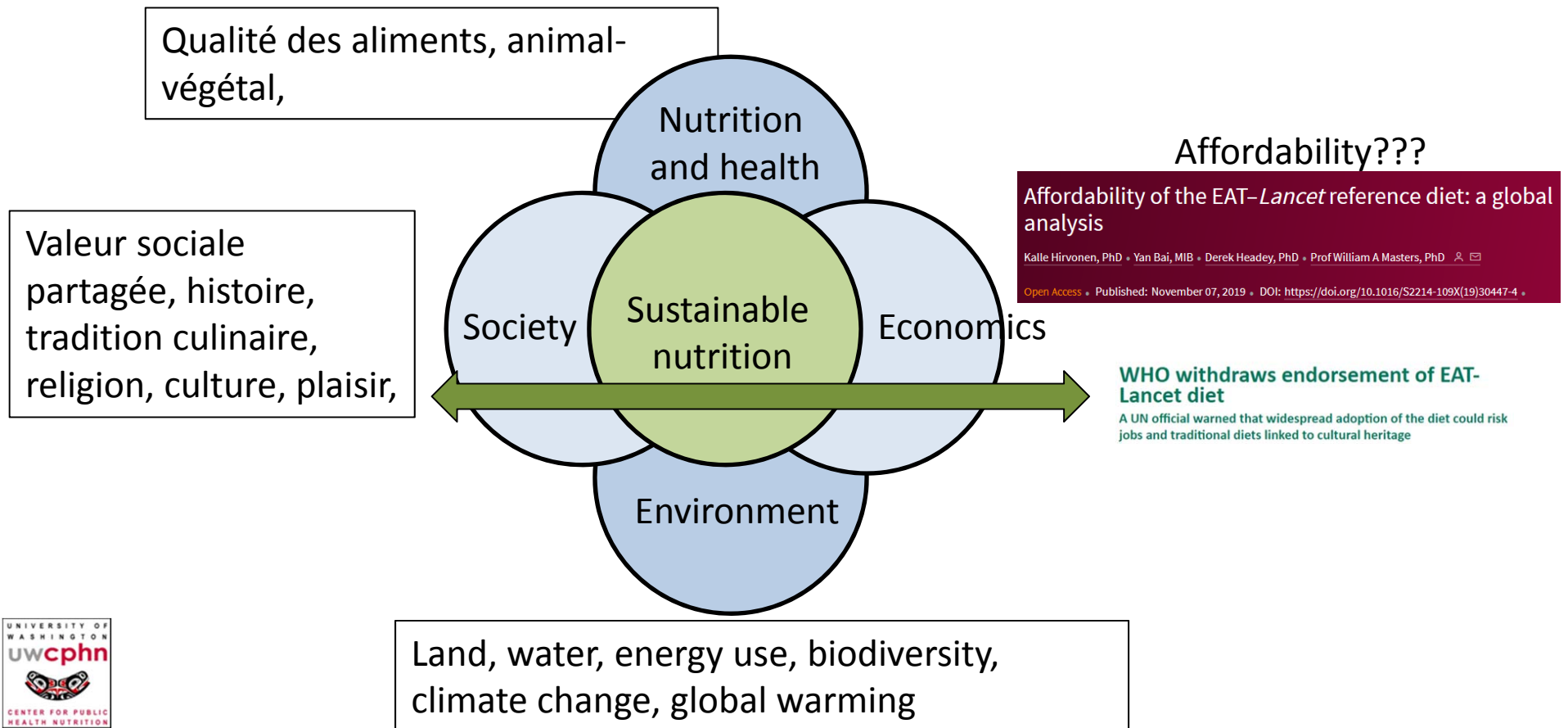
Incompatibilités?



Les domaines de l'alimentation durable

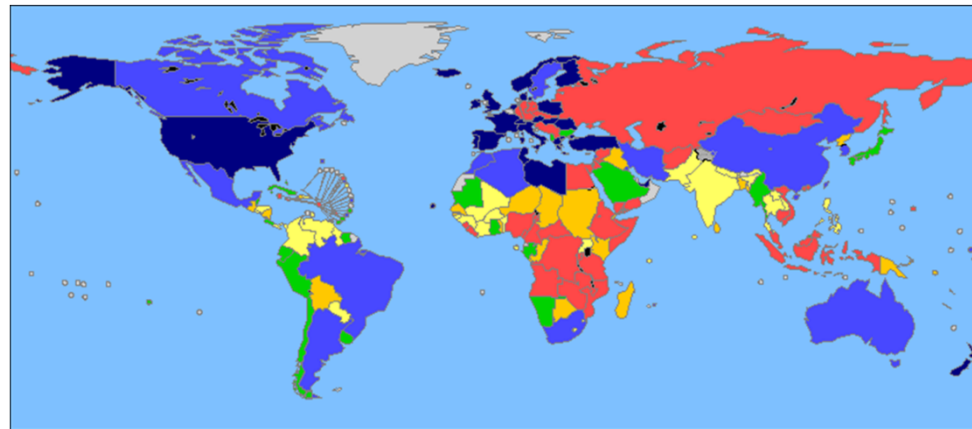


Les domaines de l'alimentation durable



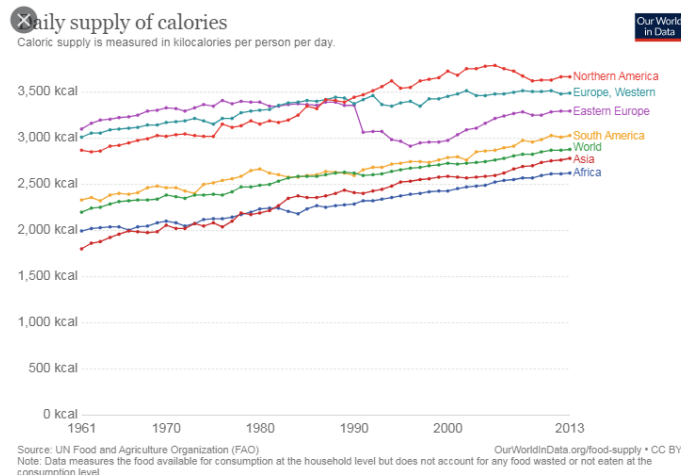
Dans les coulisses de “EAT-Lancet”

- La **disponibilité alimentaire** pour les fruits et légumes et pour la viande rouge (FAO) a été convertie en estimations de la **consommation alimentaire** en utilisant des données régionales sur le gaspillage alimentaire, combinées à des facteurs de conversion en matière comestible.

