The world on a plate

Reducing the food chain's role in greenhouse gas emissions

Tara Garnett

Food Climate Research Network

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Presentation today

1. Overview of food GHG impacts
    - By life cycle stage
    - By food type
2. Special focus on livestock
3. Climate change & human nutrition: the need for integrated policy
4. Mitigation options
    - The role of technology and good management
    - Changing what we eat
5. What is the food industry doing?
6. Observations and implications for circular agriculture
7. About the Food Climate Research Network

1. Overall food related GHG emissions

Defining terms

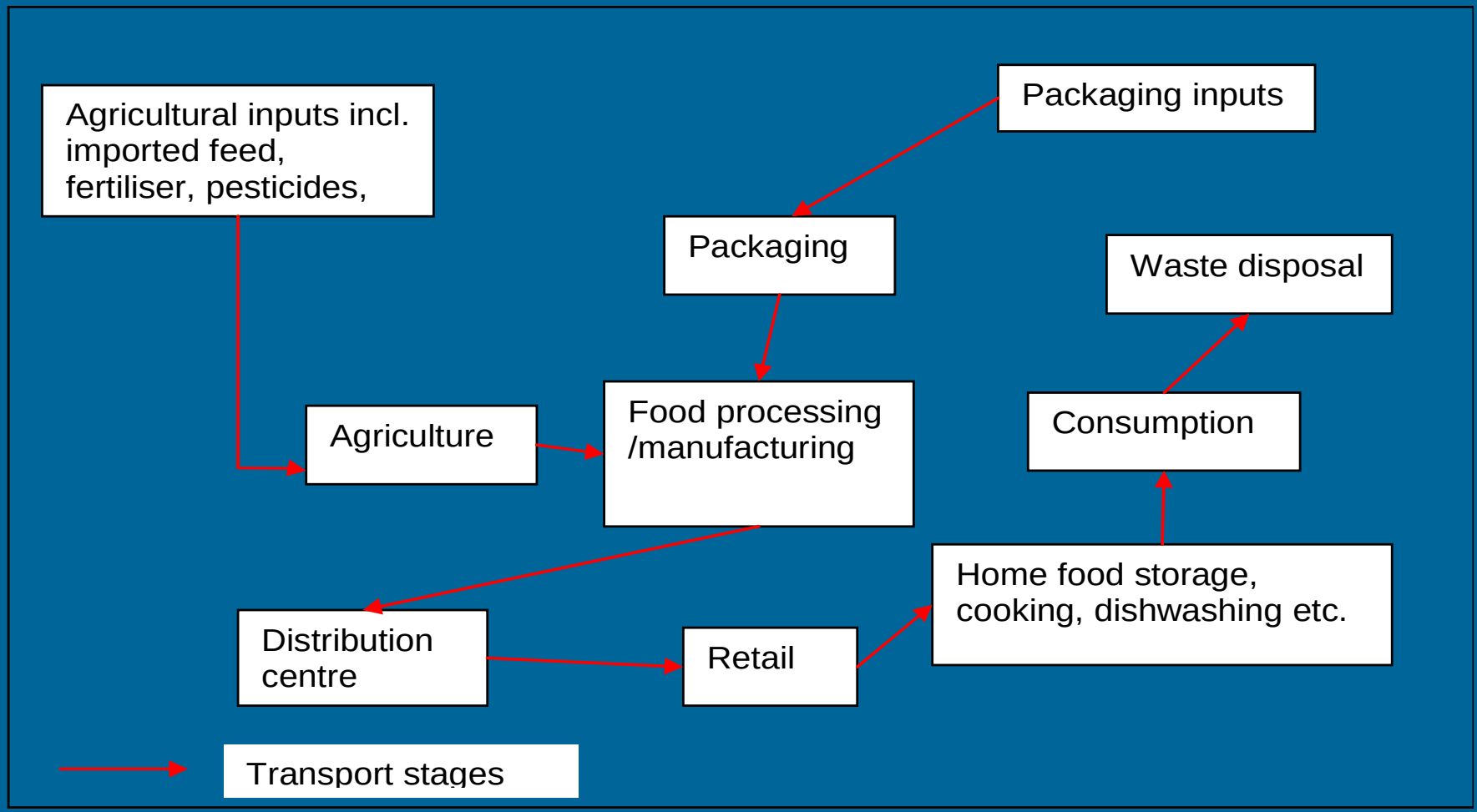
- GHGs = greenhouse gas emissions
- CO_2

- Methane: 23x more potent than CO_2

- Nitrous oxide: 298x more potent than CO_2

- Refrigerant gases: thousands of times more potent…

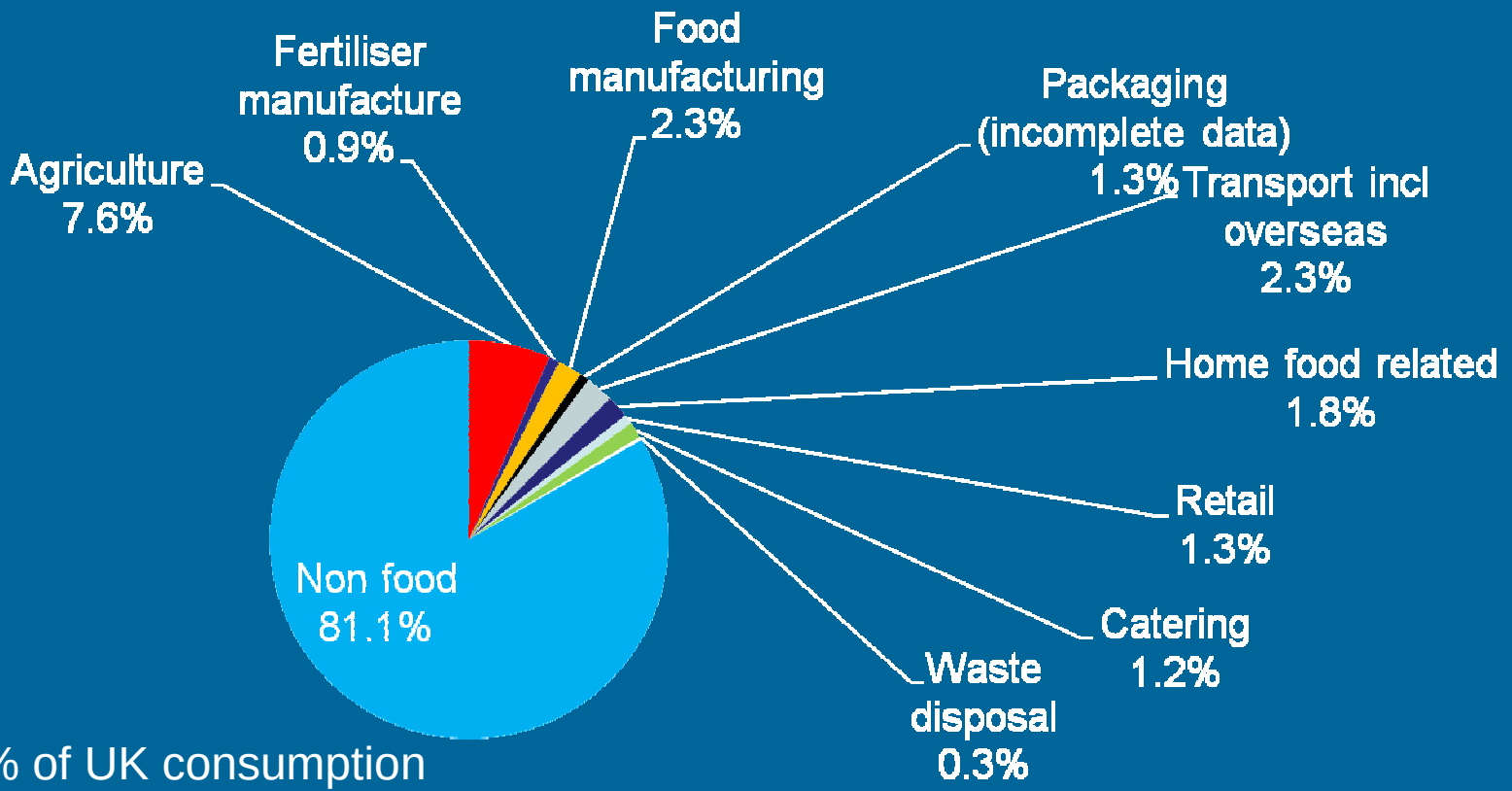
The life cycle analysis (LCA) perspective



