Dr. Jude Capper
@bovidiva

Harper Adams University

Climate change, carbon and cows – what does it mean on the ground?

Dr. Jude L. Capper

1st June 2021

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Source: Dr. Jude L. Capper, 2021

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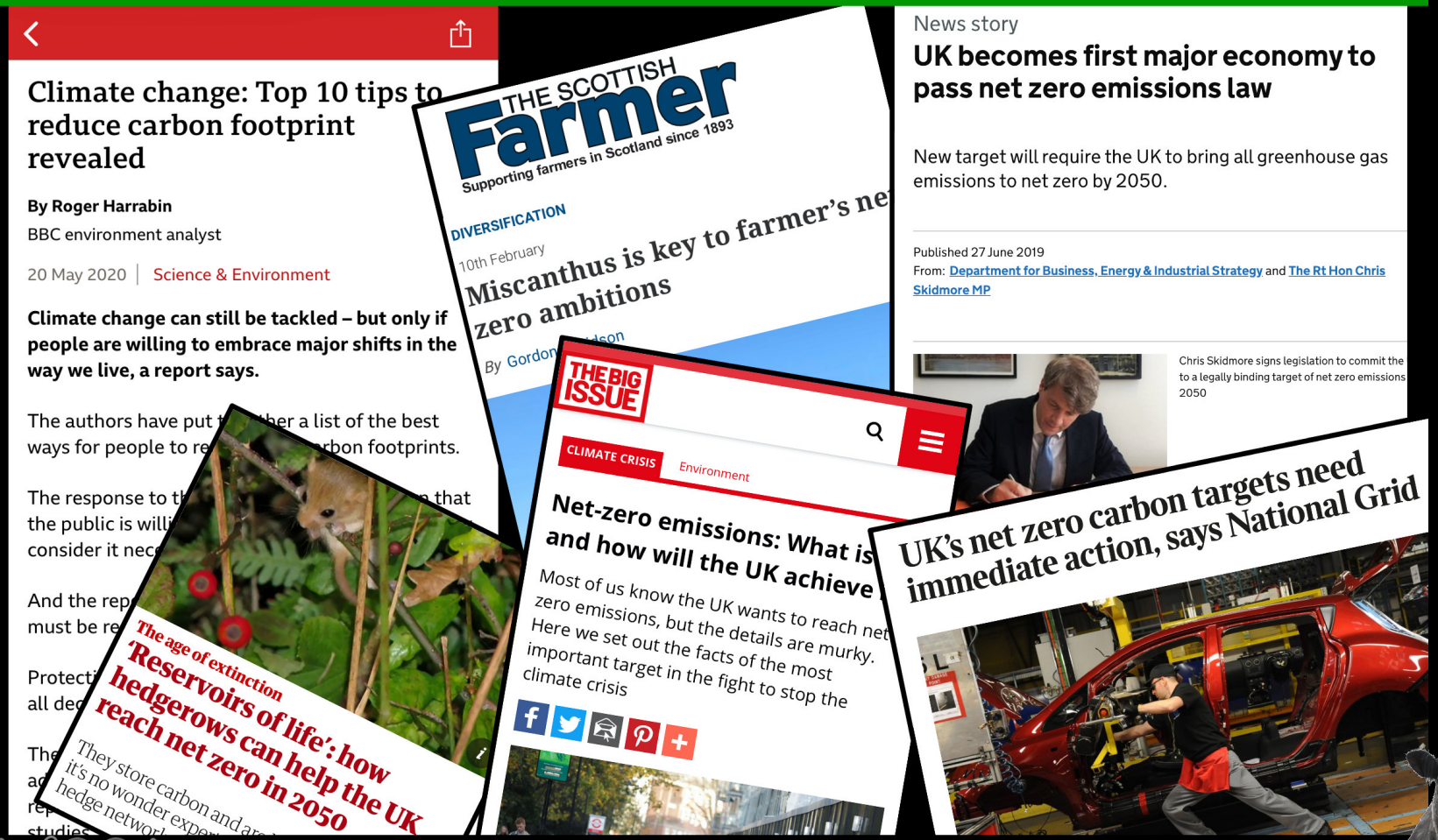
S

The UK government has pledged to reach net zero



Source: Created by Dr. Jude L. Capper, 2021; Screenshots from various publications.

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S

Committee on Climate Change aims to free 22% of agricultural land by 2050

Actions must be taken now...

- Increase **low-carbon farming practices** for soils & livestock.
- Increase annual tree-planting to between **90-120 million** trees, equivalent to 30,000 hectares per year.
- Use **10%** of farmland for agro-forestry.
- Restore at least **55%** of peatland area by 2050.
- Increase the use of land for energy crops to **23,000 hectares** per year.

Behaviour change is also needed:

Reduce beef, lamb and dairy consumption by **20%** per capita by 2050.

Reduce food waste by **20%** by 2030.

Source: Created by Dr. Jude L. Capper, 2021. Infographic from Committee on Climate Change (2020) : https://www.theccc.org.uk/wp-content/uploads/2020/01/Land-use-Policies-for-a-Net-Zero-UK-Infographic.pdf

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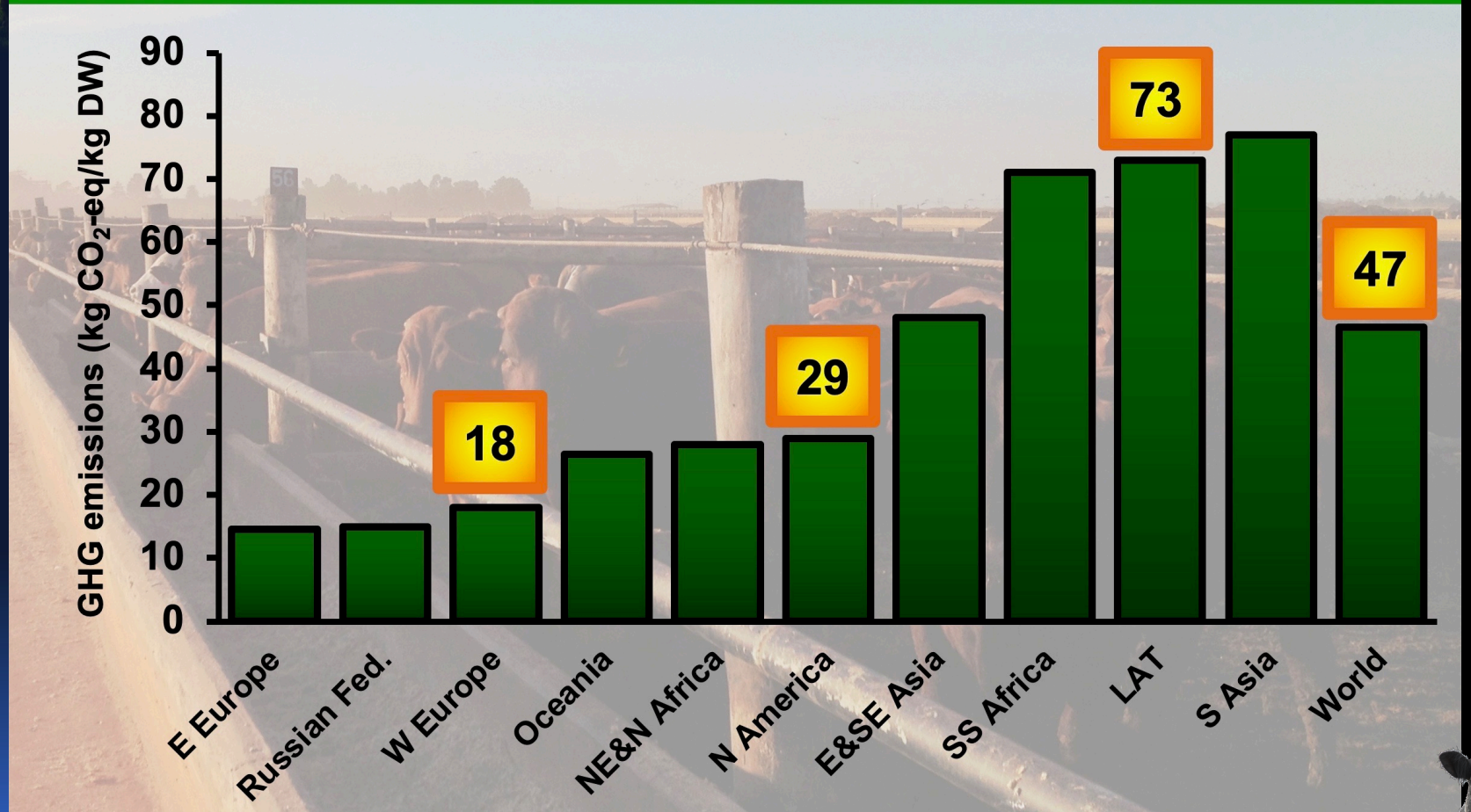
B

The carbon footprint of beef production varies across the globe



Source: Created by Dr. Jude L. Capper, 2020; data from Gerber et al. (2013) Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. FAO, Rome, Italy.