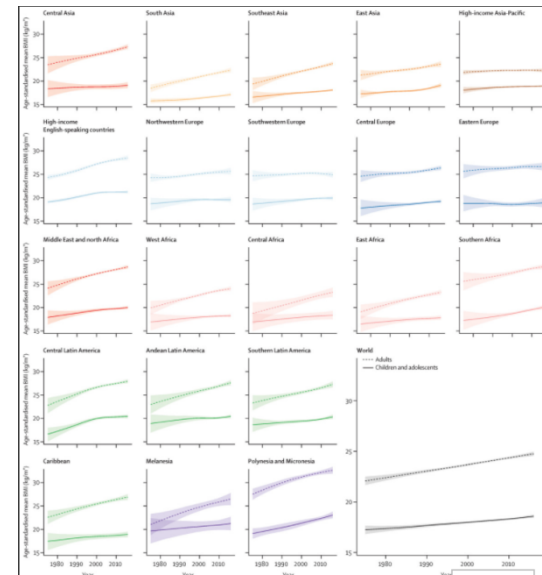


Dans les coulisses de “EAT-Lancet”

- Nous avons lié l'approvisionnement alimentaire au poids corporel en associant les bilans alimentaires de la FAO pour les années 1980–2009 aux données de l'OMS sur l'IMC, en utilisant « polynomial trend model ».



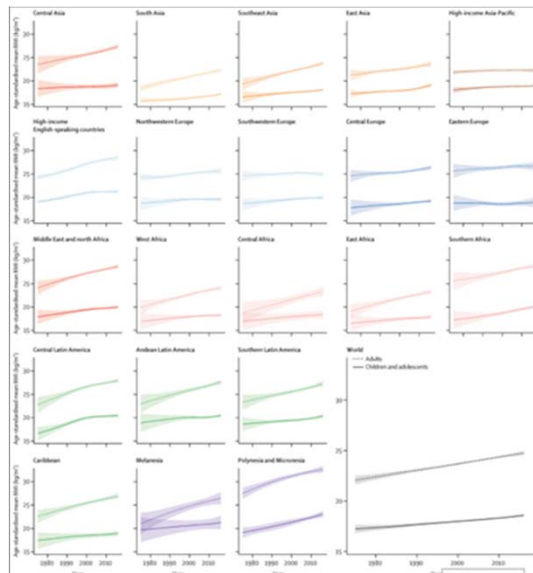
FAO



WHO

Dans les coulisses de “EAT-Lancet”

- Les paramètres de risque relatif liés au régime alimentaire et au poids ont été obtenus à partir d'analyses groupées d'études prospectives de cohorte et de méta-analyses.



???



THE LANCET. PUBLIC HEALTH
ELSEVIER
FREE Full-Text Article

Lancet Public Health. 2017 Jun; 2(6): e277–e285. PMID: 28628032
Published online 2017 May 19. doi: 10.1016/S2468-2667(17)30074-9

Overweight, obesity, and risk of cardiometabolic multimorbidity: pooled analysis of individual-level data for 120 813 adults from 16 cohort studies from the USA and Europe

Mika Kivimäki, Prof, PhD,^{a,b,c,d} Eeva Kuusma, MSc,^b Jane E. Ferrie, PhD,^{a,d} Riitta Luukkonen, PhD,^b Søren T. Nyberg, MSc,^b Lars Alfredsson, Prof, PhD,^{a,f} G. David Batty, PhD,^g Eric J. Brunner, PhD,^g Eleanor Fransson, PhD,^{h,i} Marcel Goldberg, Prof, MD,^j Anders Knutsson, Prof, PhD,^j Markku Koskenvuo, MD,^k Maria Nordin, PhD,^l Tuula Oksanen, PhD,^k Jaana Pentti, MSc,^k Reiner Rupples, Prof, PhD,^{m,n} Martin J. Shipley, MSc,^o Archana Singh-Manoux, PhD,^{a,b} Andrew Steptoe, Prof, PhD,^g Sakari B. Svaminathan, MD,^{p,q} Tores Theodor MD,^r Juha Vahtera, Prof, MD,^{s,t} Marianna Virtanen, Prof, PhD,^u Ester Westendorp, Prof, MD,^v Hugo V. Prof, PhD,^w Marc Zins, MD,^x Mark Hamer, Prof, PhD,^{a,y} Joshua A. Bell, PhD,^{a,y} Adam G. Tabak, PhD,^a Markus Jokela, PhD^a

> N Engl J Med. 1999 Oct 7;341(15):1097-105. doi: 10.1056/NEJM199910073411501

Body-mass index and mortality in a prospective cohort of U.S. adults

E E Calle¹, M J Thun, J M Petrelli, C Rodriguez, C W Heath Jr

Affiliations + expand
PMID: 10511607 DOI: 10.1056/NEJM199910073411501
Free article

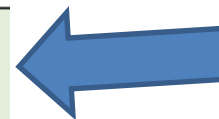
> Obes Res Clin Pract. 2010 Jul;4(3):e171–e181. doi: 10.1016/j.orcp.2010.01.001.

Body mass index, waist circumference, and risk of coronary heart disease: a prospective study among men and women

Alan J Flint¹, Kathryn M Rexrode, Frank B Hu, Robert J Glynn, Hervé Caspard, Joann E Manson, Walter C Willett, Eric B Rimm

Affiliations + expand
PMID: 21116472 PMID: PMC2992336 DOI: 10.1016/j.orcp.2010.01.001

Nutrient	Reccomendation				
		Flexitarian	Pescatarian	Vegetarian	Vegan
Calories, kcal	2084	2084	2084	2084	2084
Protein, g	>52	70.6	72.5	65.0	64.7
Carbohydrates, g	<391	274	278	289	304
Fat, g	..	81.8	78.1	77.3	71.3
Saturated fatty acids, g	<23	19.7	17.5	17.2	13.4
Monounsaturated fatty acids, g	..	31.4	28.1	27.7	26.1
Polyunsaturated fatty acids, g	>14	27.7	27.2	27.4	27.6
Vitamin C, mg	>42	148	163	171	196
Vitamin A, µg	>544	627	679	694	703
Folate, µg	>364	553	577	644	733
Calcium, mg	>520	621	660	630	489
Iron, mg	>17	18.8	19.3	19.5	21.1
Zinc, mg	>6.1	10.4	10.4	10.2	10.3
Potassium, mg	>3247	3383	3555	3634	3952
Fibre, g	>29	35.5	36.6	39.9	44.6
Copper, mg	>0.8	2.3	2.3	2.5	2.7
Phosphorus, mg	>757	1379	1429	1366	1337
Thiamin, mg	>1.1	1.5	1.5	1.5	1.6
Riboflavin, mg	>1.1	0.9	1.0	0.9	0.9
Niacin, mg	>14	17.5	17.4	16.0	16.8
Vitamin B6, mg	>1.2	6.1	6.2	6.1	2.3
Magnesium, mg	>205	527	543	561	596
Pantothenate, mg	>4.7	5.4	5.4	5.3	4.9
Vitamin B12, µg	>2.2	2.4	3.7	0.8	0.0