Overall food-related contribution to GHG emissions

- Europe wide report: 31% all EU consumption related GHGs
- FCRN UK estimates: around 19% – UK Government estimates similar
- World agriculture contribution – 17 - 32% total global emissions
- Huge uncertainty / variability between countries / differences in what's included in figure and what's not

Food GHG impacts – by life cycle stage – UK 43 MTCeq



As % of UK consumption related GHG emissions est .at 234 MTCe

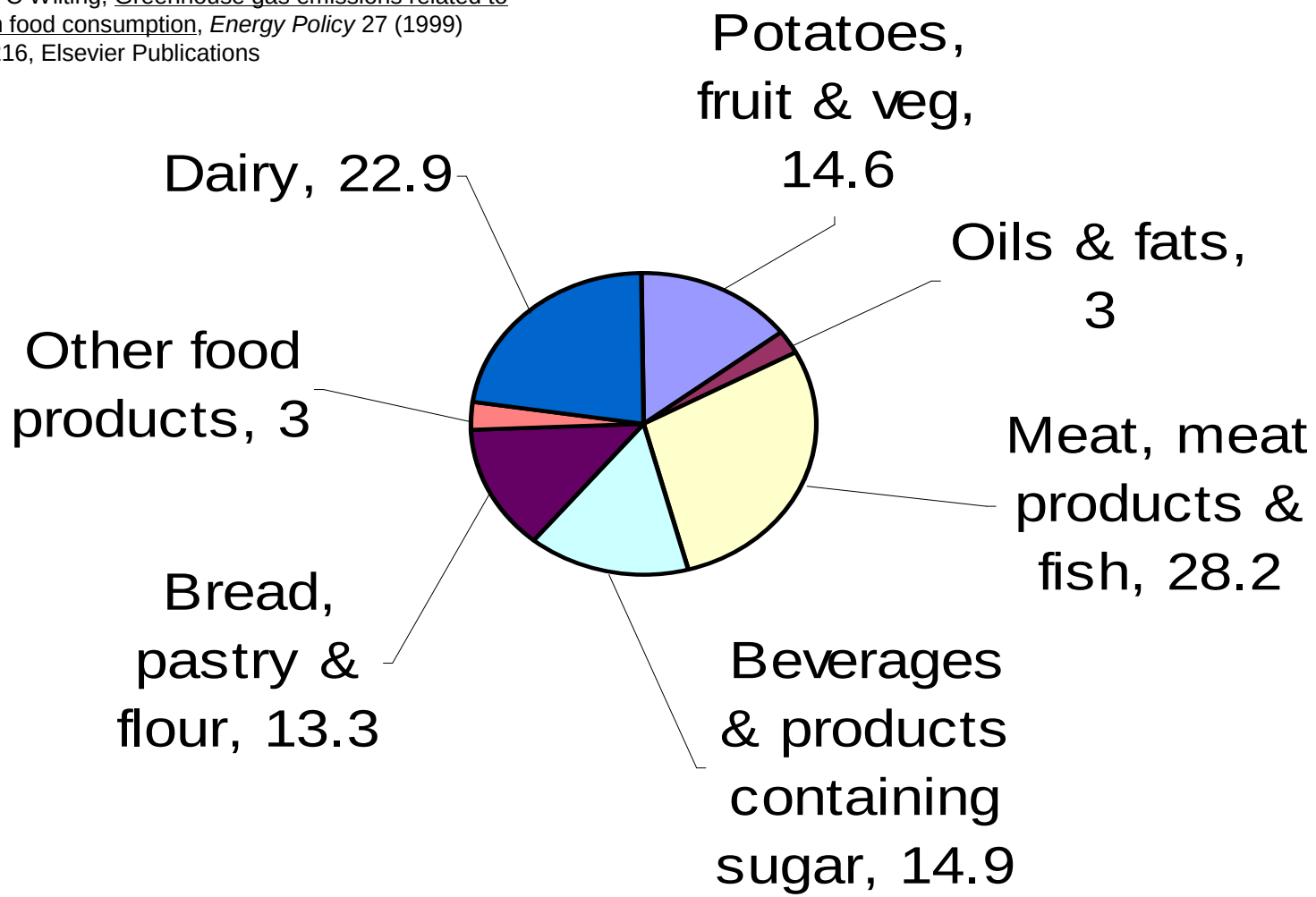
Source: Food Climate Research Network 2008

Agriculture dominates but

- The GHG hotspots vary by food type:
  - Meat & dairy: Agriculture
  - Field veg: Transport and cooking
  - Protected veg: Agriculture
  - Crisps & bread: Agriculture; processing; transport combined
  - Small bottle beer: Packaging
  - Baked potato, pasta, tea: Cooking

Contribution of food groups to Dutch GHG emissions KG/CO2e

Klaas Jan Kramer, Henri C Moll, Sanderine Nonhebel, Harry C Wilting, Greenhouse gas emissions related to Dutch food consumption, *Energy Policy* 27 (1999) 203-216, Elsevier Publications



