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Carbon footprint of fish from the New Zealand deepwater fishing fleet and from other New Zealand products

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Background

- Increased awareness of product environmental impacts, particularly on Climate Change
- Environmental labelling
- How does NZ fish compare with other meat and milk protein sources both in NZ and overseas?

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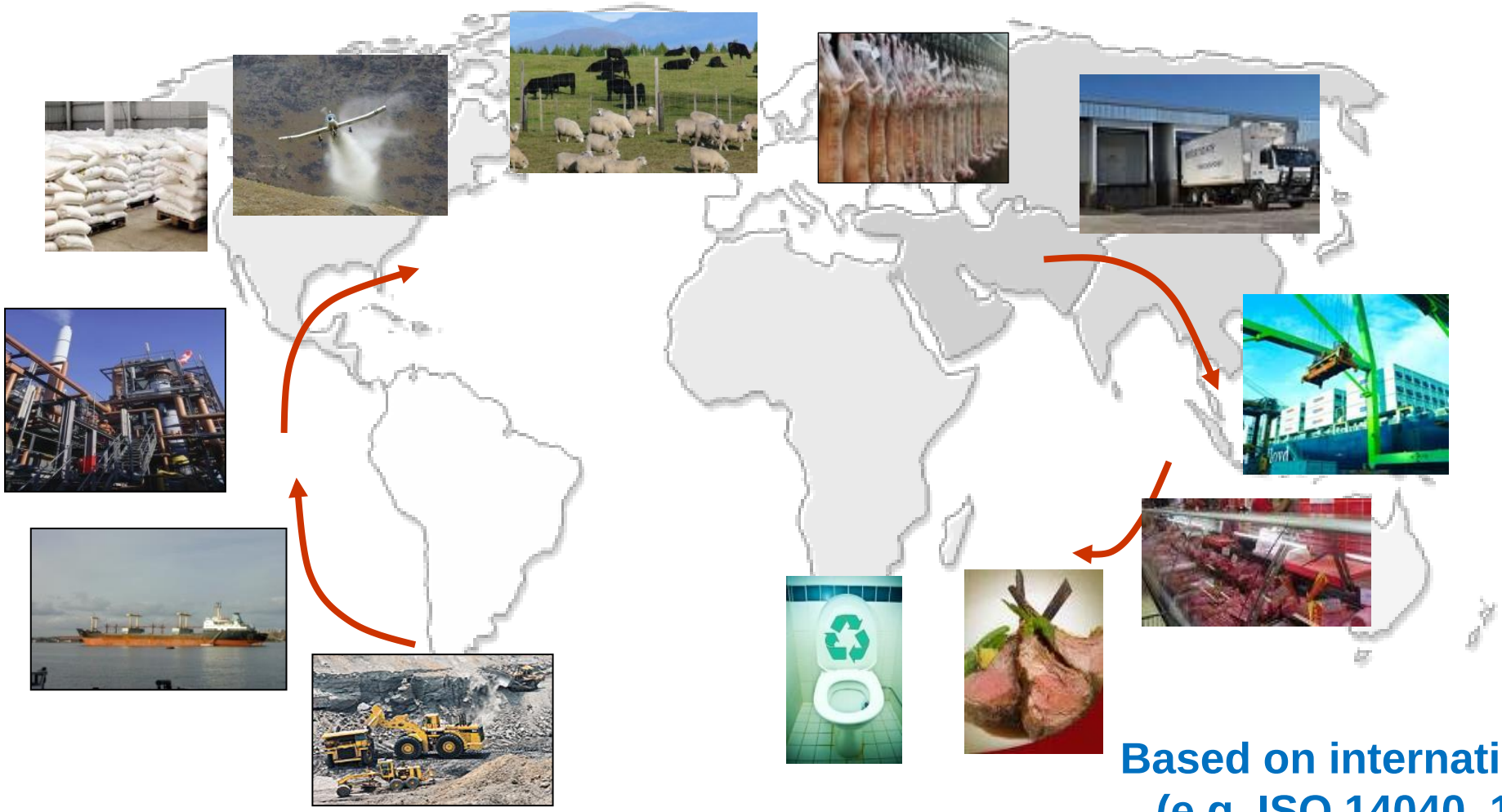
LCA = Total resource use or environmental emissions of a <u>product</u> from “cradle-to-grave”



Based on international standards (e.g. ISO 14040, 14044)

European Product Environmental Footprint (PEF)


Marine Fish PEFCR DRAFT - 06.09.2022

Product Environmental Footprint Category Rules (PEFCR) for unprocessed Marine Fish Products

Version: Draft v5 for Supporting Studies
Version date: 06.09.2022
Validity: Supporting Studies

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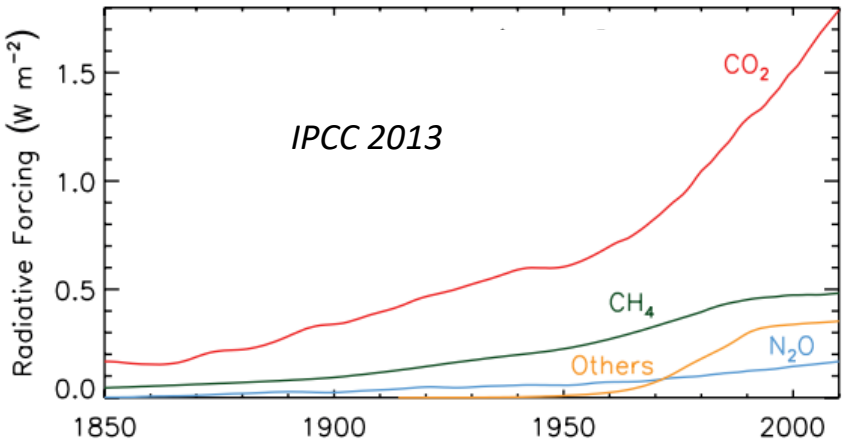
Functional units