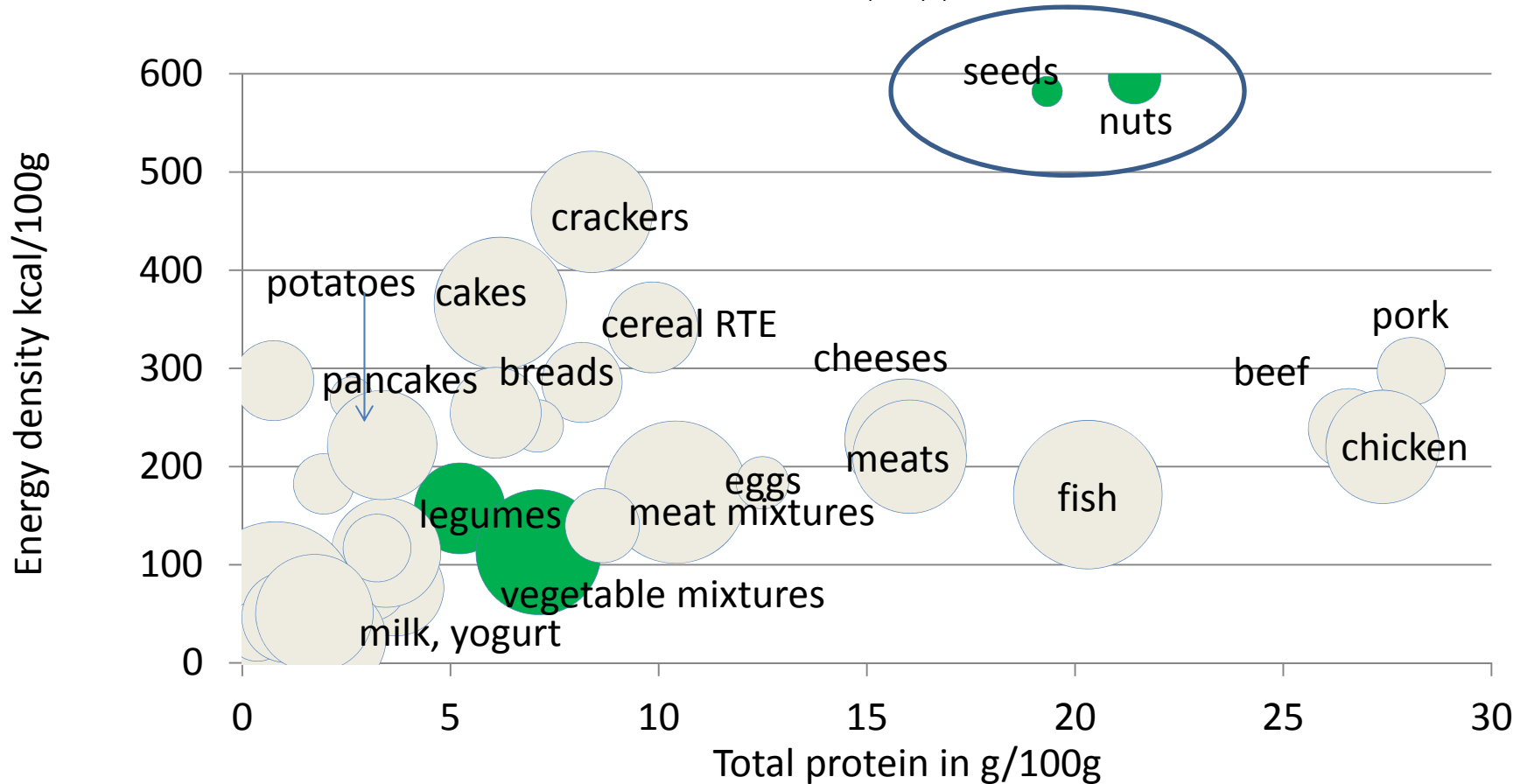


Protéines d'origine végétale

- L'adoption des scénarios conduit au respect de la quasi-totalité des recommandations définies par l'OMS.
- **Pas d'estimation des teneurs en** vitamine D, sucres totaux et ajoutés, acides gras trans, DHA ou sodium
- **Teneurs en calcium, B-2 et B-12 inférieures aux recommandations** dans les scénarios d'exclusion totale de produits animaux.
- **Biodisponibilité pas prise en compte**

Le taux en protéine par 100g du produit

Data for 378 foods from Fred Hutch food frequency questionnaire



Durabilité de l'alimentation : comment la mesurer ?

Comment faire une comparaison des prix?

- Par poids comestible (€/100 grammes comestibles)
- Par valeur énergétique d'un aliment (€/calorie)
- Par valeur nutritionnel d'un aliment (€/nutriment)
- Par portion moyenne (€/portion moyenne).

Nutrients are expensive. Calories are not.

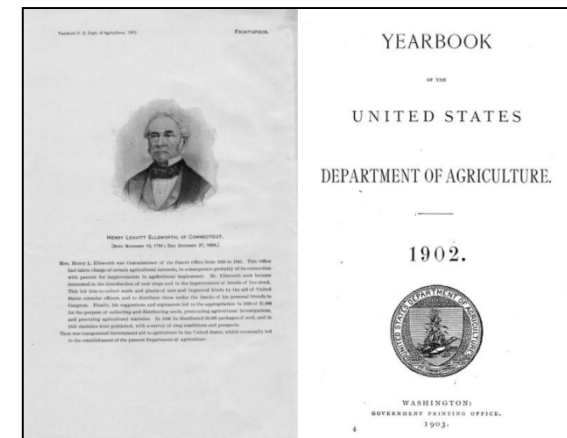
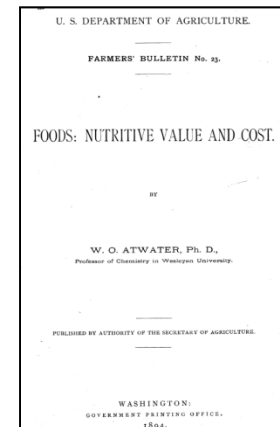


Monsivais, P. and Drewnowski, A. 2007. The Rising Cost of Low-Energy-Density Foods. *Journal of American Dietetic Association* 107: 2071-2076.

Accessibilité économique en 1902

Le chou à 2,5 centimes la livre semble bon marché a cause de son poids... mais pour 10 centimes, le chou ne fournit que 500 calories d'énergie tandis que la farine de blé à 3 centimes la livre contient 0,38 livres de **protéine** et fournit 5490 **calories** d'énergie. La farine représente un produit alimentaire a la fois abordable et nutritionnel.

it furnishes large amounts of protein and energy. Those foods which supply an abundance of protein or energy, or both, at a reasonable price are of most importance from an economic standpoint. A low-priced article is not necessarily a cheap source of nutrients. Cabbage at 2.5 cents a pound is low in price when judged by its bulk; but 10 cents worth of cabbage furnishes only 0.056 pound of protein, and 500 calories of energy, while 10 cents worth of wheat flour at 3 cents per pound furnishes 0.38 pound of protein and 5,490 calories of energy, and is truly cheap. In the same way it is shown that "the best" food, as popularly understood to mean the highest priced, is not necessarily "the cheapest." Ten cents spent for flour or beans or salt mackerel



L'impact carbone des aliments
est aussi estimé par kilogramme
de quoi que ce soit.