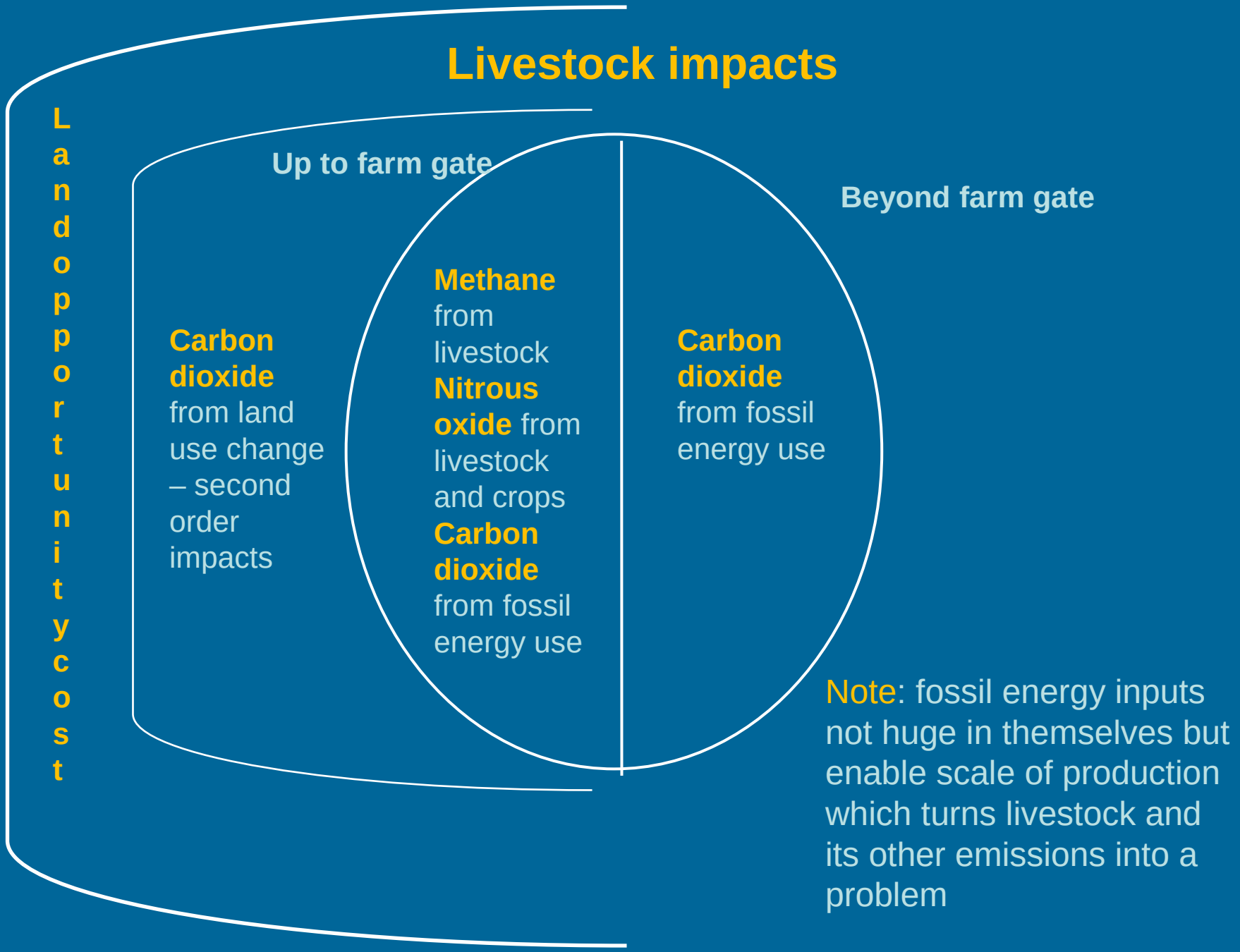
2. Focus on livestock

Livestock: the main concern

- Global – 18% global emissions (FAO 2006)
- EU:15% EU GHGs or 50% of all food impacts (EIPRO 2006)
- Kramer et al (1999): 50% of all food impacts
- UK (from FCRN study): about 8.5%

- Variation depends on what's included (eg. LU change) & baseline consumption GHGs

Livestock impacts



Note: fossil energy inputs not huge in themselves but enable scale of production which turns livestock and its other emissions into a problem

Livestock's impacts significant even when...

- Foods are highly processed:
  - Ready meal vs. home cooking study (Sonesson et al 2005) (*0% total footprint)
  - Cadbury's chocolate bar (60% total footprint)
- Or come from far away:
  - New Zealand study
- Farm stage and pre-farm stage emissions dominate

Livestock: benefits & disbenefits

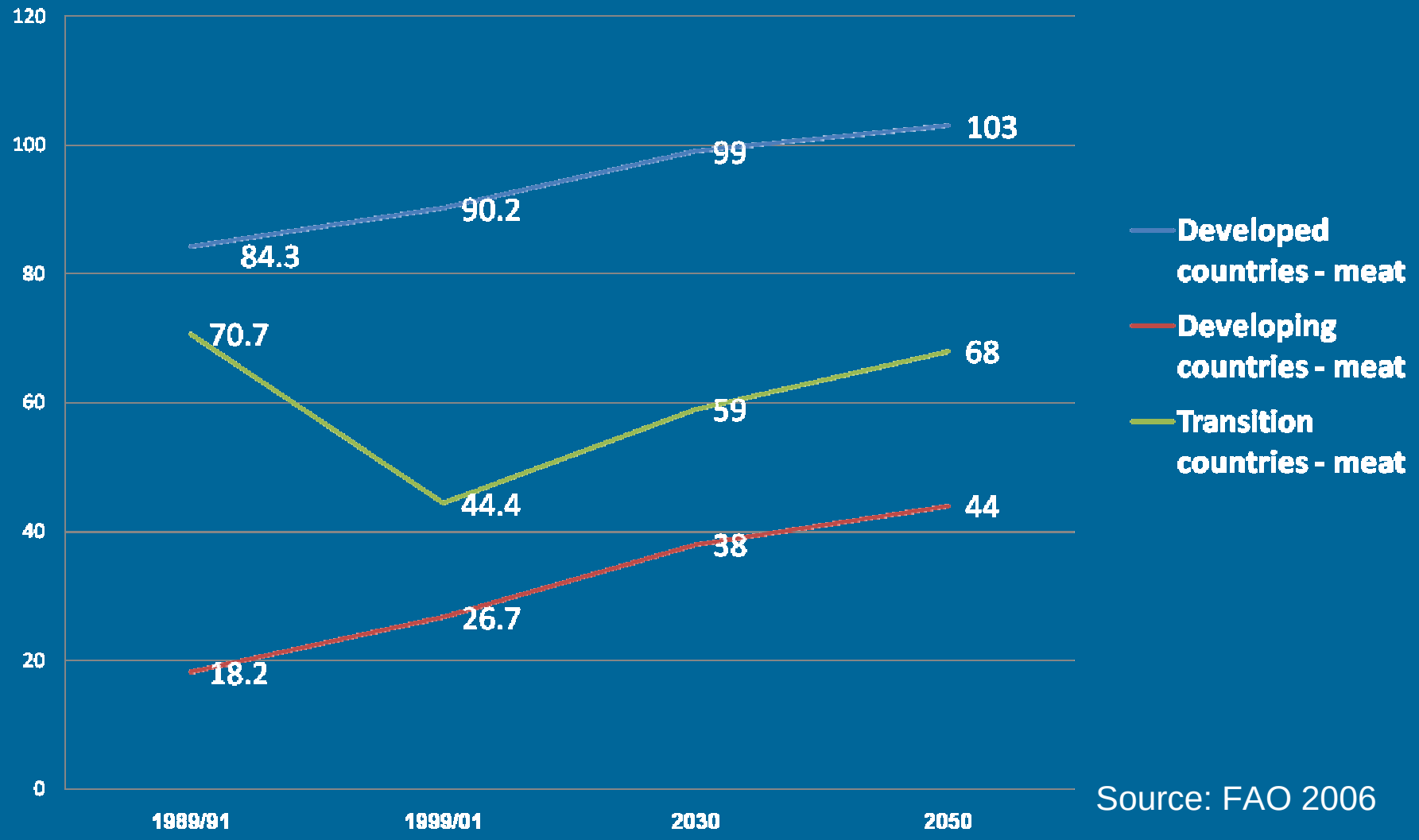
	Benefits	Disbenefits	Comment
Nutrition	Excellent for protein, calcium, iron, vit B12	Excessive fat	Animal foods not essential; plants can substitute
Non food benefits	Leather, wool, manure, rendered products	Manure can be a pollutant	Quantities needed?
Substitution cost	Eating will always produce an impact	Generally plant foods have lower GHG profile	
Carbon storage	Pasture land stores carbon	Excessive grazing & land use change releases carbon	
Resource efficiency	Livestock can consume grass & byproducts	Supplemented with grains & cereals in intensive systems	Byproducts can be used directly as energy source in AD systems
Geography	Some land not suitable for	Arable land used for	