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B

Improving animal productivity reduces the environmental impact of milk and meat

Total livestock
Total time

Land
Water
Fuel
GHG

Growth rate
Meat yield
Milk yield

£££

Source: Created by Dr. Jude L. Capper, 2020. Data from: Capper, JL. 2015. Sustainability and One Health. In: Cockcroft, P. *Bovine Medicine.* Wiley-Blackwell, Oxford, UK.

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B

Reducing age at slaughter has both economic and environmental benefits

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	27 mo	30 mo
Birth weight	40 kg	40 kg
Slaughter weight	670 kg	670 kg
Total gain	630 kg	630 kg
Age at slaughter	27 months	30 months
Daily liveweight gain	0.77 kg/d	0.69 kg/d
Maintenance feed needed	821 days	912 days

Source: Created as an example by Dr. Jude L. Capper, 2021.

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Reducing age at slaughter has both economic and environmental benefits

91 fewer days of feed, land and greenhouse gases. Opportunity cost?

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Source: Created as an example by Dr. Jude L. Capper, 2021.

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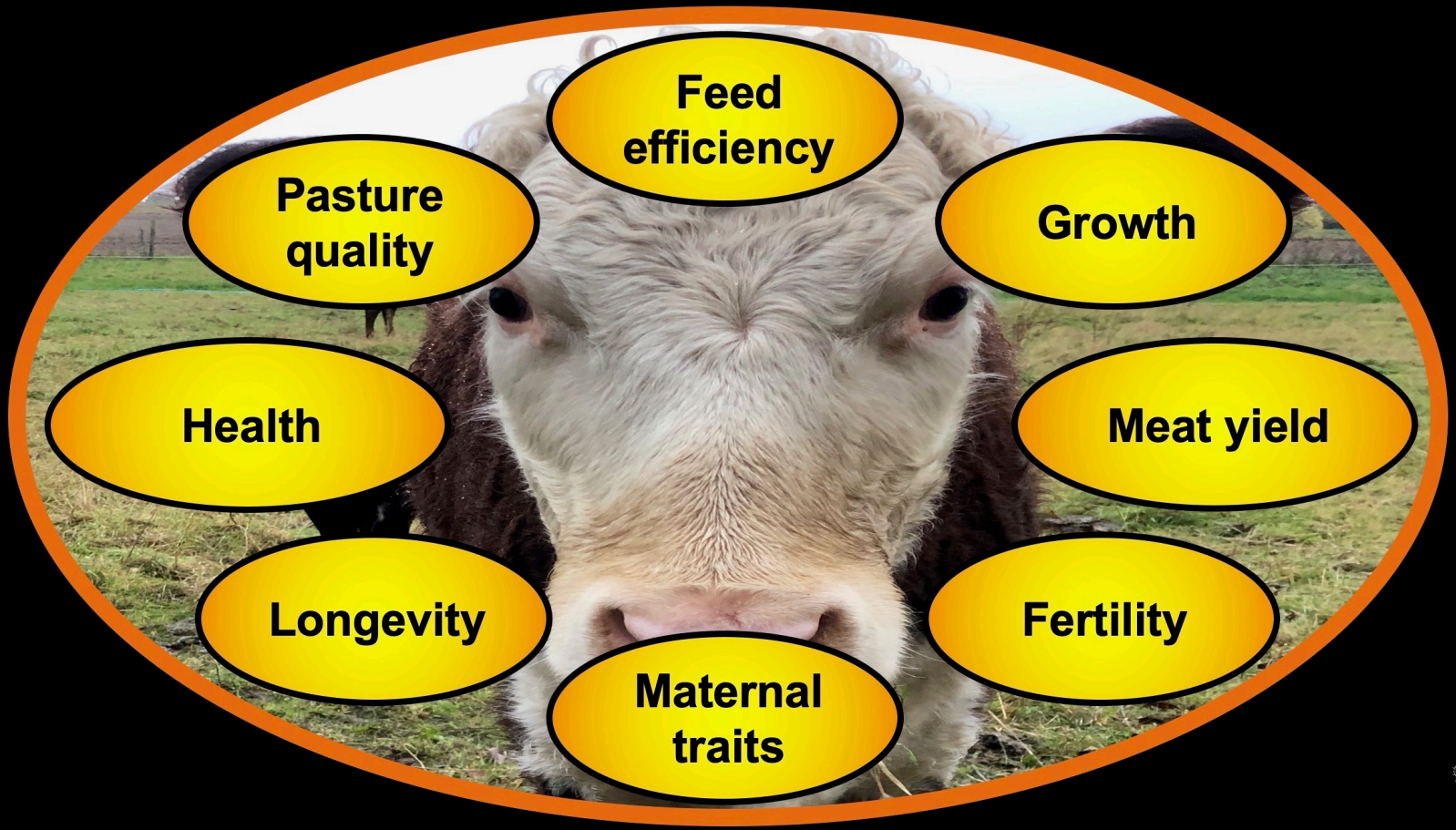
B

Improving key performance indicators reduces environmental impacts



Source: Created by Dr. Jude L. Capper, 2020

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D

Improving key performance indicators reduces environmental impact and economic cost

- Nutrition
- Reproduction
- Lameness
- Mastitis
- Metabolic disease
- Infectious disease
- Dry period length
- Age at first calving
- Antibiotic residues
- Feed wastage
- Pasture management

Source: Created by Dr. Jude L. Capper, 2020

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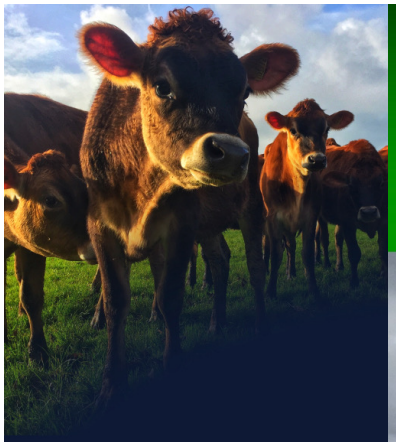

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D

What could global dairying look like if we improved health, nutrition and genetics?

Global average yield	UK average yield	Dairy cows
2,577 kg	8,140 kg	-181 million

If all dairy cattle had UK yields, global milk supply could be maintained using 181 million fewer cows (69%).

At US average yields, 200 million fewer cows (75%)

Source: Created by Dr. Jude L. Capper, 2020. Data from: FAOSTAT (2020) http://www.fao.org/faostat/en/

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B

All components of the carbon cycle must be accounted for

CH_4 N_2O CO_2

Source: Created by Dr. Jude L. Capper, 2021.

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All components of the carbon cycle must be accounted for

CH_4

N_2O

CO_2

Photosynthesis

C in grass

Cattle respiration

Source: Created by Dr. Jude L. Capper, 2021.

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B

All components of the carbon cycle must be accounted for

CH_4

N_2O

CO_2

C in soil

Photosynthesis

C in grass

Cattle respiration

Source: Created by Dr. Jude L. Capper, 2021.

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B

All components of the carbon cycle must be accounted for

CH_4

N_2O

CO_2

Enteric fermentation

Fuel

C in soil

Photosynthesis

Manure

Cattle respiration

C in grass

Source: Created by Dr. Jude L. Capper, 2021.