- ‘Farm gate/wharf’: 1 kg live-weight, milk *or* 1 kg raw fish
- ‘Processor gate’: 1 kg meat, cheese *or* 1 kg edible fish
- 100 g protein

Greenhouse gases - impacts

Global Warming Potential 100-years in CO_2-equivalents (IPCC 2013)

- **carbon dioxide (CO_2) 1**
- **methane (CH_4) - fossil 30**
- **methane (CH_4) - biological 28**
- **nitrous oxide (N_2O) 265**
- **refrigerants e.g. R22 3960**



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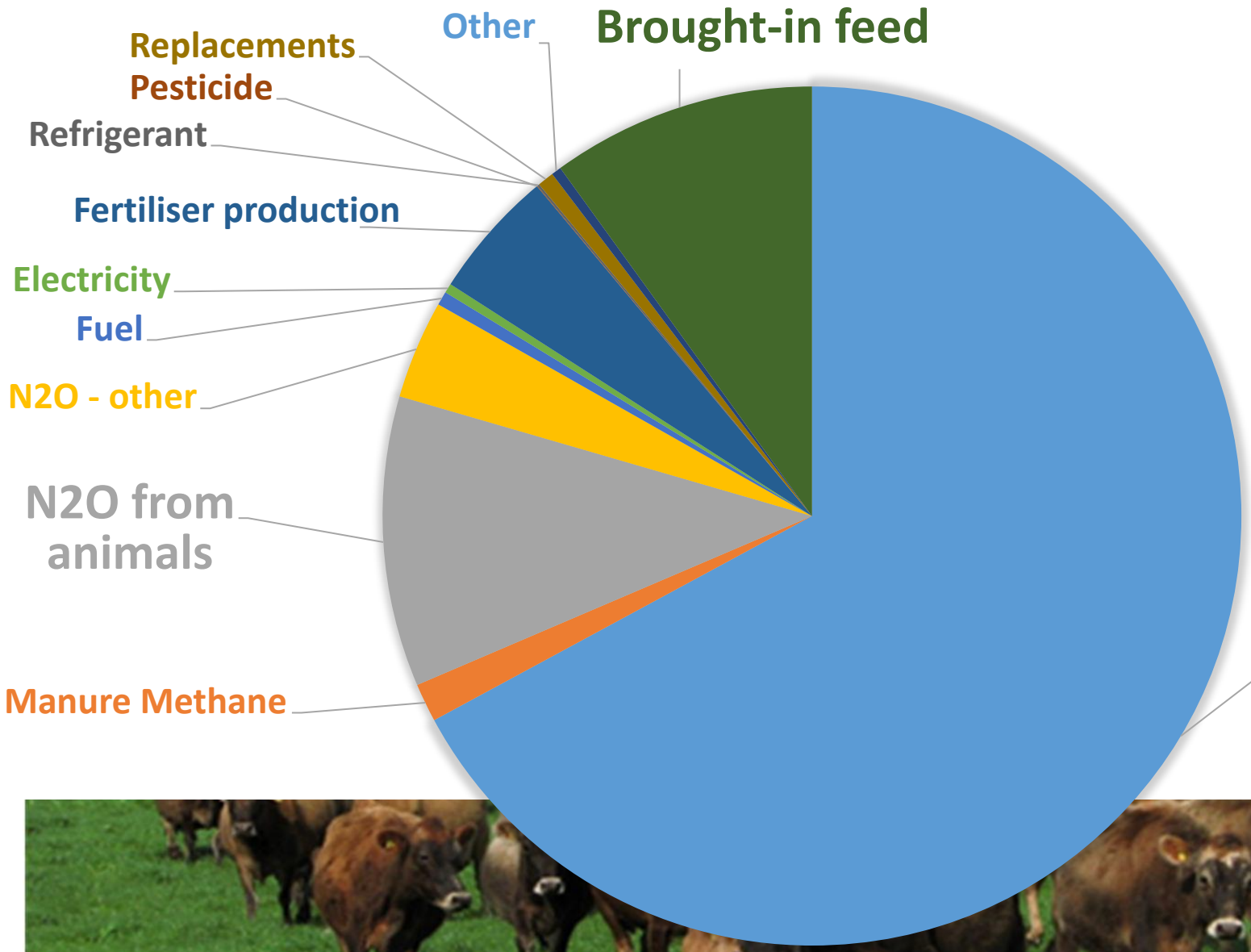
Dairy, sheep and beef carbon footprint studies, and learnings from them