Global trends in demand

	2000 (6 bn people)	2050 (9 bn people)
Total demand – meat (tonnes)	**228**	**459**
Total demand – milk (tonnes)	**475**	**883**

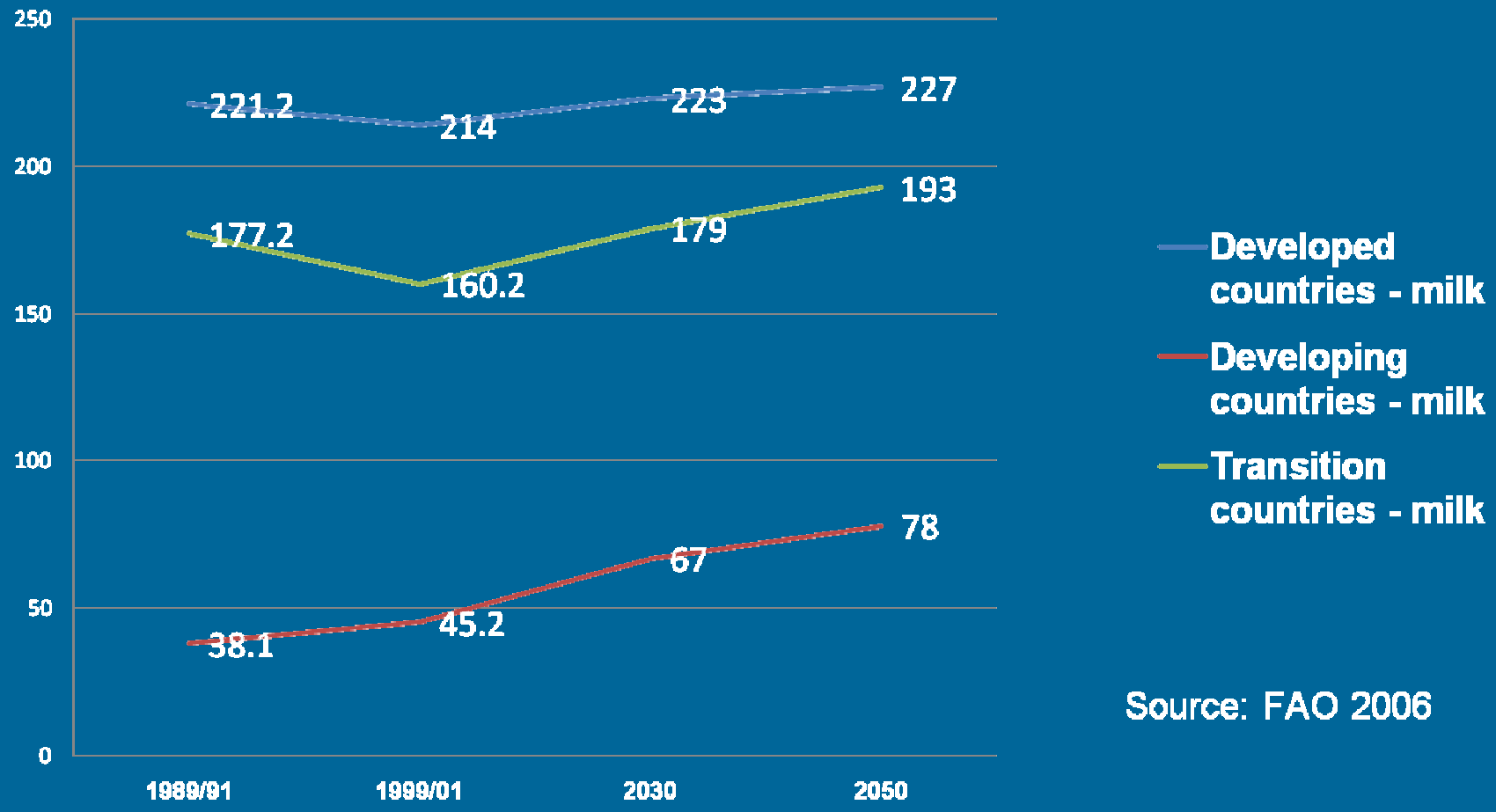
Source: FAO 2006

Inequality continues: p.c. meat to 2050



Source: FAO 2006

Per cap. milk to 2050



Source: FAO 2006

Chinese livestock consumption trends

(source: FAO 2007)	Per capita consumption KG		
	1990	2005	Growth %
Eggs	6.07	18.35	Nearly tripled
Poultry	3.27	11.36	Nearly trippled
Pork	19.98	38.09	Doubled
Beef	1.01	6.62	X 6
Sheep and goat	0.96	3.49	quadrupled
Meat total(ex eggs)	25.22	59.56	X 2.5
Milk, fresh	5.99	17.95	Tripled

Emission reduction options

- Nutrient use optimisation: fertiliser applications; breeding crops for better N use efficiency
- Build soil carbon stocks
- On farm energy efficiency
- Anaerobic digestion
- Managing the diet: feed inputs*, grass breeding
- Animal genomics & breeding* for: longevity, fertility, low methane, productivity

*2nd order impacts?