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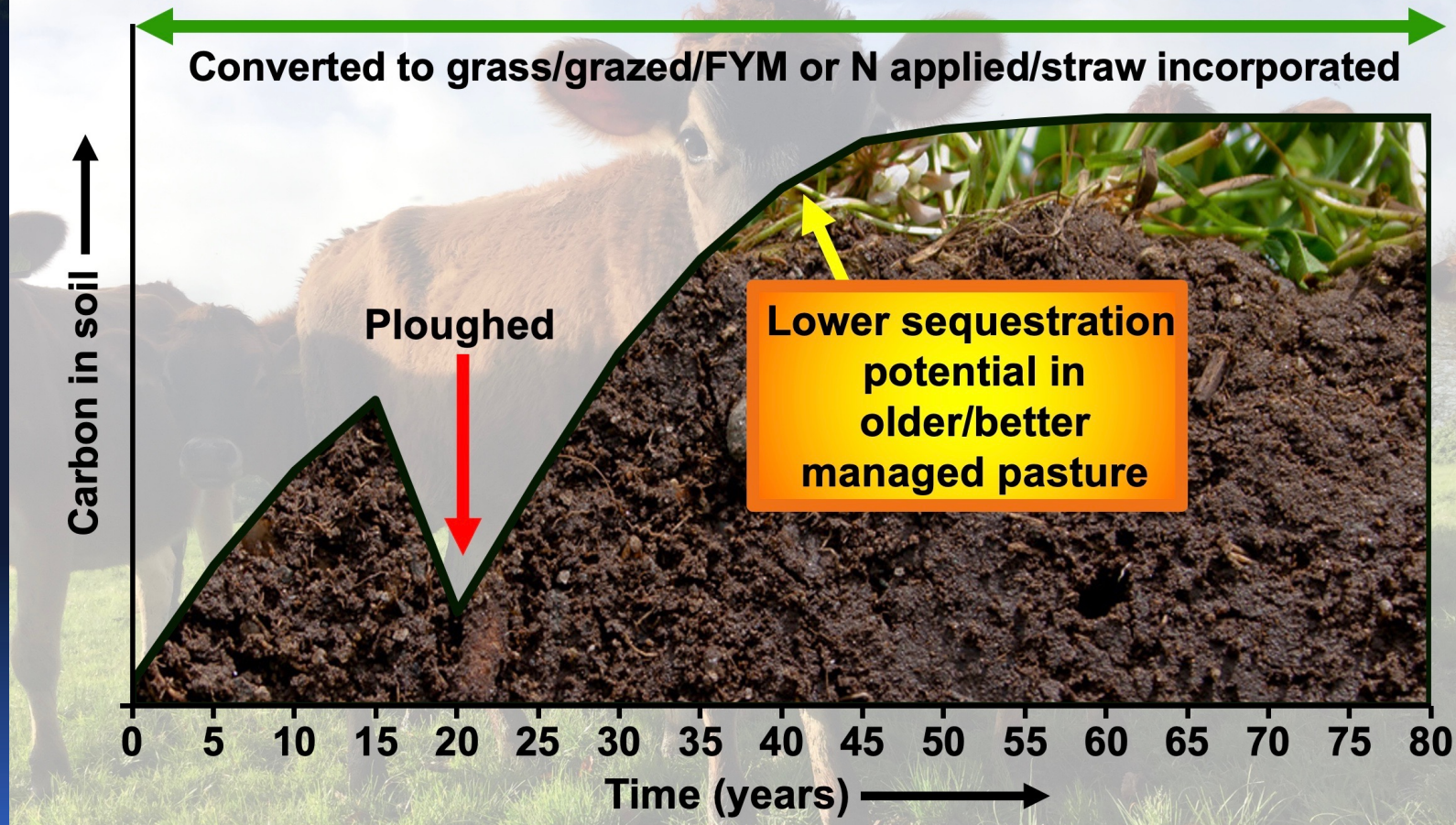
Carbon sequestration offers promise – but isn't a magic bullet



Source: Created by Dr. Jude L. Capper, 2020 as an example of soil carbon sequestration. Data from: Poulton et al. (2017) *Global Change Biology.*

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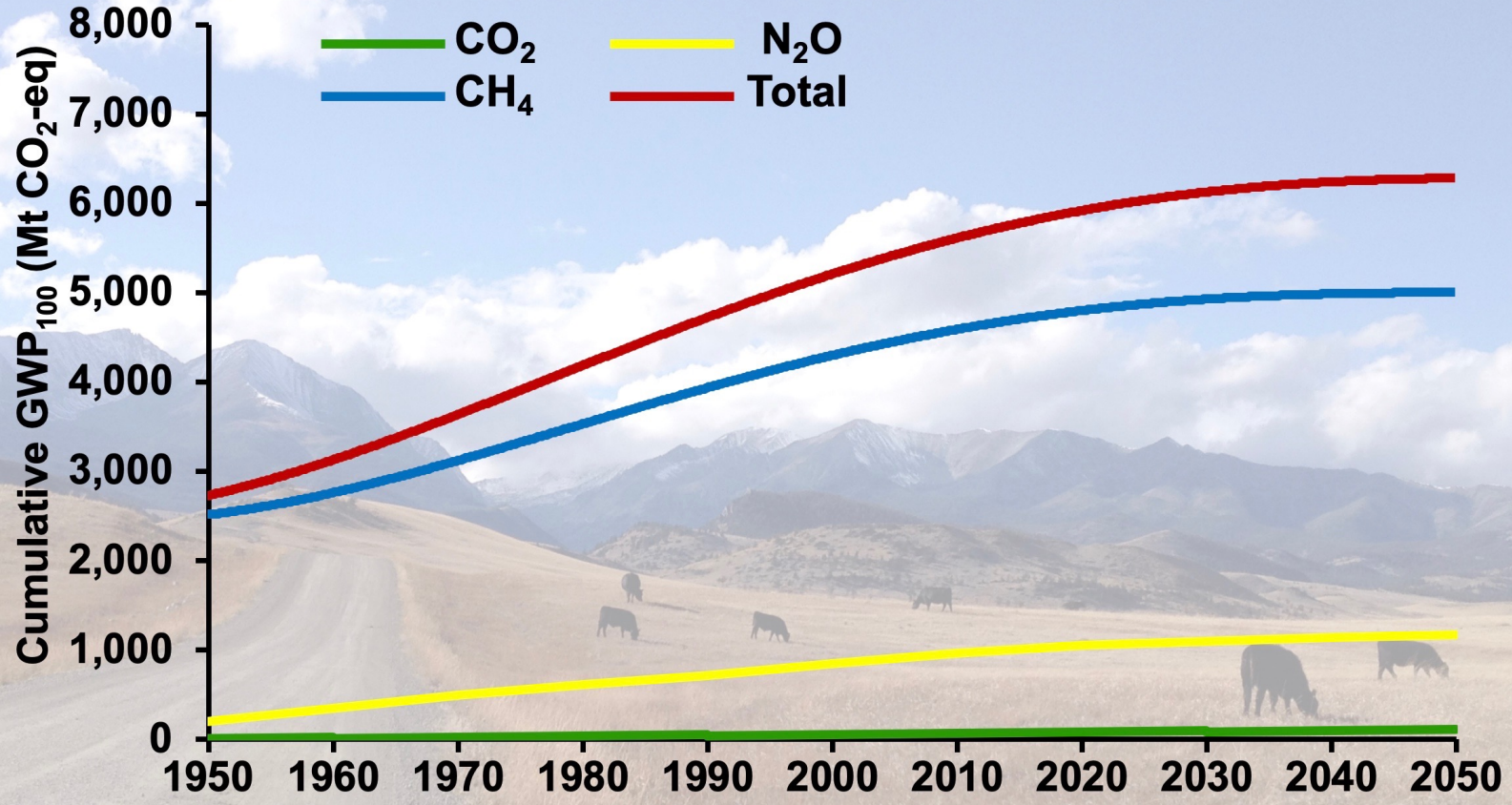
Under GWP_{100}, methane is a major contributor to global warming



Source: Created by Dr. Jude L. Capper, 2020. Graph adapted from Allen et al. (2019) Agricultural Emissions on a Path to Net Zero. Available at: https://www.slideshare.net/Sustainablefoodtrust/myles-allen-154983406