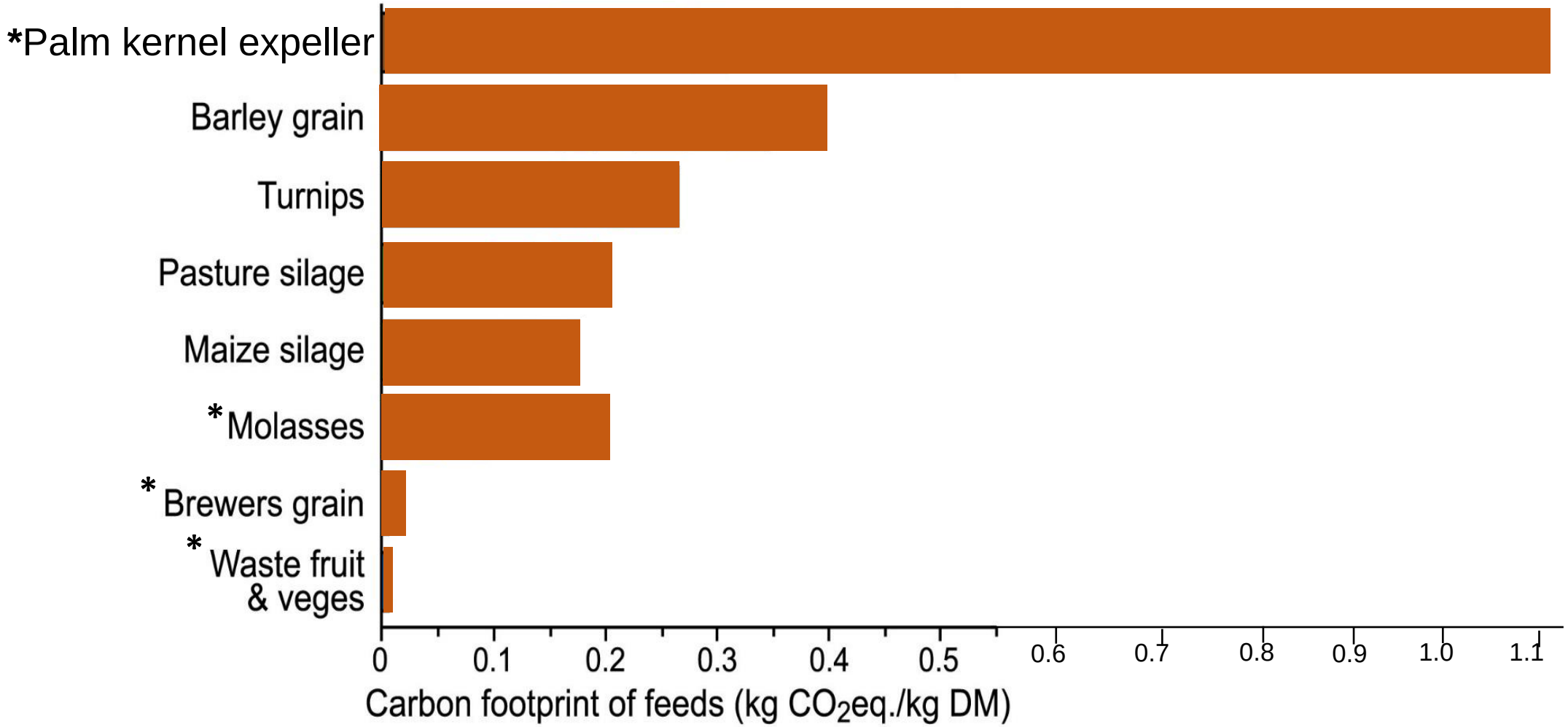
GHG sources for NZ average dairy farm (in CO_2-equivalents, GWP100yrs)



Top 4 contributors:

1. Enteric methane produced in the rumen 67%
2. N_2O from animals' urine and faeces 11%
3. Brought-in feed 10%
4. Fertiliser production 5%

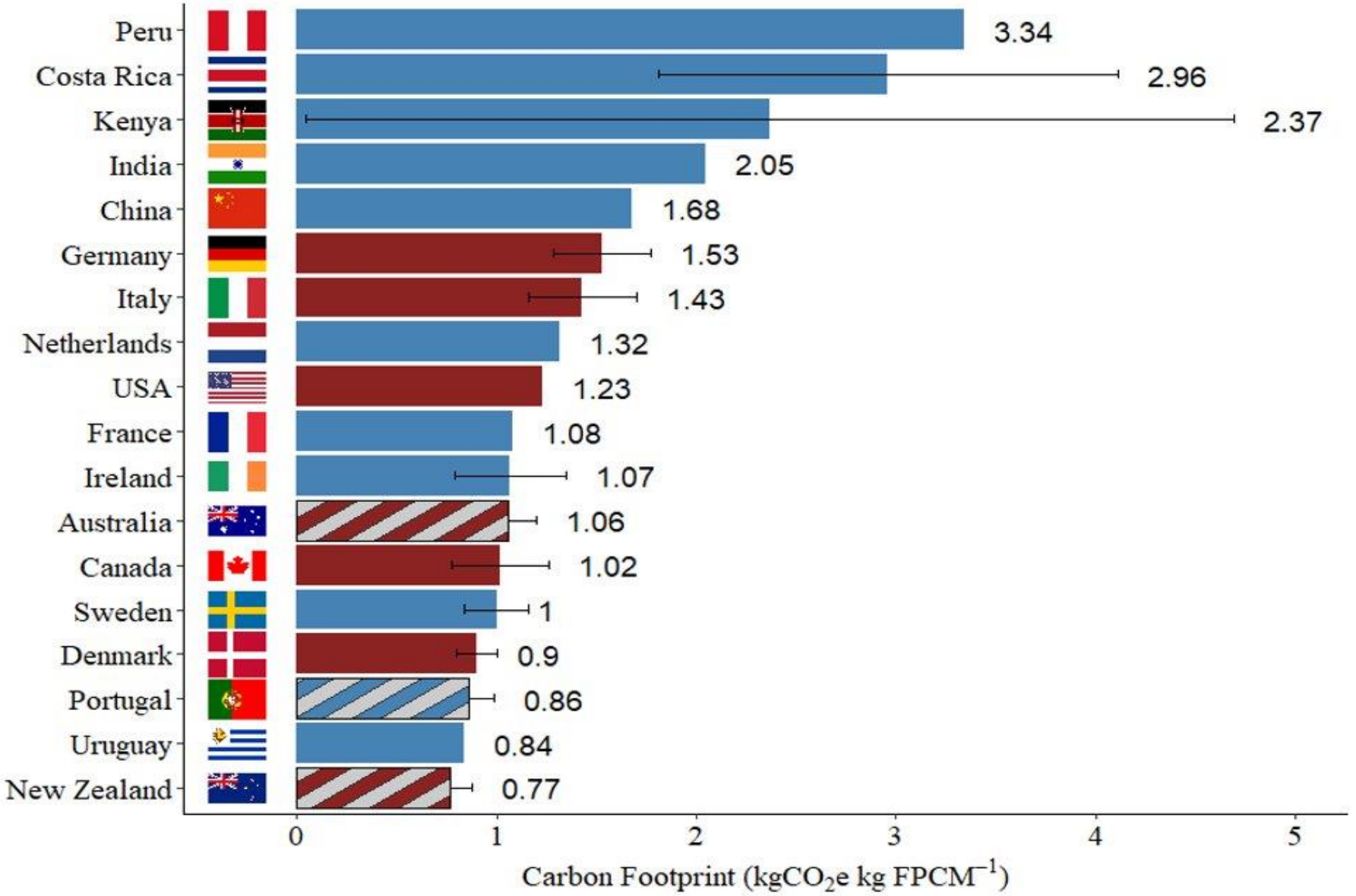
Carbon footprint of different feeds in NZ