Cereal/ oilseed inputs and land use change

Animal welfare implications

Biodiversity

Even if technological improvements could reduce livestock impacts by 50%

- (*and this is ambitious*)
- We wouldn't have a *reduction* in GHG emissions – just no increase
- Reduction in consumption needed too
- But by how much?

If yr 2000 PRODUCTION levels were maintained

- At 9 billion people this would mean:
  - Meat: 25 kg year (500g/week)
  - Dairy: 53 kg a year (a litre a week).
- Similar to developing world average today.
- Chinese and UK consumpton levels today
  - Meat: 60kg China; 84.5kg developed world
  - Milk: 18kg China; 221kg developed world

3. Climate change & human nutrition

The relationship

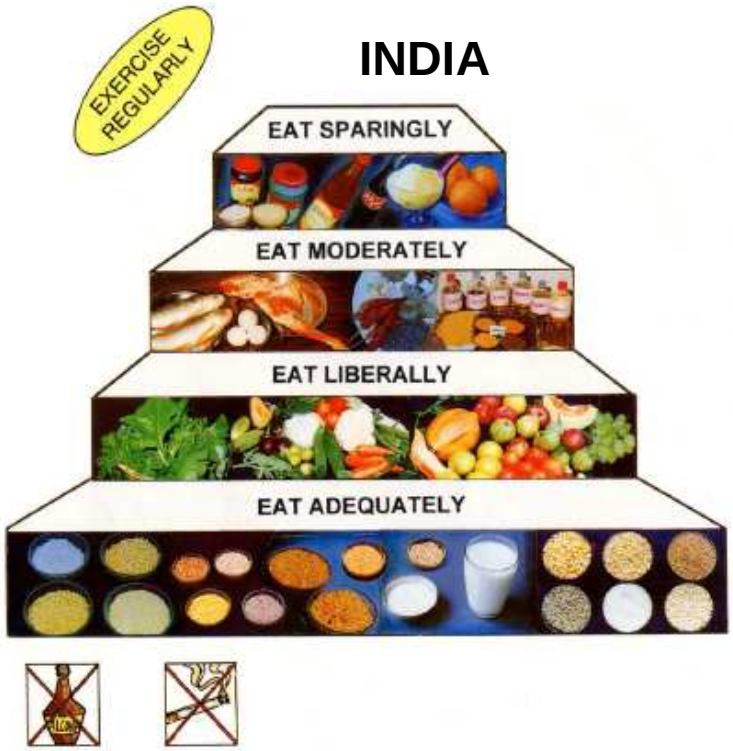
Health: Are nutrition and GHG reduction goals compatible?

What is a healthy diet according to the :World Health Organisation?

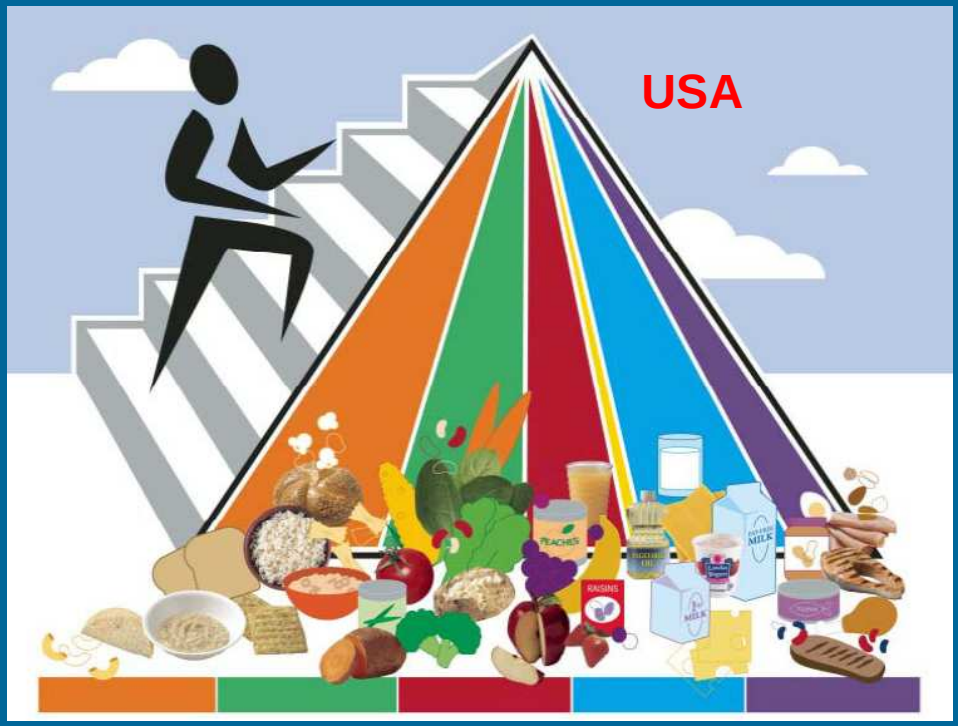
Food category	WHO daily nutritional recommendations
Fruit and vegetables	>400 g a day
Overall fat	15–30%
Saturated fat	< 10%
Protein	0.83 g/kg/day. For an average 65 kg British woman this is 53.95 g. For an average 80 kg man this is 66.4g.
Iron	8.7 mg (men) and 14.8 mg (women)
Calcium	700 mg – more for some population groups
Vitamin B12	1.5 μg