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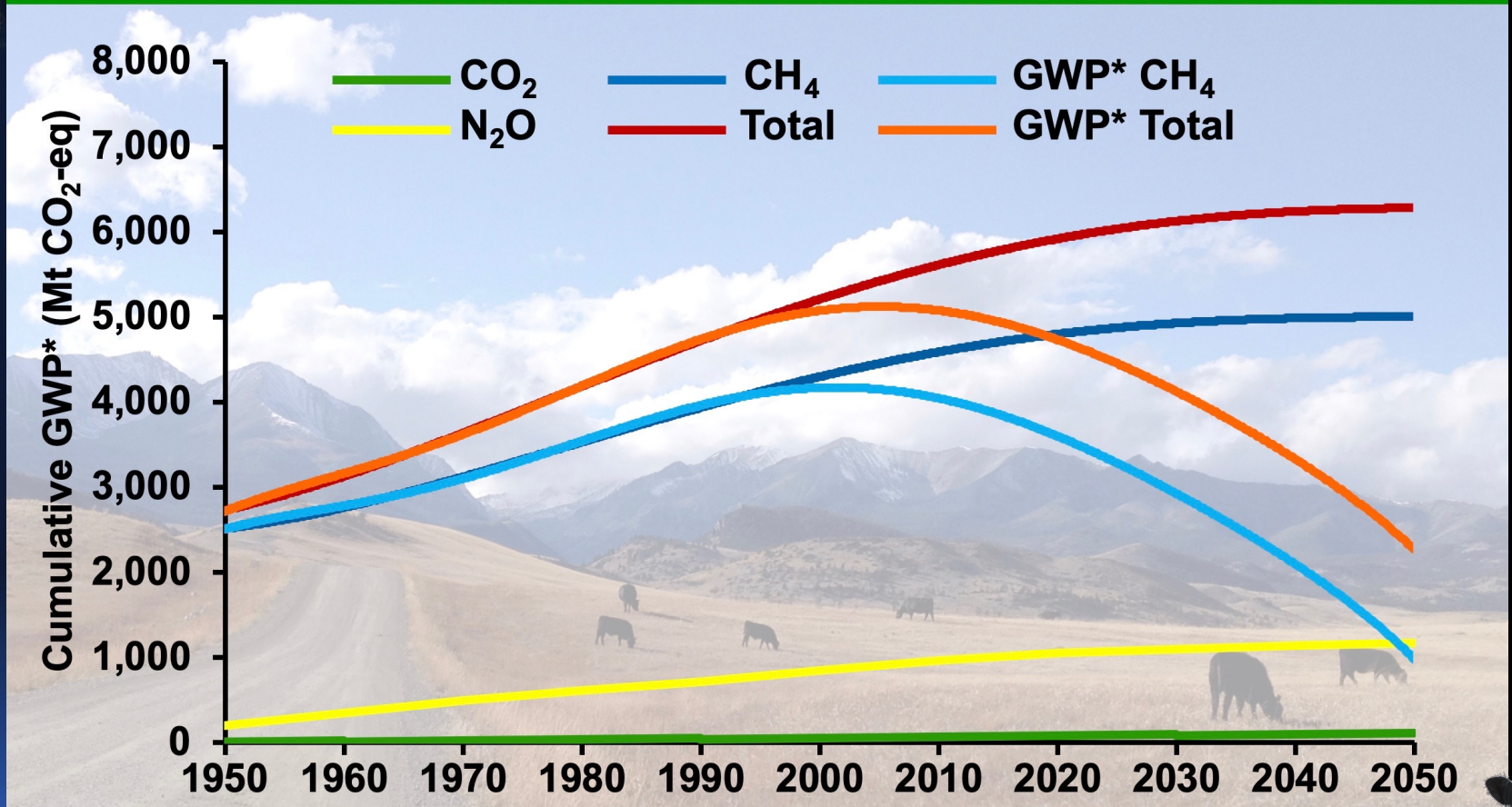
Under GWP*, methane actually contributes to global cooling



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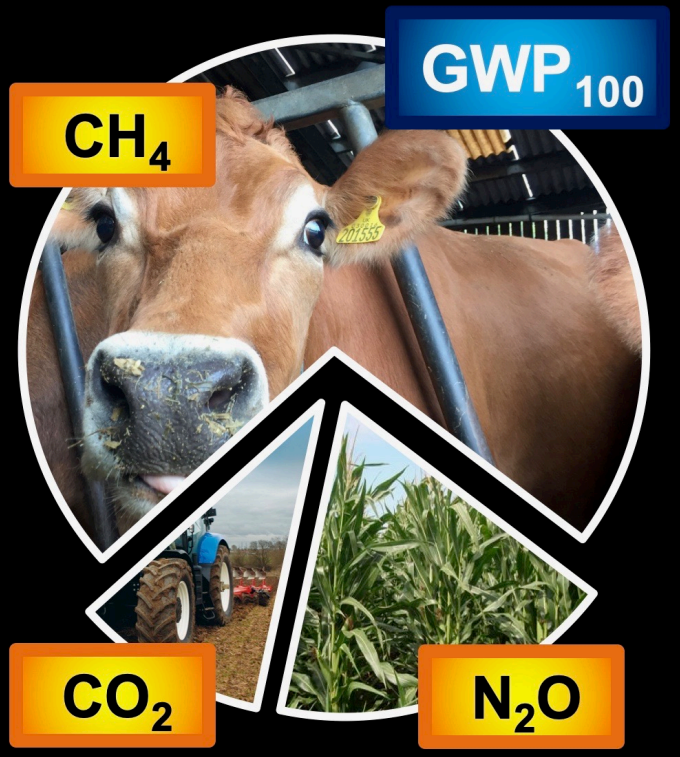
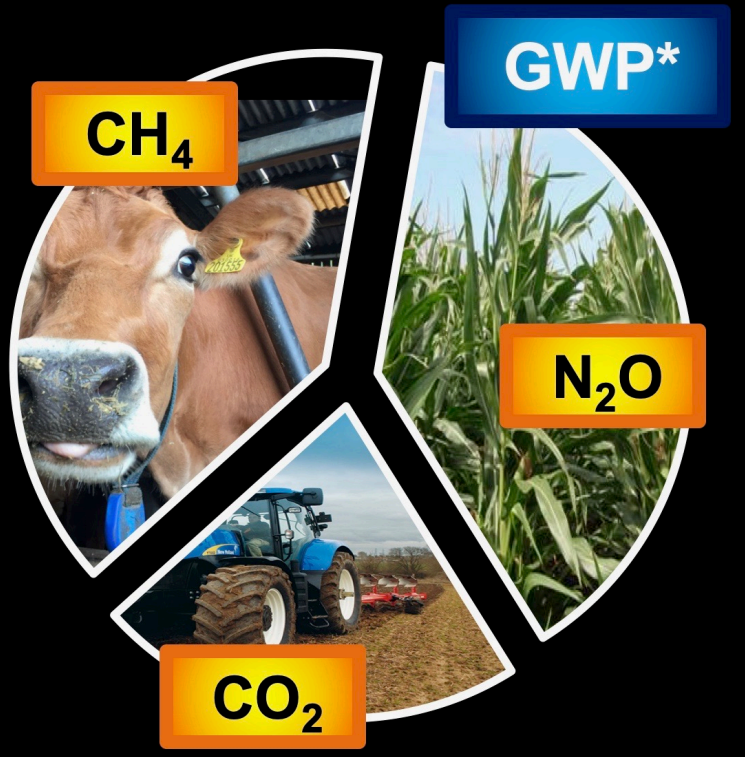
Under GWP*, the carbon footprint of dairy would be considerably reduced





GWP_{100} = 1.08 kg CO_2/kg milk

GWP* = 0.43 kg CO_2/kg milk

Source: Created by Dr. Jude L. Capper, 2020. Calculation based on typical carbon footprint of UK dairy production.

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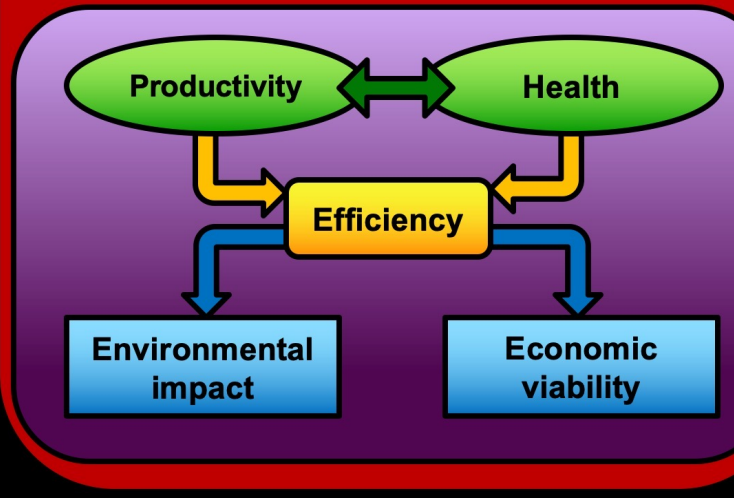
COM

Social acceptability and consumer trust are vital for sustainable livestock production

Social Acceptability



Sustainability

Source: Created by Dr. Jude L. Capper, 2020.

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B

Market share for plant-based meat/dairy alternatives is growing

Tesco sets 300% sales target for plant-based alternatives to meat

In UK first, supermarket's five-year commitment aims to offer more sustainable options

A 300% sales target is impressive… yet the magnitude of the results depends on the (2018) baseline

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Source: Created by Dr. Jude L. Capper, 2020. Screenshot from: The Guardian (2020). https://www.theguardian.com/business/2020/sep/29/tesco-sets-300-per-cent-sales-target-for-plant-based-alternatives-to-meat

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D

Is the rise in plant-based food sales related to consumer demand?