* After allocation of GHGs to main products

Carbon footprint of milk – country comparison
(total GHG emissions to farm-gate)

Summary of 25 papers on carbon footprint of milk – adjusted to same methodology



Mazzetto et al. 2022 J Dairy Sci

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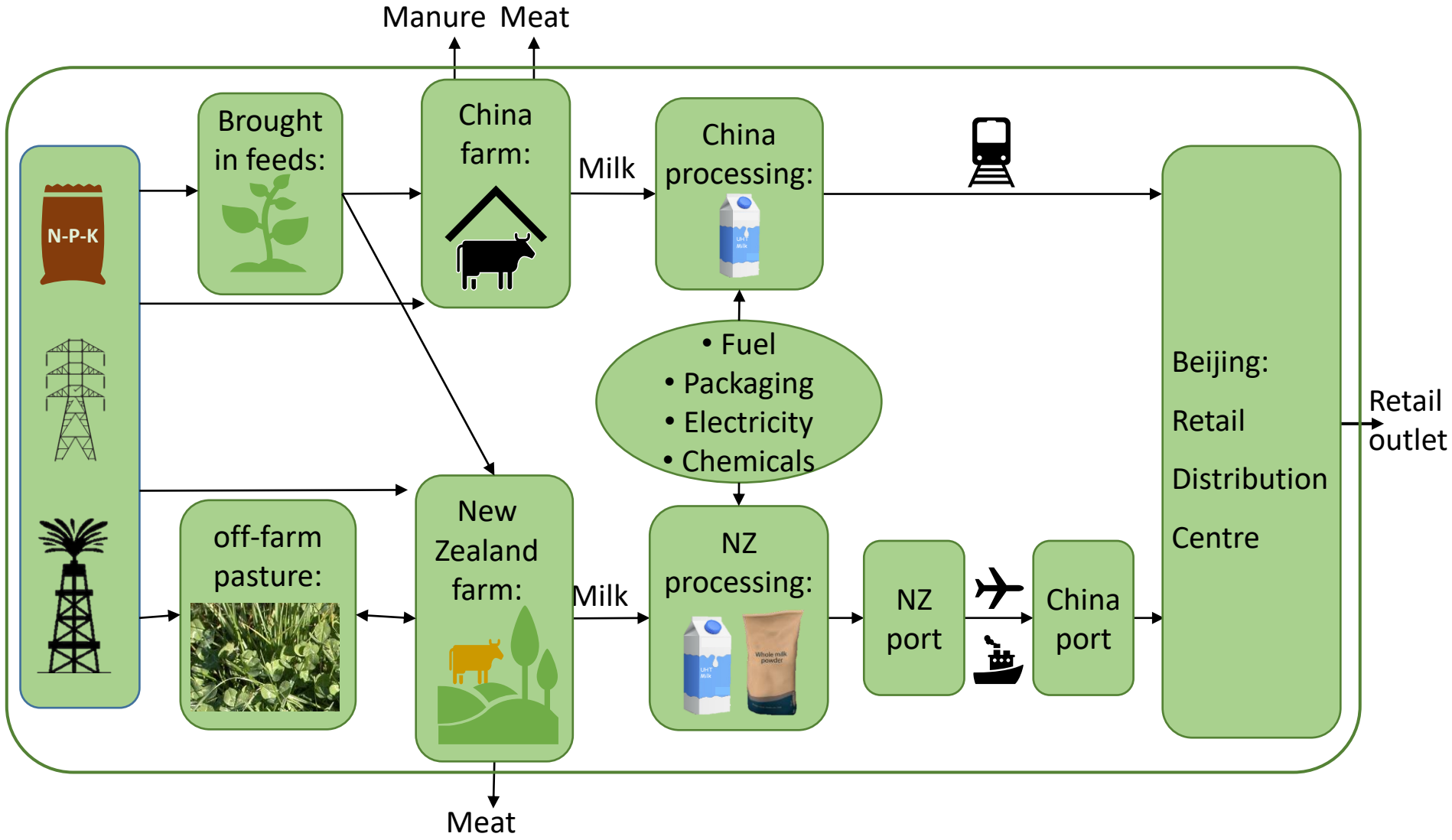
Carbon footprint of milk from NZ or China to Beijing