The Balance of Good Health

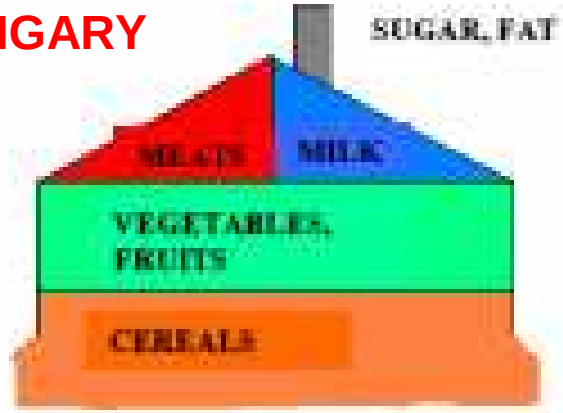
INDIA



USA

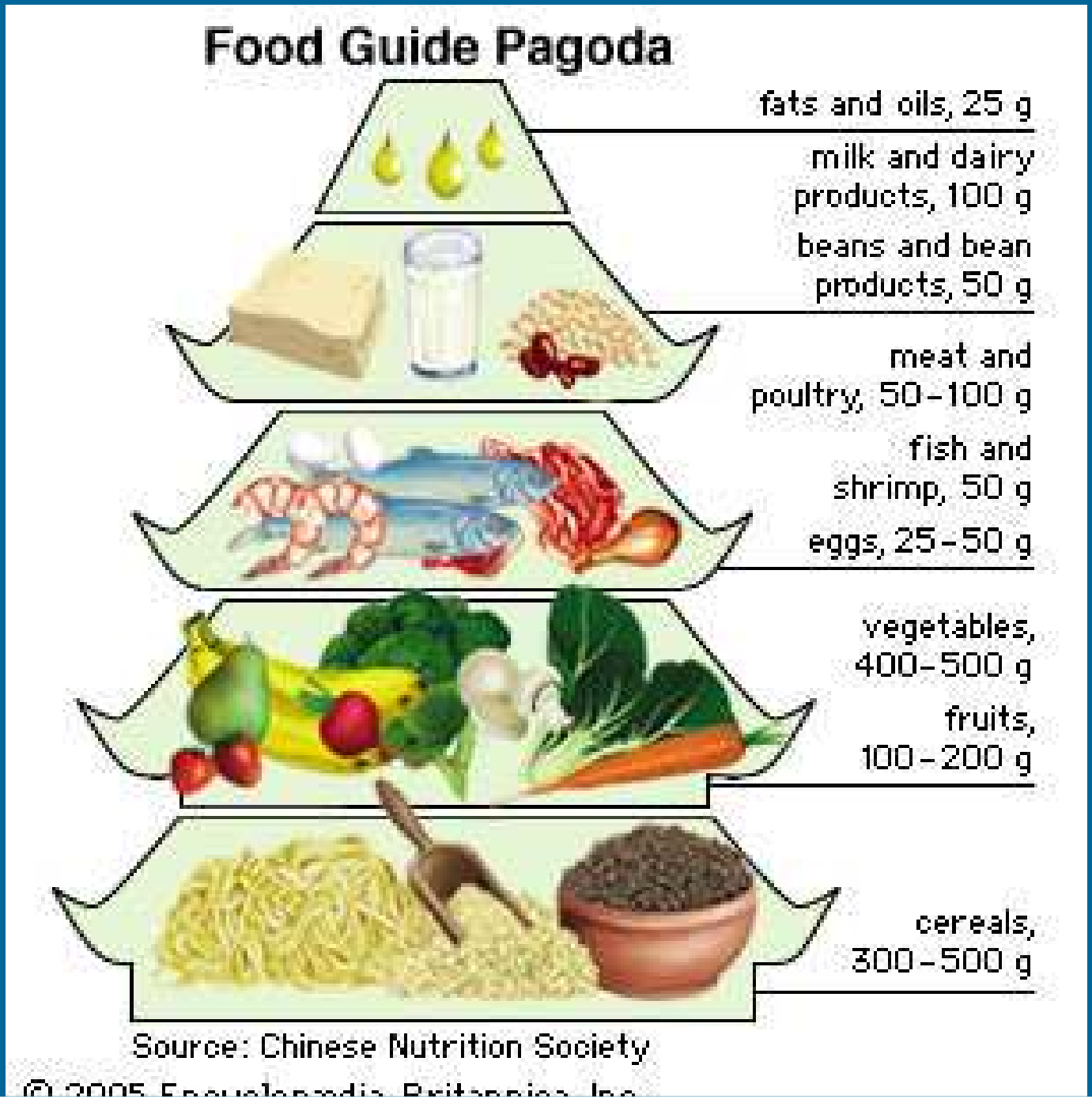


HUNGARY

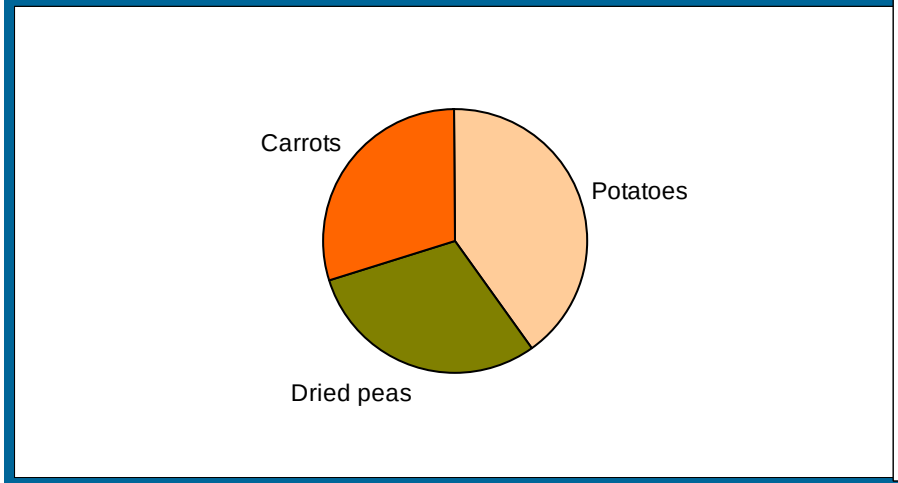


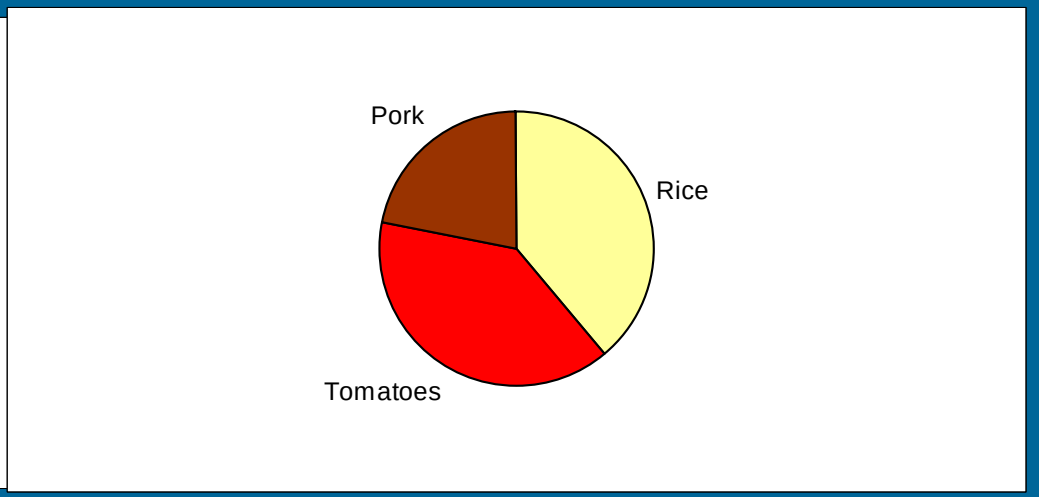
MALAYSIA

CHINA


Food Guide Pagoda
fats and oils, 25 g
milk and dairy products, 100 g
beans and bean products, 50 g
meat and poultry, 50–100 g
fish and shrimp, 50 g
eggs, 25–50 g
vegetables, 400–500 g
fruits, 100–200 g
cereals, 300–500 g
Source: Chinese Nutrition Society

Two nutritionally balanced meals… A ninefold GHG difference





Health AND environment policy approach or health VERSUS environment?