Lockdown preparations in local food hall indicate that dairy may be a priority for many panic-buyers

Source: Created and photo by Dr. Jude L. Capper, 202

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B

Nutrient composition must be considered when assessing environmental impact

Beef burger

Nutrition Facts

Serving size	(113g)
Amount Per Serving	
Calories	**220**
	% Daily Value*
Total Fat 14g	18%
Saturated Fat 5g	25%
Trans Fat 0g	
Cholesterol 60mg	20%
Sodium 70mg	3%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 23g	46%
Vitamin D 0.1mcg	0%
Calcium 12mg	0%
Iron 2mg	10%
Potassium 289mg	6%
Thiamin 0.05mg	4%
Riboflavin 0.2mg	15%
Niacin 4.8mg	30%
Vitamin B6 0.4mg	25%
Folate 6mcg	2%
Vitamin B12 2mcg	80%
Phosphorus 175mg	15%
Zinc 4.6mg	40%

Soy-based burger

Nutrition Facts

Serving size	(113g)
Amount Per Serving	
Calories	**250**
	% Daily Value*
Total Fat 14g	18%
Saturated Fat 8g	40%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 370mg	16%
Total Carbohydrate 9g	3%
Dietary Fiber 3g	11%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 19g	38%
Vitamin D 0mcg	0%
Calcium 180mg	15%
Iron 4.2mg	25%
Potassium 610mg	15%
Thiamin 28.2mg	2350%
Riboflavin 0.4mg	30%
Niacin 4.8mg	30%
Vitamin B6 0.4mg	25%
Folate 115mcg	30%
Vitamin B12 3mcg	120%
Phosphorus 180mg	15%
Zinc 5.5mg	50%

Pea-based burger

Nutrition Facts

Serving size	(113g)
Amount Per Serving	
Calories	**260**
	% Daily Value*
Total Fat 18g	23%
Saturated Fat 5g	25%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 350mg	15%
Total Carbohydrate 5g	2%
Dietary Fiber 2g	7%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 20g	40%
Vitamin D 0mcg	0%
Calcium 100mg	8%
Iron 4mg	20%
Potassium 280mg	6%

Source: Created by Dr. Jude L. Capper, 2021; data from van Vliet et al. (2020) Front. Sustain. Food Syst. https://doi.org/10.3389/fsufs.2020.00128

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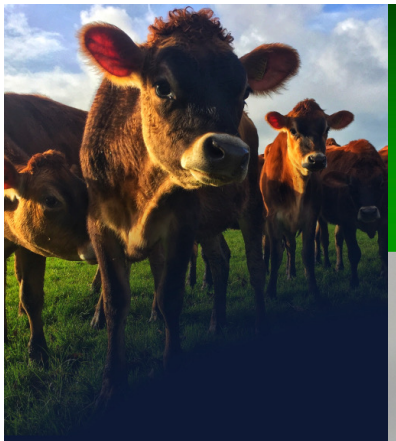
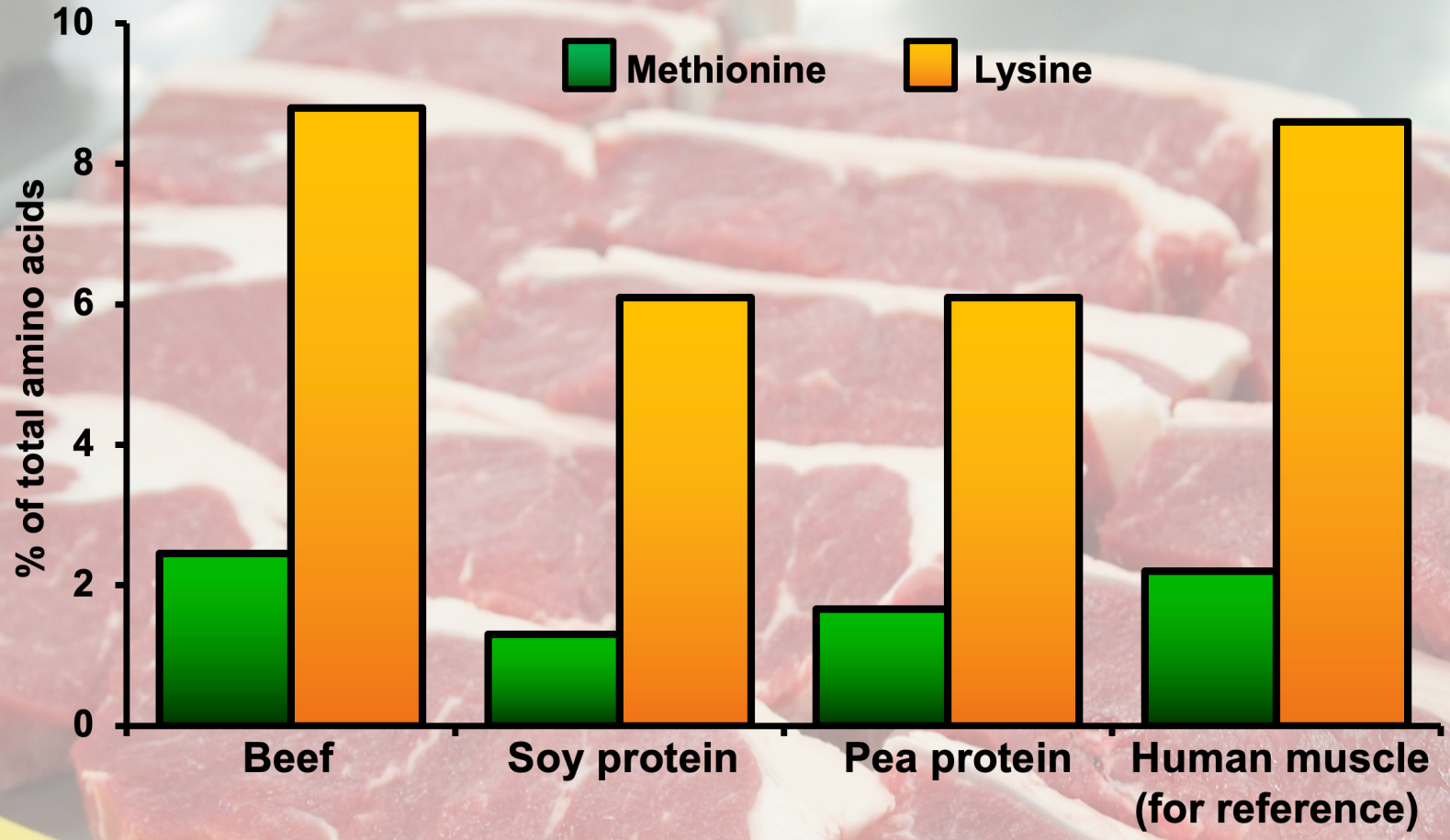


B

Essential amino acid content varies according to protein source



Source: Created by Dr. Jude L. Capper, 2021; data from van Vliet et al. (2020) Front. Sustain. Food Syst. https://doi.org/10.3389/fsufs.2020.00128

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S

All foods have an environmental impact

Source: Created by Dr. Jude L. Capper, 2013

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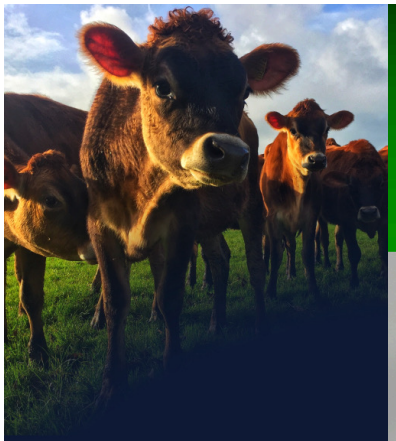