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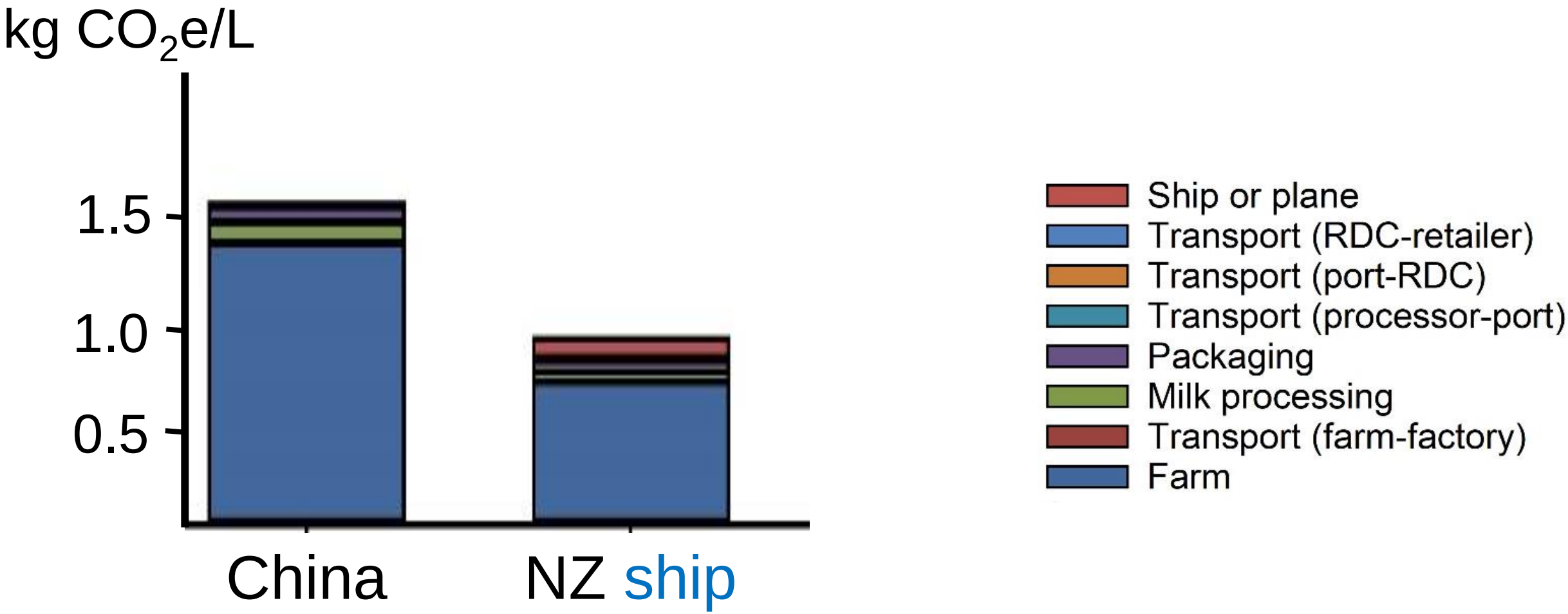