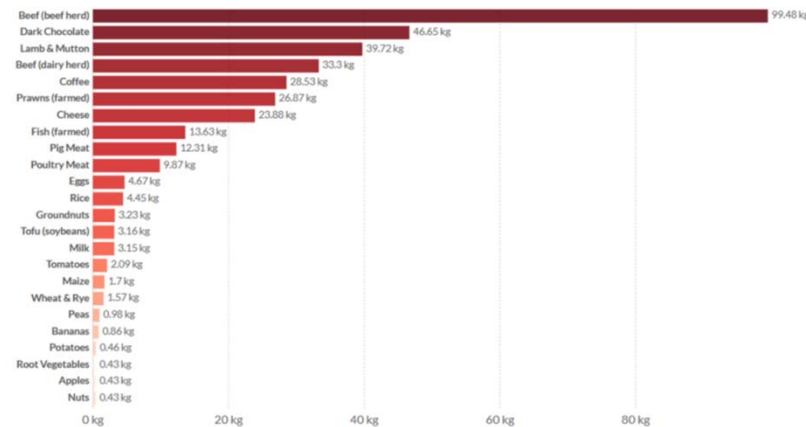
kilo



Greenhouse gas emissions per kilogram of food product

Greenhouse gas emissions are measured in kilograms of carbon dioxide equivalents (kgCO₂e/kg) per kilogram of food product. This means non-CO₂ greenhouse gases are included and weighted by their relative warming impact.

[Add food](#)

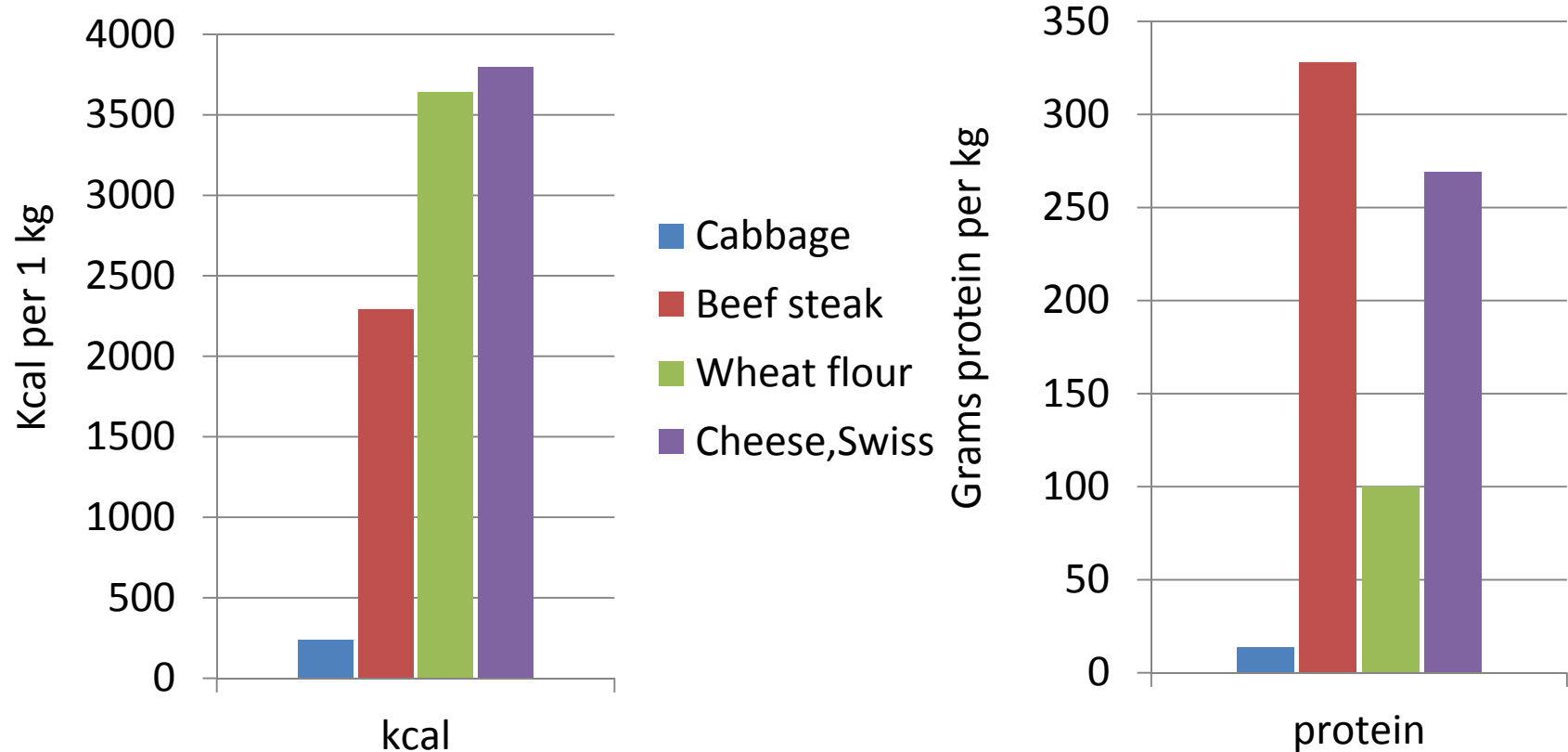


Source: Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers.

Note: Data represents the global average greenhouse gas emissions from food products based on a large meta-analysis of food production covering 38,700 commercially viable farms in 119 countries.

OurWorldinData.org/environmental-impacts-of-food • CC BY

Le kilogramme ne mesure pas ni calories ni la valeur nutritionnelle des aliments



Also measured per 1000 kcal or 100g protein (Poore & Nemecek 2018)

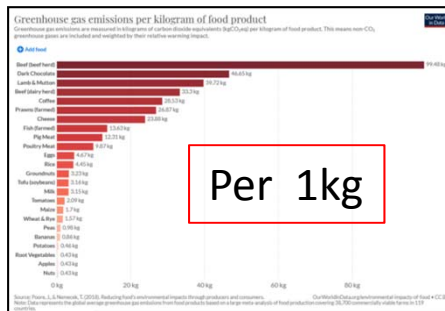


Table S1. Functional units (FUs) used.