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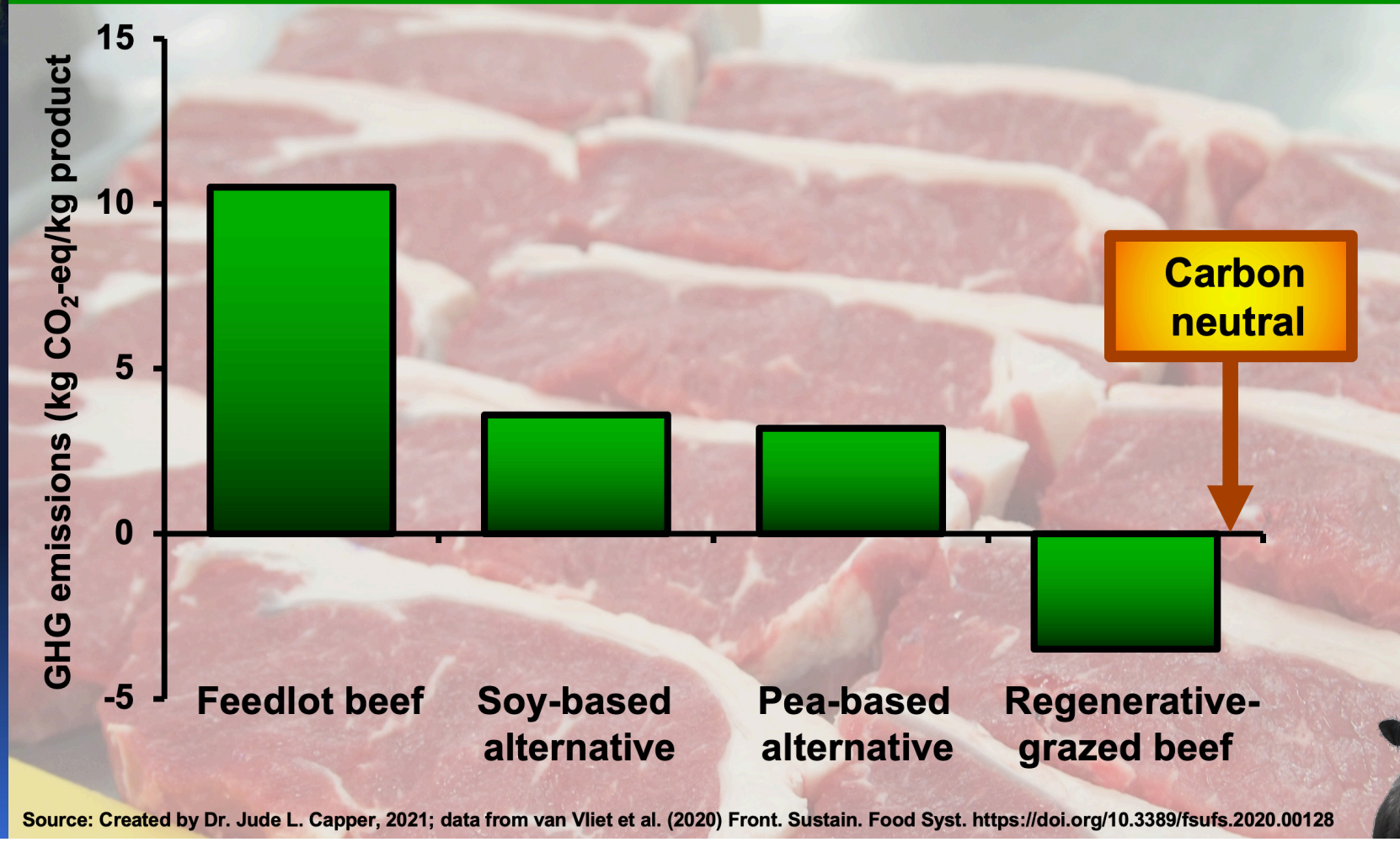
B

Greenhouse gas emissions from plant-based alternatives aren't necessarily lower than beef



Source: Created by Dr. Jude L. Capper, 2021; data from van Vliet et al. (2020) Front. Sustain. Food Syst. https://doi.org/10.3389/fsufs.2020.00128

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CV

New CREDS report puts transport, energy and food choices into context

Top 10 options for reducing your carbon footprint

1	2.04	Live car-free
2	1.95	Battery electric vehicle
3	1.68	One less flight (long-haul return)
4	1.6	Renewable electricity
5	0.98	Public transport
6	0.895	Refurbishment and renovation
7	0.8	Vegan diet
8	0.795	Heat pump
9	0.65	Improved cooking equipment
10	0.64	Renewable-based heating

CREDS

Source: Created by Dr. Jude L. Capper, 2020. . Infographic adapted from Centre for Research into Energy Demand Solutions (2020). Available at: https://twitter.com/CREDS_UK/status/1262984570175176704?s=20

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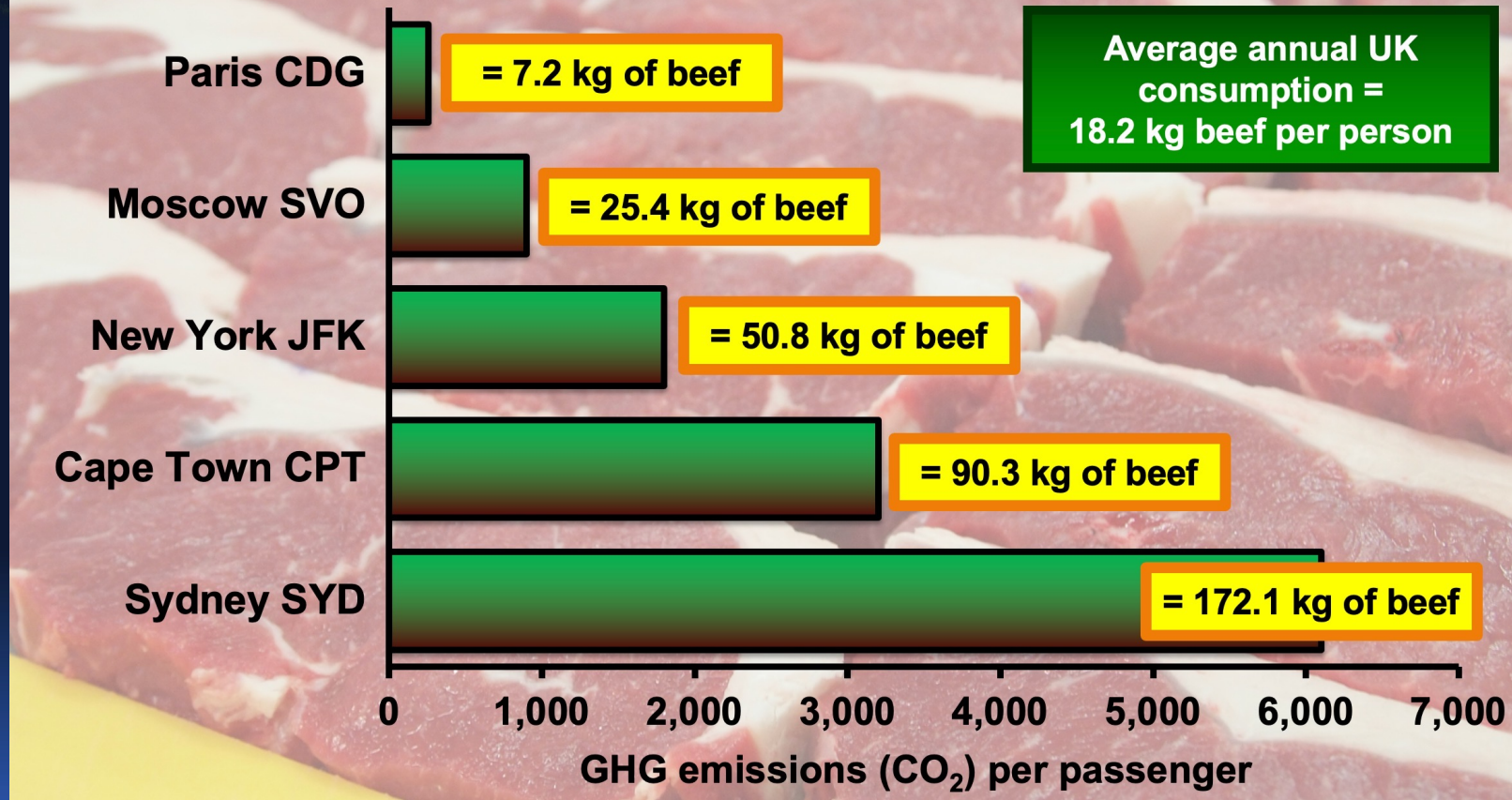
International flights emit considerable quantities of carbon compared to beef production



Source: Created by Dr. Jude L. Capper, 2020. Calculations based on GHG emissions flight data from: https://co2.myclimate.org/en/flight_calculators/new, and on a carbon footprint per kg of boneless beef of 35.5 kg CO2-eq (under GWP100) from AHDB: http://beefandlamb.ahdb.org.uk/wp-content/uploads/2013/05/p_cp_down_to_earth300112.pdf

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COM

Bad news bias – need five positive stories to cancel out each negative

We are programmed to believe bad news stories. Tidal wave of factual information needed to overcome them.