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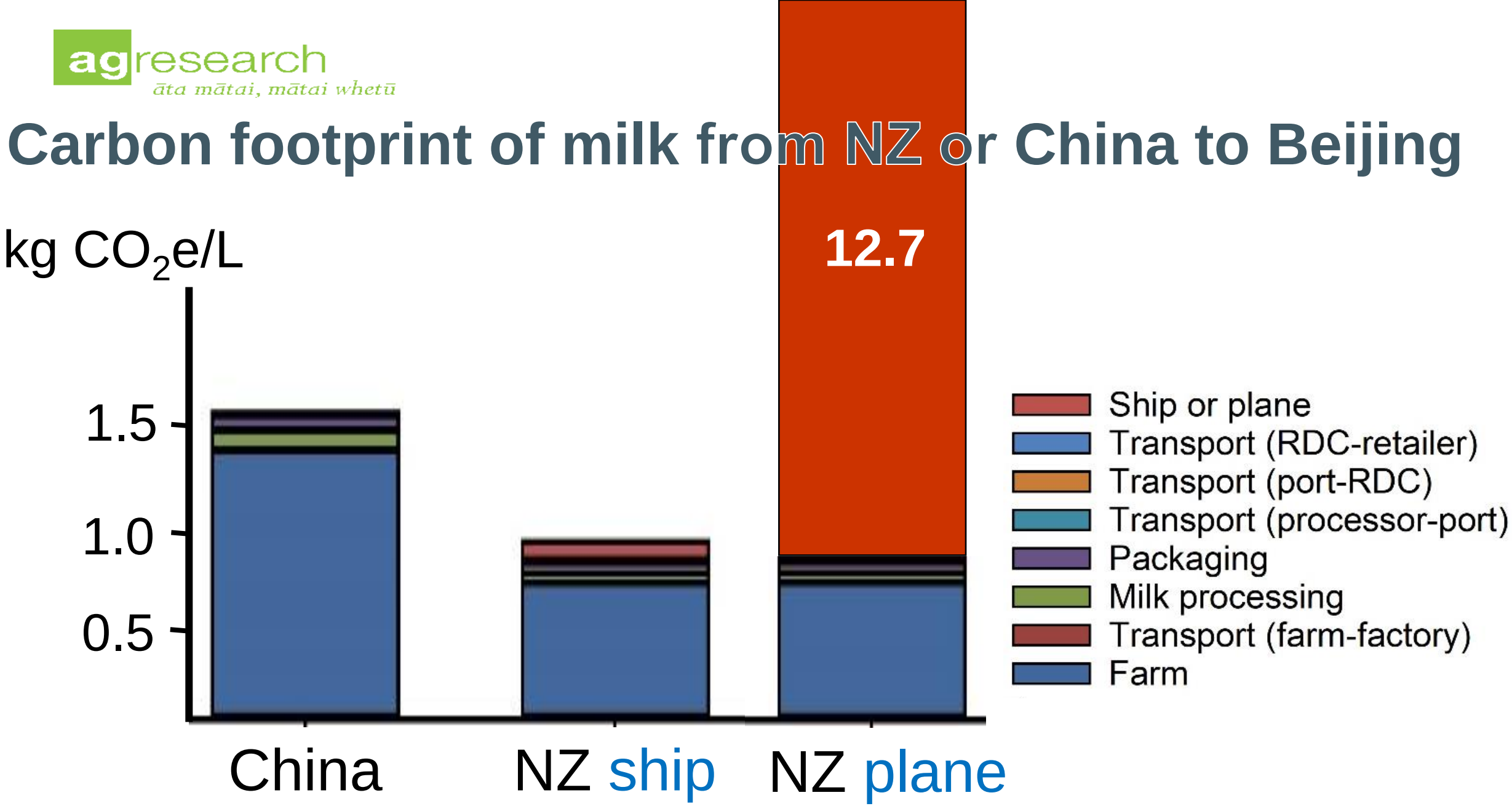
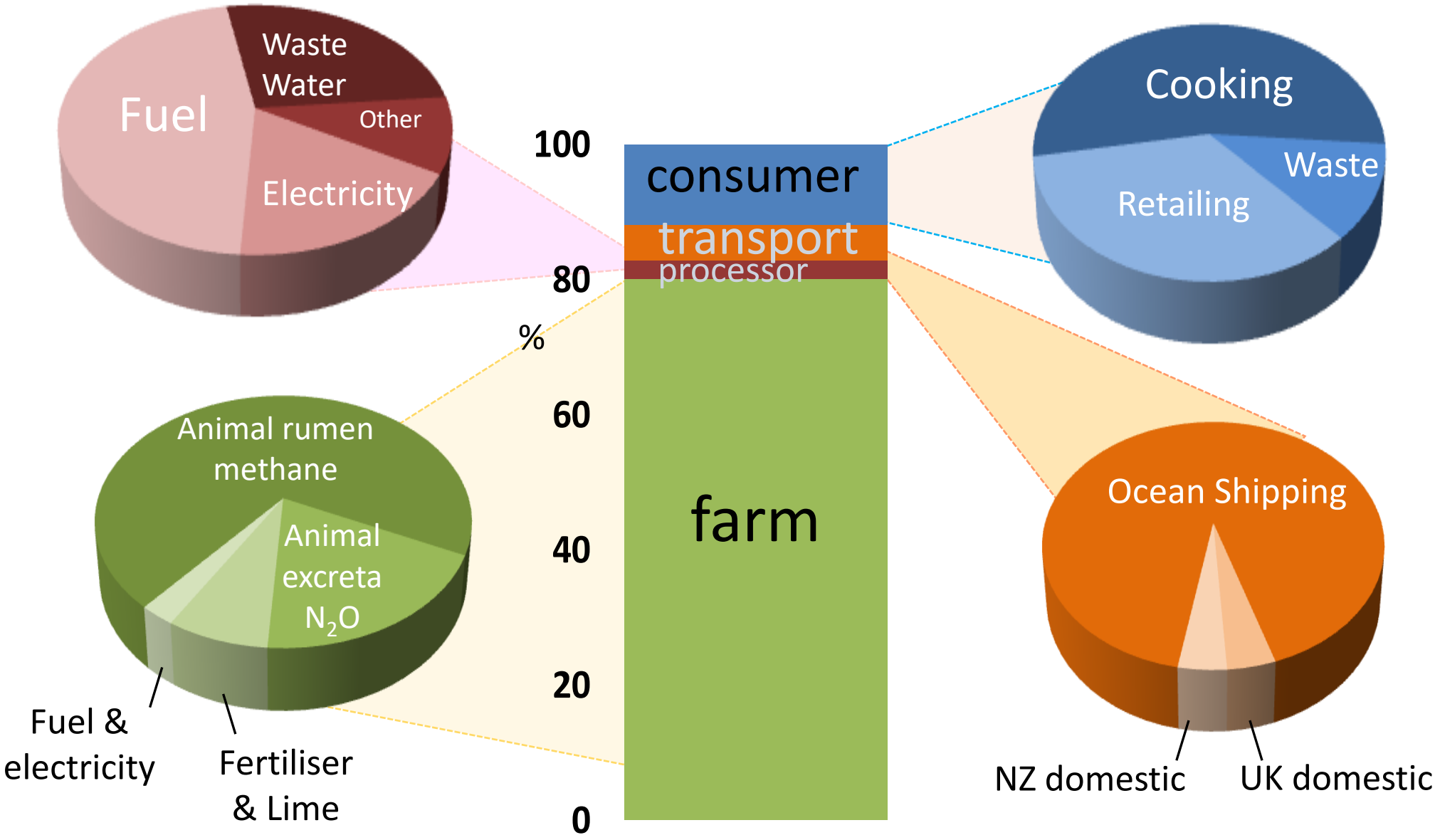