	Mass / Volume FU	Nutrition FU	Nutrient Density
Starch-Rich			
Wheat & Rye	1 kg of bread (variable protein wheat)	1000 kcal energy	2695 kcal kg ⁻¹
Maize	1 kg of meal (for polenta)		4165 kcal kg ⁻¹
Oats	1 kg of rolled oats		2605 kcal kg ⁻¹
Rice	1 kg of full grain white or brown rice		3685 kcal kg ⁻¹
Potatoes	1 kg of soil free tuber		730 kcal kg ⁻¹
Cassava	1 kg of soil free tuber		975 kcal kg ⁻¹
Protein-Rich			
Peas	1 kg of dry pea without pod	100 g protein	215 g kg ⁻¹
Other Pulses	1 kg of dry pulse without pod		220 g kg ⁻¹
Nuts	1 kg of shell free, dry nut		160 g kg ⁻¹
Groundnuts	1 kg of shell free, roasted nut		260 g kg ⁻¹
Soybeans	1 kg of tofu (~16% protein)		160 g kg ⁻¹
Cheese	1 kg of cheese		225 g kg ⁻¹
Eggs	1 kg of eggs		110 g kg ⁻¹
Poultry Meat			175 g kg ⁻¹
Pig Meat	1 kg of fat and bone-free meat and		160 g kg ⁻¹
Lamb & Mutton	edible offal		200 g kg ⁻¹
Beef		200 g kg ⁻¹	
Fish	1 kg of edible fish		230 g kg ⁻¹
Crustaceans	1 kg of head-free meat (shell-free for large shrimp)		150 g kg ⁻¹

← Per 1000 kcal

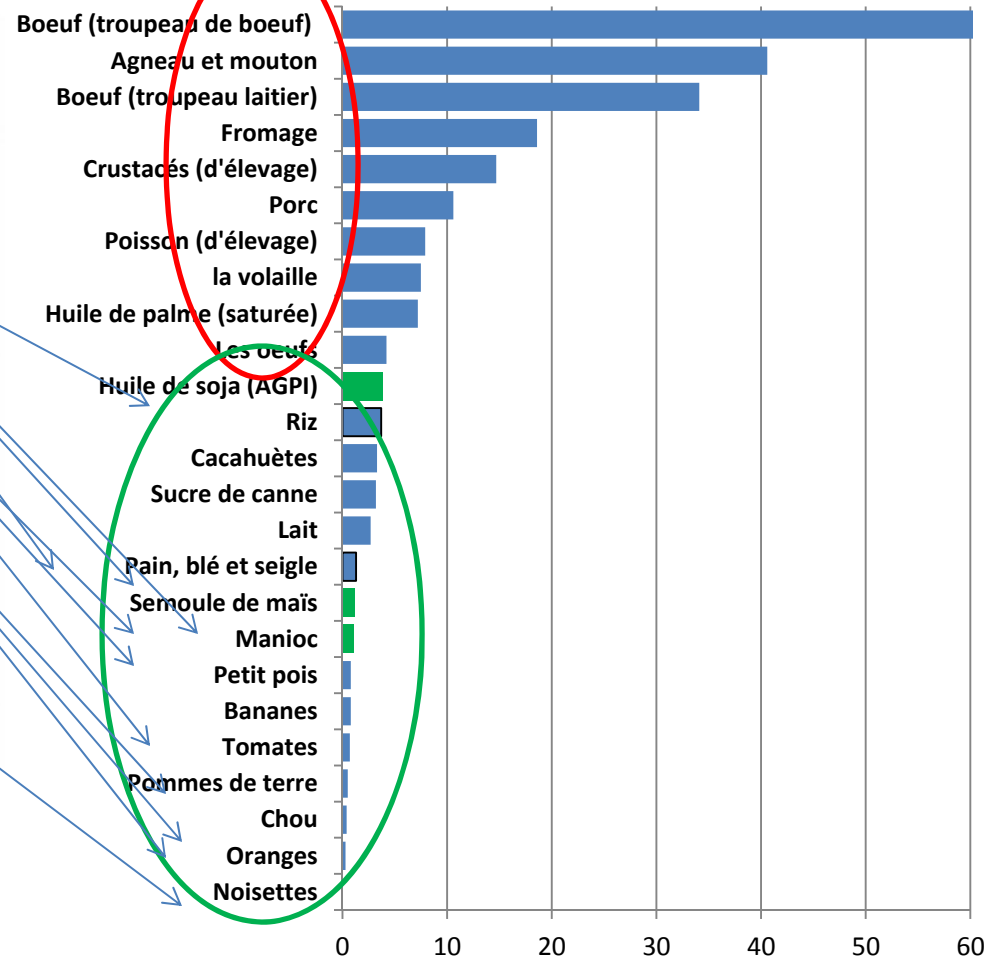
← Per 100 g protein

The Planetary Health Diet

	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
Whole grains Rice, wheat, corn and other	232	811
Tubers or starchy vegetables Potatoes and cassava	50 (0-100)	39
Vegetables All vegetables	300 (200-600)	78
Fruits All fruits	200 (100-300)	126
Dairy foods Whole milk or equivalents	250 (0-500)	153
Protein sources		
Beef, lamb and pork	14 (0-28)	30
Chicken and other poultry	29 (0-58)	62
Eggs	13 (0-25)	19
Fish	28 (0-100)	40
Legumes	75 (0-100)	284
Nuts	50 (0-75)	291
Added fats		
Unsaturated oils	40 (20-80)	354
Saturated oils	11.8 (0-11.8)	96
Added sugars		
All sugars	31 (0-31)	120