The nutrition challenge

- The rich: Less meat, less fat, less sugar; more grains & veg – *win-win for health & environment*
- The poor: Develop food production systems that *maximise nutrition at minimum GHG cost*
  - Some livestock products nutritionally useful for vulnerable groups
  - role for area-specific livestock production
- Need to integrate nutrition/CC policy

4. Reducing food's GHG contribution:

Technological and managerial improvements

Changing what and how we eat

Technological options?

- Agriculture: plant breeding; better nutrient use; alternative fuel sources for protected cropping; anaerobic digestion; improved efficiency
- Manufacturing: CHP / trigeneration / life cycle costing
- Refrigeration: 20-50% efficiency savings possible; novel technologies including non HFC refrigeration, trigeneration (increases efficiency from 38% to 76%).
- Packaging: lightweighting, alternative materials, ambient storage packaging

Technology continued...

- Transport: modal shift, efficient supply chains; cleaner fuels (in future years)
- Retailing: Massive potential for improved lighting,heating and refrigeration efficiencies; on site renewables
- Domestic: energy efficient appliances; smart metering
- Lots of little impacts/solutions rather than one big one

But

- Will this get the UK to an 80% cut by 2050?
- (And is 80% possible for food?)
- What we choose to eat dictates what we
- choose to grow / rear ... and so...
- Agricultural emissions driven by patterns of food demand.
- Post farm gate emissions influenced by
- energy policy

What might a less GHG intensive way of eating look like?

- Less meat and dairy – more plant based foods
- Seasonal field grown foods (less storage, heating & transport)
  - Local /regional seasonal when possible
- Not eating certain foods
  - Avoiding hothoused/air freighted produce (although trade offs with support for developing world

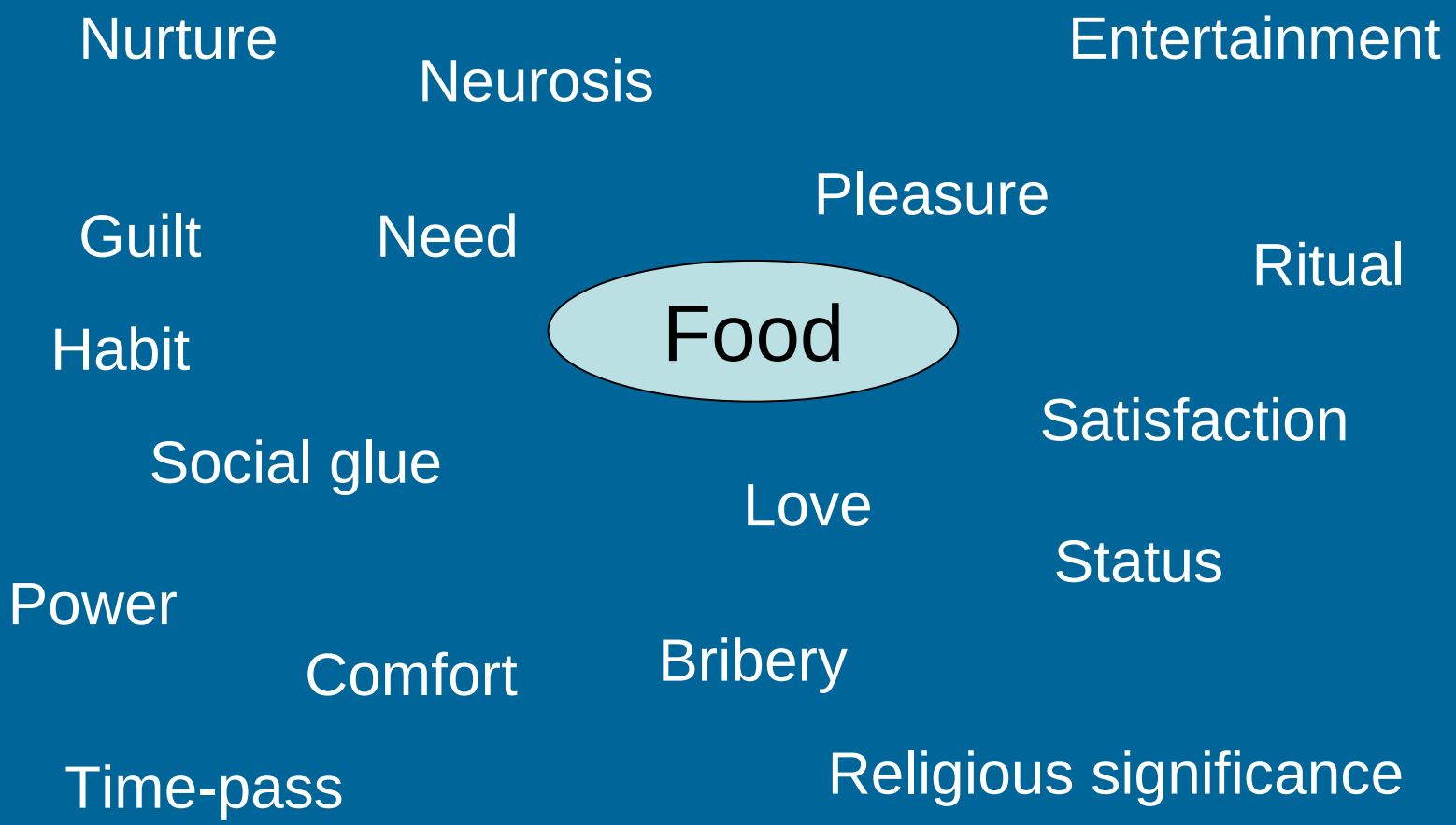
Less GHG intensive eating

- Reducing dependence on refrigation (while avoiding waste)
  - Robust foods (including less processed)
  - Frequent non car based shopping
- But wasting less
  - Eat what we buy, soon after we've bought it
  - Accepting variability of quality and supply
- Efficient cooking
  - Cook for more people and for several days; less oven use
- Redefining quality
  - Accepting different notions of quality
  - Accepting more variability /non availability

How?

Life is complicated and
food is a complex part of life

Food and its meanings



Influenced by wider forces

- Price / affordability
- Availability
- Time
- Culture, social & family expectations, norms, aspirations
- Knowledge, information, fashions & beliefs (education, media, marketing)
- Demographic changes: (In UK: ageing population, single person society, wealth
- Technological innovations (eg. Ready meals, instant foods)
- Season
- Tastes
- Habits

How far can we expect people to change voluntarily?