Carbon footprint of NZ lamb to UK



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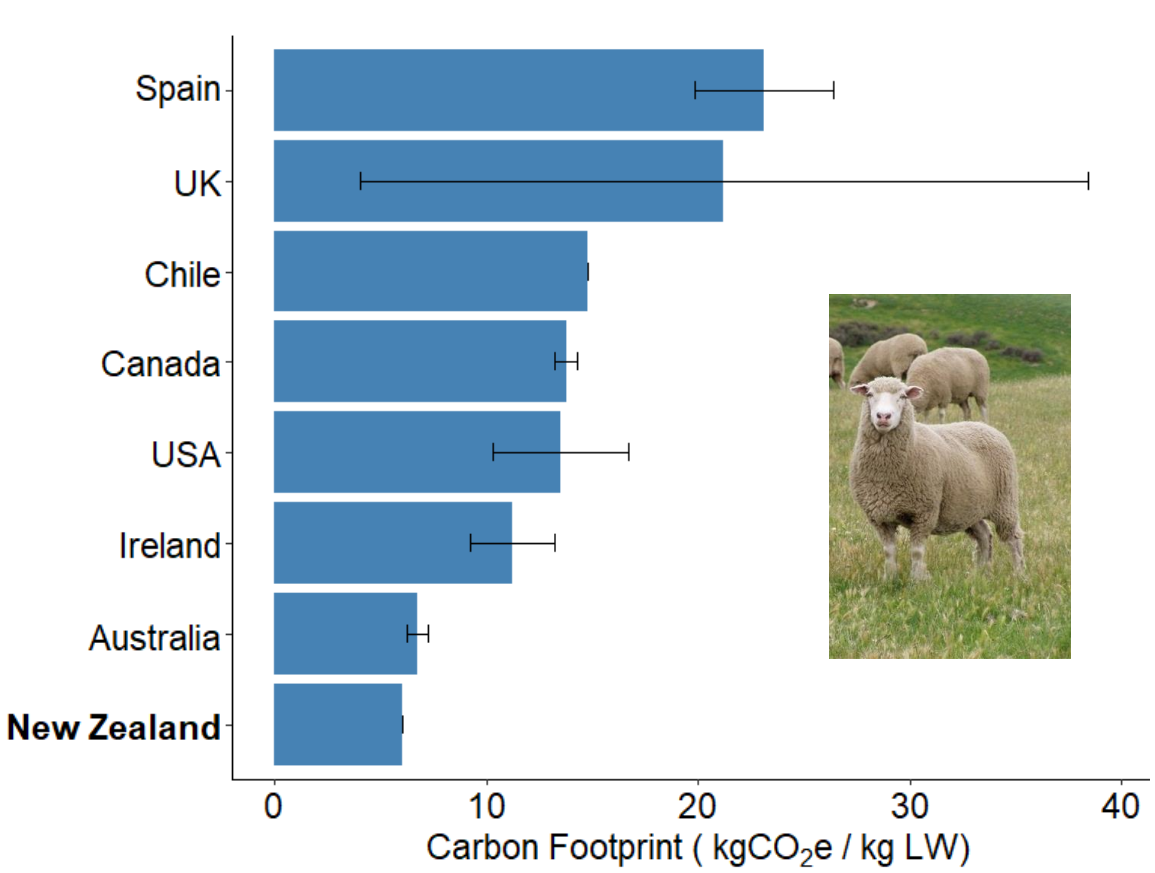
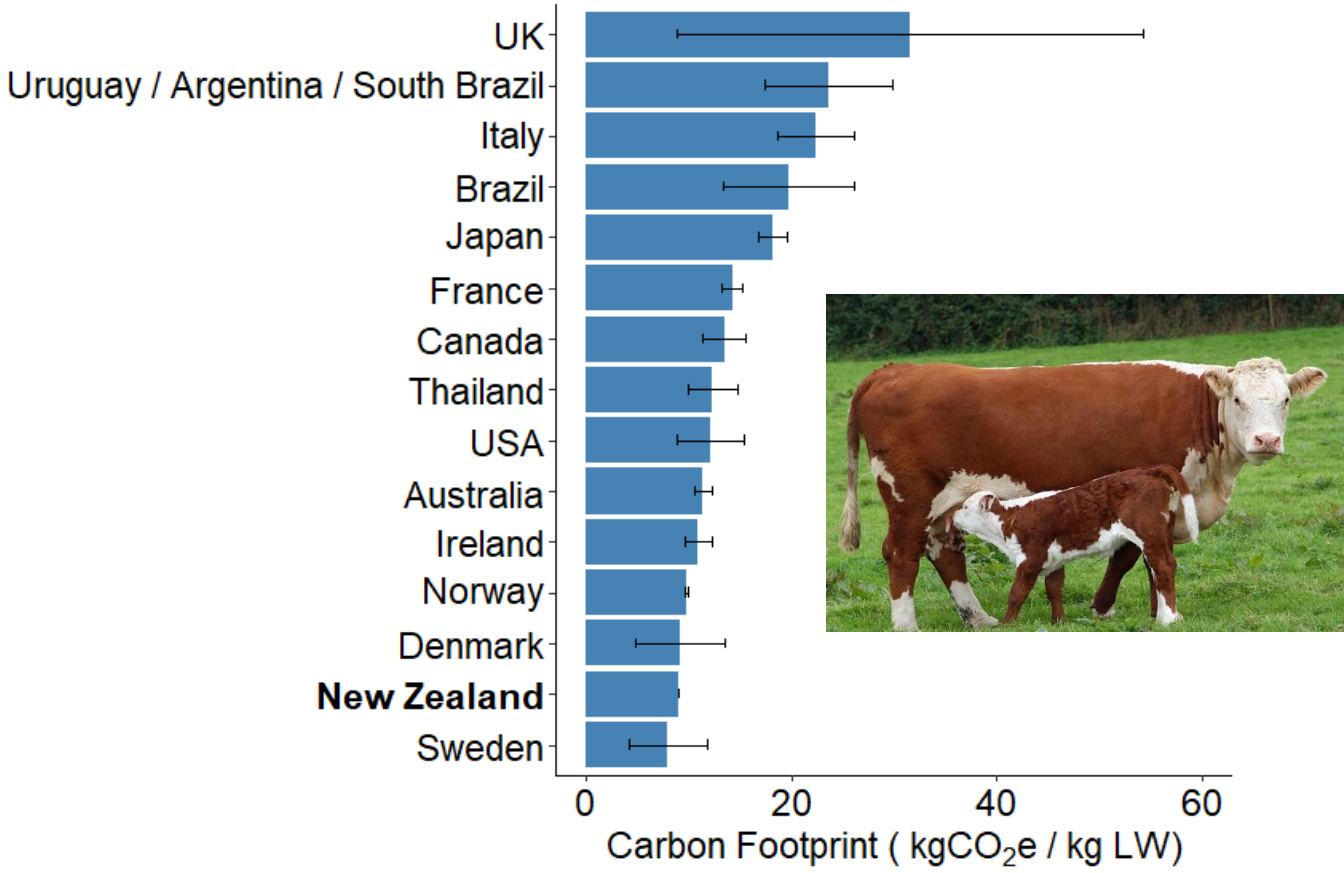
Carbon footprint meta-analysis (cradle-to-farm-gate)

Sheep meat



Beef



Mazzetto, Ledgard et al., 2021, 2022

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Carbon footprint of fish from deepwater fishing fleet

System Boundary: Deepwater fisheries

Background processes
Raw materials, basic processing, manufacturing, transport)

Vessel construction
Ballast
Batteries
Electric network
Engine
Fishing net
Hull and structure
Propeller