Median GHGE per kg of food

Data from Poore and Nemecek 2018



The Planetary Health Diet

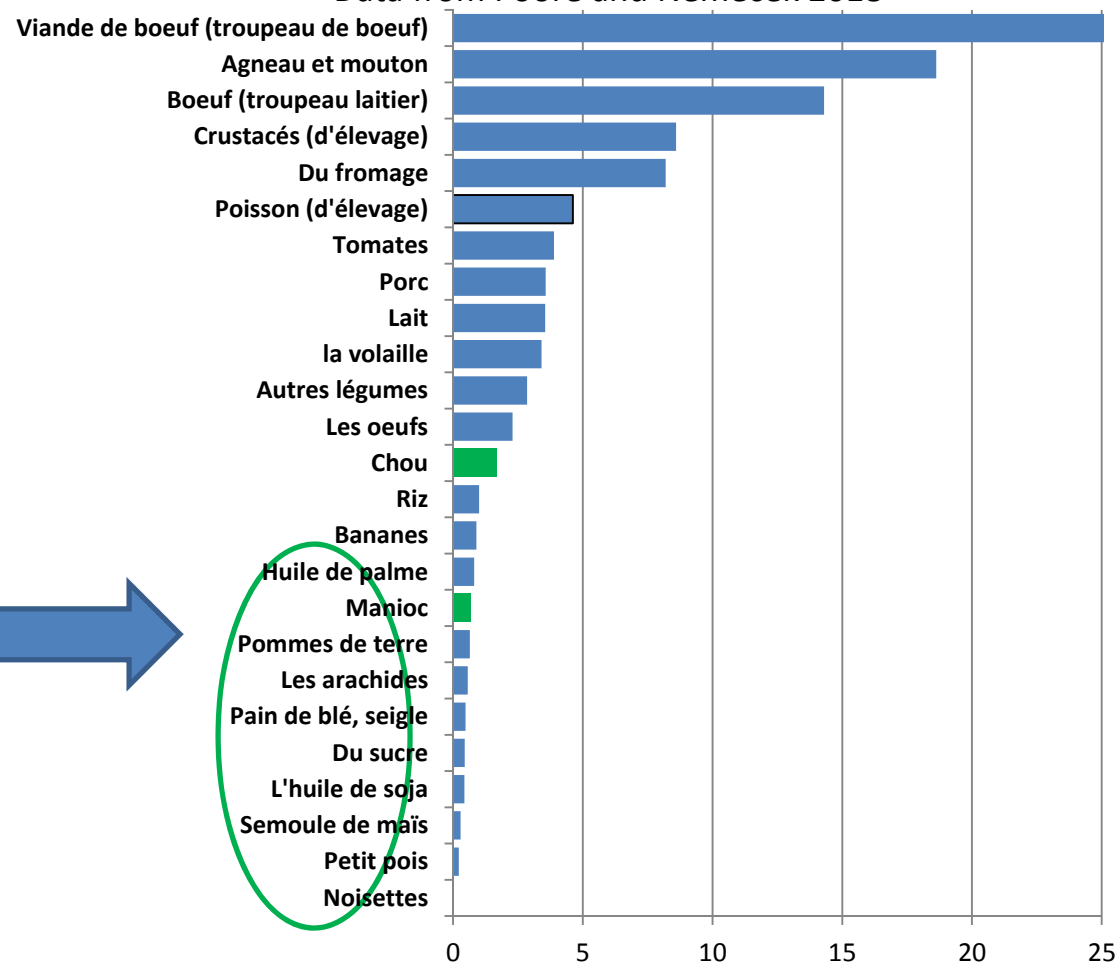
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Dairy foods <i>Whole milk or equivalents</i>	250 (0-500)	153
Protein sources <i>Red, lamb and pork</i>	14 (0-28)	30
<i>Chicken and other poultry</i>	29 (0-58)	62
<i>Eggs</i>	13 (0-26)	19
<i>Fish</i>	39 (0-78)	40
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- Planet friendly calories
 - Manioc, potatoes, peanuts
 - Palm, soybean oil
 - Corn, wheat
 - Sugar
 - Nuts



Median GHGE per 1000 kcal of food

Data from Poore and Nemecek 2018



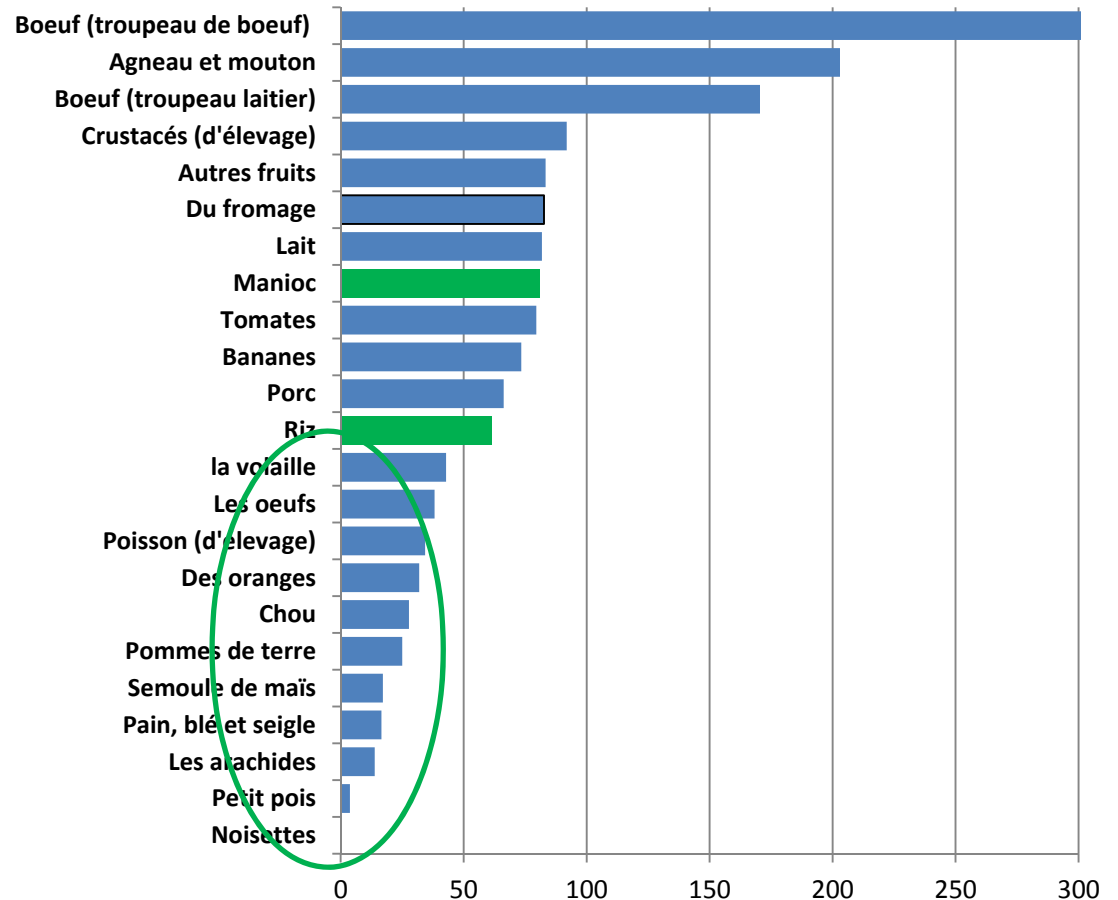
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- Planet friendly protein
 - Nuts, peas, peanuts
 - Corn, wheat, rice
 - Fish, chicken, eggs
 - Pork

Median GHGE per 1000g protein

Data from Poore and Nemecek 2018



Protein Digestibility Corrected Amino Acid Score

- Toutes les protéines végétales ne sont pas équivalentes sur le plan nutritionnel aux protéines du lait.
- La FDA américaine exige le PDCAAS pour les produits destinés aux enfants de moins de 4 ans ou ceux qui font une allégation.
- Les calculs du coût environnemental doivent prendre en compte la qualité des protéines (PDCAAS).