- Information necessary but not enough
- Information may not lead to action
- People won't change unless they have to
- Govt and industry must take the lead and change the context of consumption:
  - Pricing
  - Other incentives/ incentives
  - Choice editing
  - Regulation

5. What is the food industry doing?

Food industry initiatives: manufacturers

- Sustainable Agriculture Initiative (Nestle, Unilever, Danone, Kraft etc.): dairy footprinting work
- UK ‘milk road map’ -20-30% cut in CO2e by 2020 – aspirational only
- Tate & Lyle (sugar): biomass boiler to replace 70% fossil energy
- McCain's (processed potato products): up to 70% electricity needs from renewables including wind turbines and CHP plant running on biogas
- Cadbury’s (confectionary): 50% absolute cut in carbon emissions by 2020

Food industry initiatives: supermarkets

Tesco:

- Label and reduce air freighted produce
- 50% energy cut in stores and DCs by 2020
- £100 million renewables fund
- £25 million Sustainable Consumption Institute
- Halve distribution emissions / case in 5 yrs

Govt-industry action on life cycle emissions

- Measurement of GHG emissions; PAS 2050 – establishing the beginnings of a methodology
- Involving major retailers & manufacturers: Pepsi, Walkers, Unilever, Tesco, Danone
- Labelling - international interest - Carbon Reduction Label – links with China
- Labelling NECESSARY (maybe) but not SUFFICIENT
- No supermarket has gone as far as taking high emission goods off the shelves

5. Observations & implications for circular agriculture

The global context

- Rising population – 9 billion by 2050
- High food / oil prices
- Dash for biofuels (now moderated in EU / UK)
- Nutrition transition: more animal source foods
- More wealthy people & more poor people
- Land pressures
- Climate change legislation...

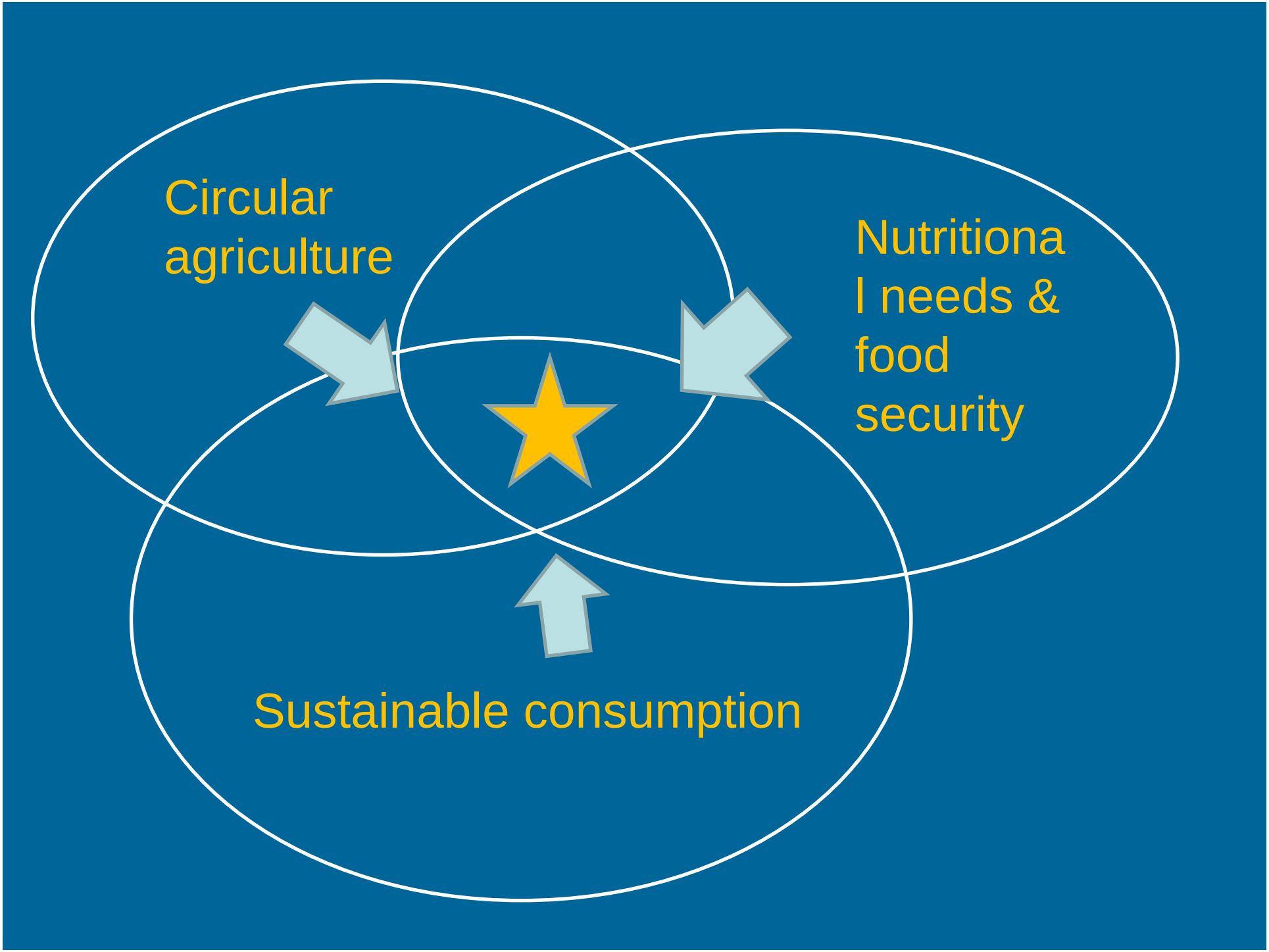
Food's GHG impacts

- Food contributes to a significant proportion of global GHG emissions
- All stages in the supply chain contribute to emissions
- Agriculture most significant stage / meat &dairy most GHG intensive food
- Global food demand is moving in more GHG intensive directions

- Technology unlikely to get us where we need to be
- Consumption changes needed too
- Food industry and government beginning to tackle problem but largely from ‘efficiency’ perspective

Implications for circular agriculture research & practice

- Circular agriculture only makes sense in the context of sustainable consumption and nutritional needs
- Not just how we grow or rear it but what we choose to grow or rear
- And how it links with our basic need for nutritious food


Circular agriculture
Nutritiona l needs & food security
Sustainable consumption

Research needs

- What level of livestock production is needed to maximise environmental benefits, minimise GHG costs and enhance nutritional wellbeing?
- What policies would encourage a shift away from consumption and production of livestock products?
- How to integrate nutritional and food CC reduction objectives?
- Challenges for China & UK wrt meat and dairy consumption increasingly similar
- Role for sharing experiences

6. About the Food Climate Research Network

The FCRN

Funded by UK research council & Defra

Based at Surrey University

Focuses on:

- Researching food chain contribution to GHG emissions and options for emissions reduction – technology, behaviour, policy
- Sharing and communicating information on food & climate change with member network

FCRN outputs

1. Five comprehensive studies so far:
    1. Fruit & vegetables
    2. Alcoholic drinks
    3. Food refrigeration
    4. Meat & dairy
    5. Synthesis paper: *Cooking up a Storm*
2. All at www.fcrn.org.uk

- Comprehensive website –see www.fcrn.org.uk
- Working seminars: To inform research
- Networking: To catalyse further research
- E-news: on food/GHGs to 1000+ members
- Please join...

Thank you

Tara Garnett
taragarnett@blueyonder.co.uk
www.fcrn.org.uk

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