Source: Created by Dr. Jude L. Capper, 2020. Infographic from: https://www.pinterest.co.uk/pin/254383078939543245/

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LSC

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65% of UK land is not suitable for growing arable crops

Sustainable Protein Production Summit

Source: Created by Dr. Jude L. Capper, 2020. Grazing land includes temporary grass on arable land (6% of total), land used for outdoor pigs or non-agricultural purposes not shown (1.7% of total). Data from DEFRA. 2019. Farming statistics - provisional crop areas, yields and livestock populations at 1 June 2019 – United Kingdom.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/837834/structure-jun2019prov-UK-10oct19.pdf

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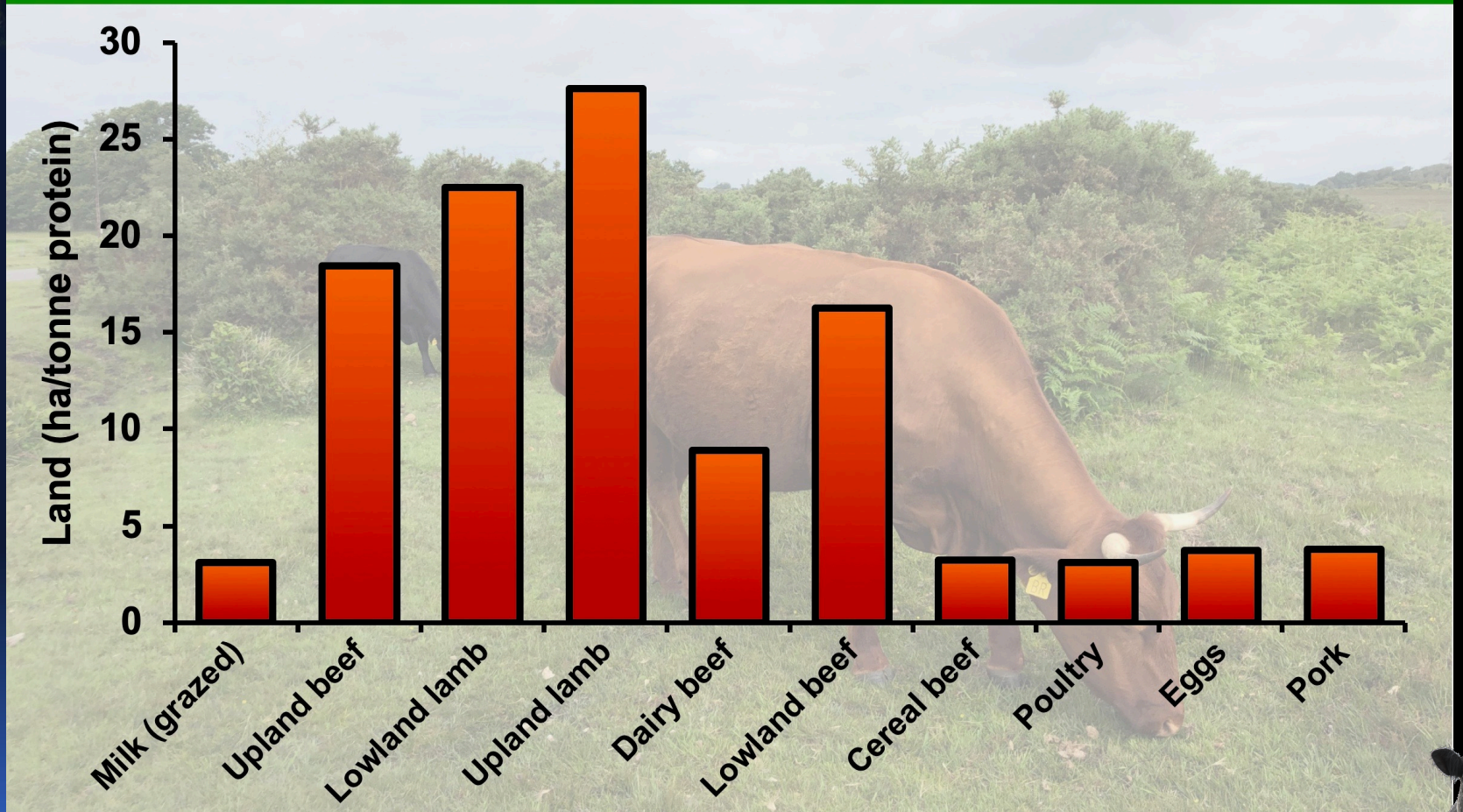
Livestock systems vary widely in land use



Source: Created by Dr. Jude L. Capper, 2020; data from Wilkinson and Lee (2018) Review: Use of human-edible animal feeds by ruminant livestock. *Animal.*

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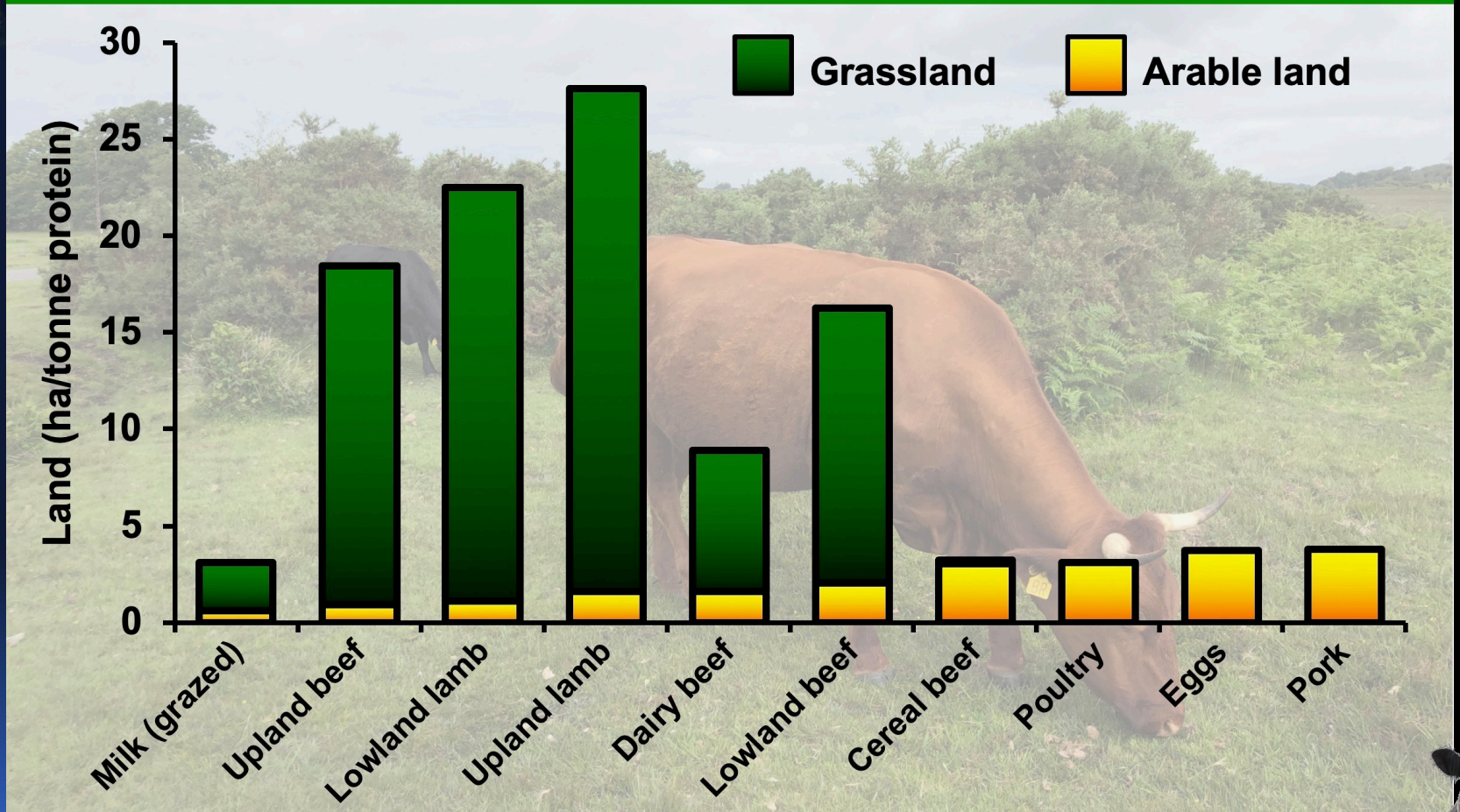
Livestock systems vary widely in arable and grassland use