Protein source	Factor	Protein source	Factor
Cow's milk	1.0	Peas/legumes	0.70
Eggs	1.0	Fruits, fresh	0.64
Casein, whey	1.0	Cereals	0.59
Beef	0.92	Peanuts	0.52
Soy	0.91-1.0	Rice	0.50
Chickpeas, soybeans	0.78	Dried fruit	0.48
Black beans	0.75	Wheat	0.42
Vegetables	0.73	Wheat gluten	0.25

Special Article

Adjusting for protein quality by food source may affect nutrient density metrics

Adam Drewnowski

Methods to assess nutrient density of foods, commonly known as nutrient profiling (NP), typically include protein as a component. In this study, the goal was to apply a correction for protein quality by food source to selected NP algorithms. Analysis of 378 component foods of the First Health food frequency questionnaire showed that animal-source foods (i.e., meat, eggs, and dairy) along with some soy products and nuts were the only foods that provided > 20% of the daily value (DV) of protein per 100 g or per 100 kcal. Most beans, pulses, legumes, grains, and vegetables provided < 10% DV of protein per 100 g or per 100 kcal. Adjusting for protein quality using a simplified Protein Digestibility Corrected Amino Acid Score (PDCAAS) had consequences for point-based NP models (namely, Nutri-Score) and for continuous nutrient density scores (namely, Nutrient Rich Foods). Quantitative methods that use protein content to capture nutrient density may require a protein quality adjustment, especially when adjusted for use in low- and middle-income countries where protein quality is an issue of public health concern.

- Les profils nutritionnels (Nutri-Score) ne s'ajustent pas à la qualité des protéines.

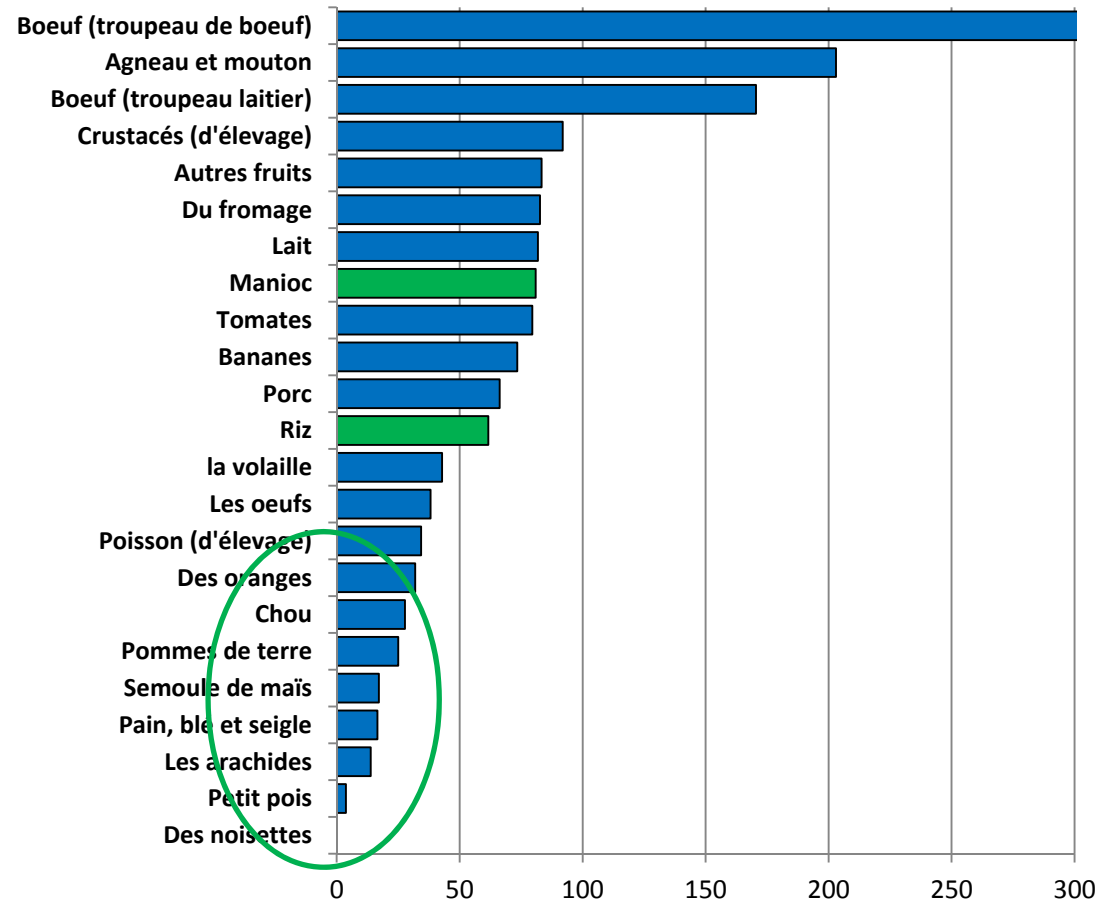
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<i>Fish</i>	39 (0-78)	40
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- Planet friendly quality protein
 - Nuts, peas, peanuts
 - Corn, wheat, rice
 - Fish, chicken, eggs
 - Pork

Median GHGE per 1000g PDCAAS protein

Data from Poore and Nemecek 2018



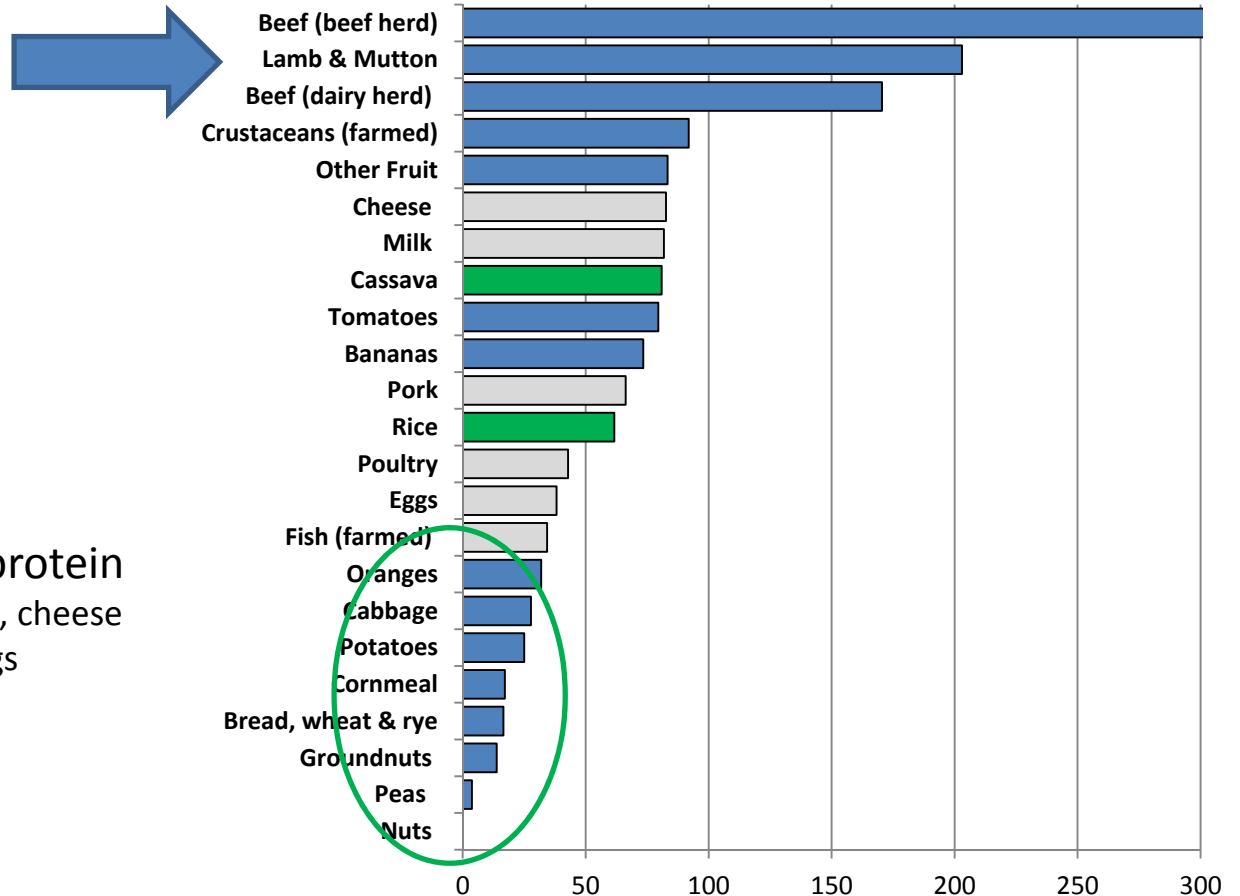
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Added sugars <i>All sugars</i>	31 (0-31)	120