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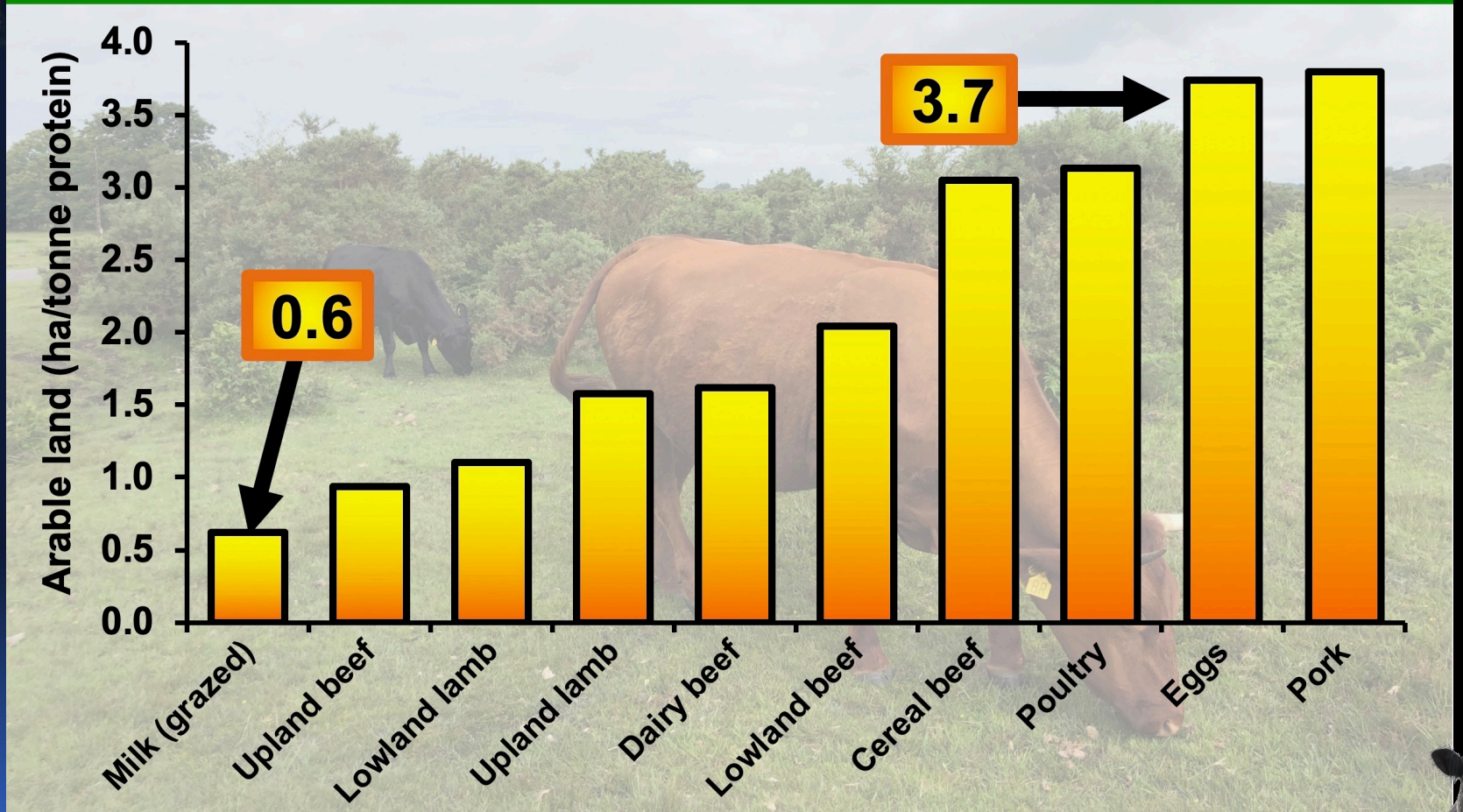
Livestock systems vary widely in arable land use



Source: Created by Dr. Jude L. Capper, 2020; data from Wilkinson and Lee (2018) Review: Use of human-edible animal feeds by ruminant livestock. *Animal.*

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What do these industries have in common?
They all provide by-products fed to animals

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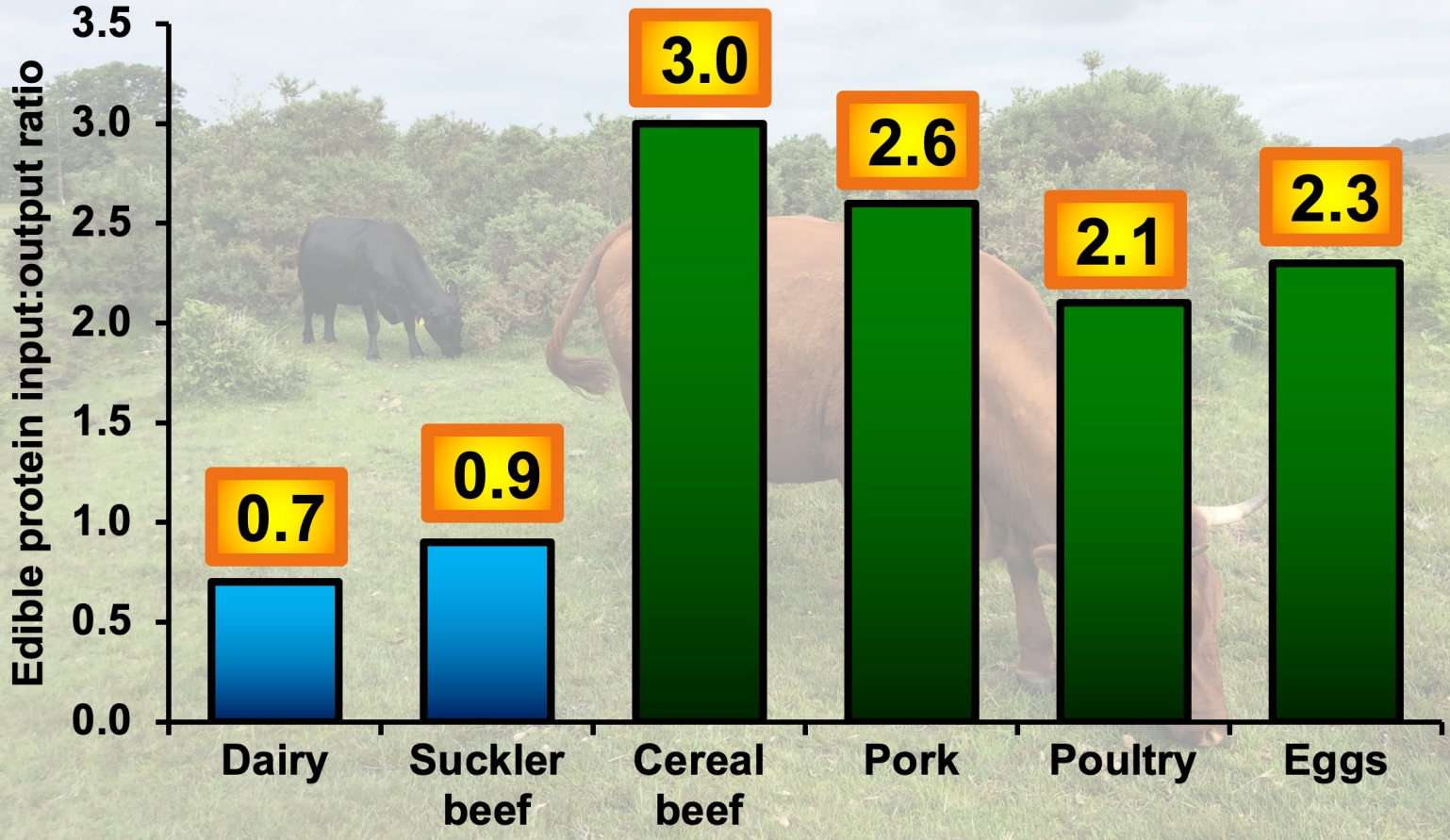
Grazing cattle systems produce more human-edible protein than they consume



Source: Created by Dr. Jude L. Capper, 2020; data from Wilkinson (2011) Re-defining efficiency of feed use by livestock. *Animal.*

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5 easy tips for positive communication

Share your values

Stay positive, polite and personal

Keep it short, simple and see-through

Focus on the important

Know when to walk away

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Source: Created by Dr. Jude L. Capper, 2019. Adapted from: Capper and Yancey. 2015. Communicating Animal Science to the General Public. *Animal Frontiers.*

B

Thank you!

jcapper@harper-adams.ac.uk

http://bovidiva.com/presentationlinks

Questions?

Source: Created by Dr. Jude L. Capper, 2020. Cartoon from: http://snipurl.com/methanecartoon

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