- Planet friendly quality protein
 - Cassava (manioc) = milk, cheese
 - Rice = pork, poultry, eggs
 - Peas, nuts

Median GHGE per 1000g PDCAAS protein

Data from Poore and Nemecek 2018



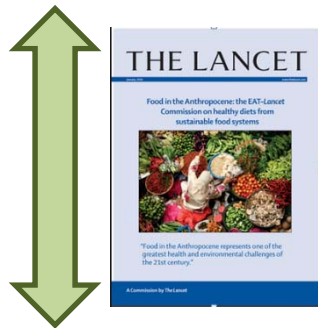
La diète EAT-Lancet

- Les régimes EAT-Lancet les plus abordables coûtaient une médiane mondiale de 2,84 USD par jour (IQR 2,41–3,16) en 2011, dont la plus grande part était le coût des fruits et légumes (31,2%), suivis des légumineuses et fruits à coque (18,7%), de la viande, des œufs et du poisson (15,2%) et des produits laitiers (13,2%).
- Ce régime coûte une petite fraction du revenu moyen dans les pays à revenu élevé, **mais n'est pas abordable pour les pauvres du monde.**
- Nous avons estimé que le coût d'un régime EAT-Lancet dépassait le revenu par habitant des ménages pour au moins 1,58 milliards de personnes.
- Le régime EAT-Lancet est également plus cher que le coût minimum de l'adéquation des nutriments, en moyenne, d'un facteur moyen de 1,60 (IQR 1,41–1,78).

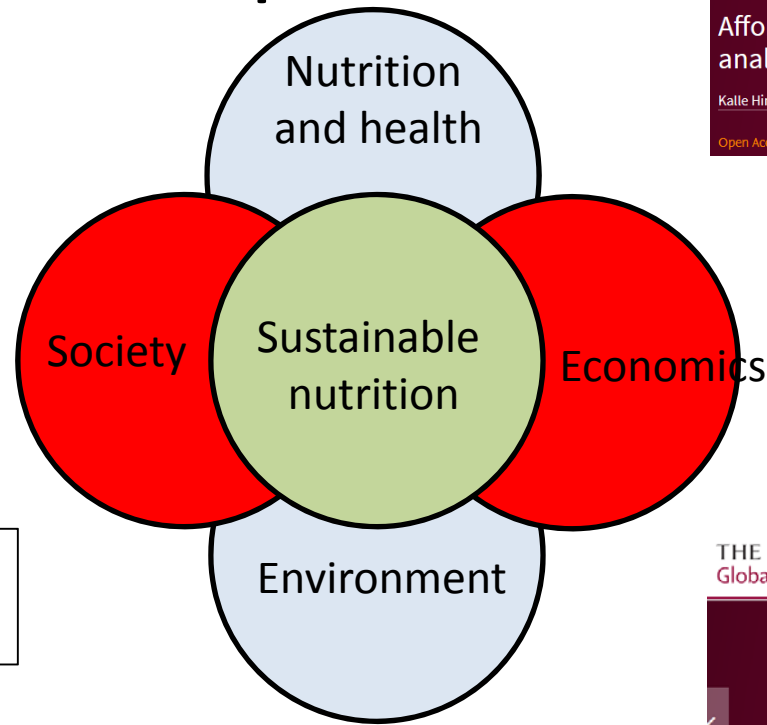
	Macronutrient intake (possible range), g/day	Caloric intake, kcal/day
Whole grains*		
Rice, wheat, corn, and other†	232 (total grains 0–60% of energy)	811
Tubers or starchy vegetables		
Potatoes and cassava	50 (0–100)	39
Vegetables		
All vegetables	300 (200–600)	–
Dark green vegetables	100	23
Red and orange vegetables	100	30
Other vegetables	100	25
Fruits		
All fruit	200 (100–300)	126
Dairy foods		
Whole milk or derivative equivalents (eg, cheese)	250 (0–500)	153
Protein sources‡		
Beef and lamb	7 (0–14)	15
Pork	7 (0–14)	15
Chicken and other poultry	29 (0–58)	62
Eggs	13 (0–25)	19
Fish§	28 (0–100)	40
Legumes		
Dry beans, lentils, and peas*	50 (0–100)	172
Soy foods	25 (0–50)	112
Peanuts	25 (0–75)	142
Tree nuts	25	149
Added fats		
Palm oil	6.8 (0–6.8)	60
Unsaturated oils¶	40 (20–80)	354
Dairy fats (included in milk)	0	0
Lard or tallow	5 (0–5)	36
Added sugars		
All sweeteners	31 (0–31)	120

La diète Lancet – inabordable pour la planète?

A single global diet
Mostly plants



Planetary boundaries
Climate change



Affordability of the EAT–Lancet reference diet: a global analysis

Kalle Hirvonen, PhD • Yan Bai, MIB • Derek Headey, PhD • Prof William A Masters, PhD

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The most affordable EAT–Lancet diets cost a global median of US\$2·84 per day (IQR 2·41–3·16) in 2011, of which the largest share was the cost of fruits and vegetables (31·2%), followed by legumes and nuts (18·7%), meat, eggs, and fish (15·2%), and dairy (13·2%).

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Analysing the affordability of the EAT–Lancet diet

Adam Drewnowski

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Merci

Adam Drewnowski, PhD

Director, Center for Public Health Nutrition,
Professor of Epidemiology, University of Washington, Seattle, WA, USA
Director, UW Center for Obesity Research