Vessel use
Fuel
Refrigerant
Lubricant oil
Antifouling

Vessel maintenance
Electric network and cables
Engine
Fishing net
Hull
Hydraulic oil
Paint and antifouling

Vessel end-of-life
Electric network and coil
Engine
Fishing net
Hull and structure

Total fish landed

Edible

Inedible e.g. fish meal

Methodology:

	Number of vessels:
Data template provided to deepwater fishing fleet – (for one-year per vessel):	**Total 21**
1. Fish catch: Raw fish	21
2. Fuels: Fuel types (and oils) and amounts used	21
3. Vessel & maintenance: Size, weights of ballast, wood, steel, hosing,…. (used Freon et al. 2014)	0
4. Refrigerants: Types and amounts replaced per year	7

Methodology:

Data template provided to deepwater fishing fleet – (for one-year per vessel):

	Number of vessels:
	Total 21
1. **Fish catch**: Processed and fish-meal weights, relative economic value	7
2. **Fishing gear & maintenance/replacement**: Nets, lines,…	7
3. **Packaging**: Types and amounts	7
4. **Anti-fouling agents**: Types and amounts	(2)
5. **Bait, consumables**: Types and amounts	(2)

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RESULTS:

	kg CO_2e/kg catch	% of total
Fuel	1.14	95%
Vessel	0.01	1%
Refrigerant	0.04	4%
TOTAL	**1.19**	

Minor underestimation due to lack of data on anti-fouling agents & consumables

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RESULTS:

	kg CO_2e/kg catch	% of total	range
Fuel	1.14	95%	0.37 - 3.19
Vessel	0.01	1%	0.007 - 0.013
Refrigerant	0.04	4%	0 – 0.21
TOTAL	**1.19**		**0.38 – 3.28**

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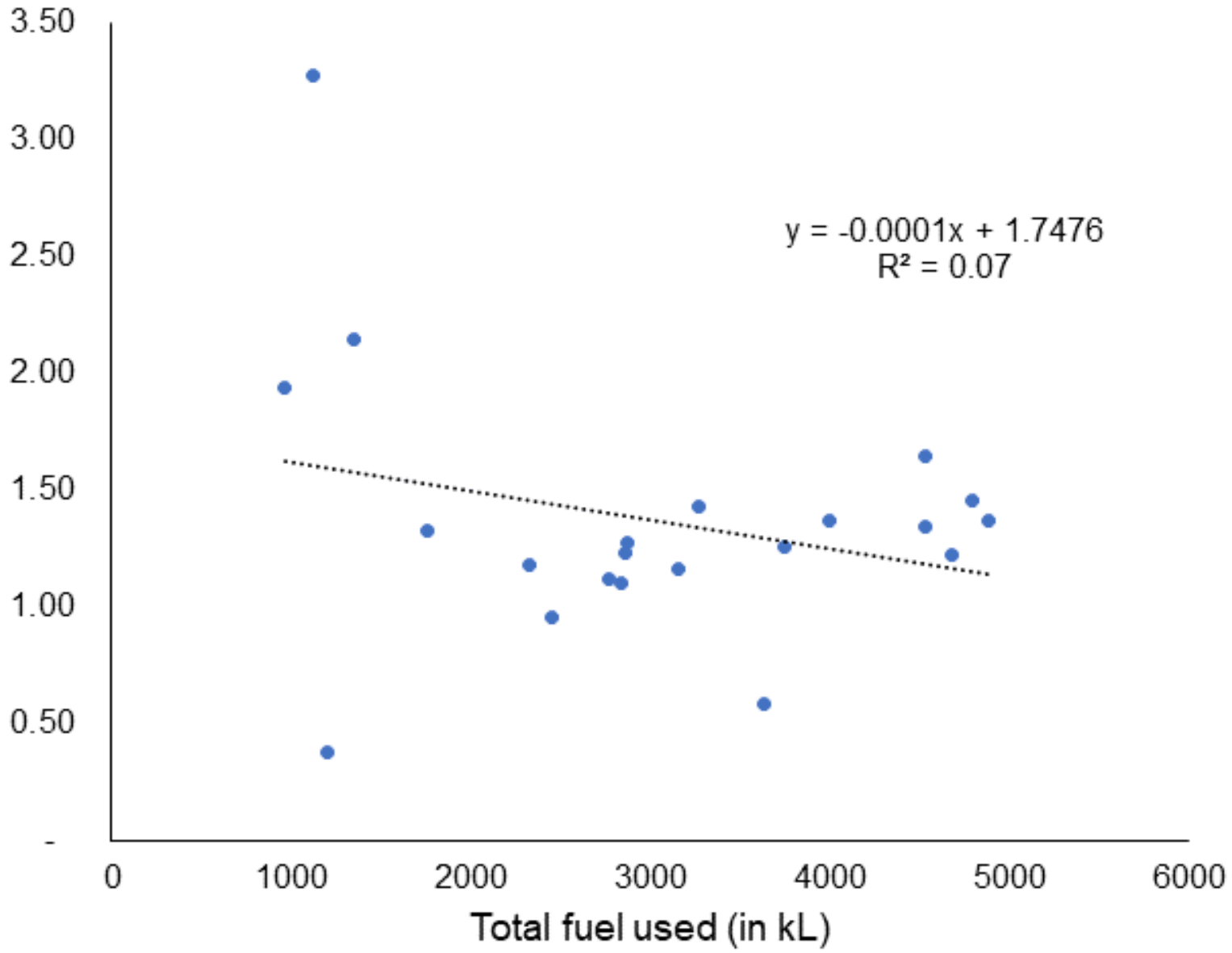
RESULTS: Sensitivity Analysis for refrigerants

	kg CO_2e/kg catch	% of total
Fuel	1.14	90%
Vessel	0.01	1%
Refrigerant	**0.11**	9%
TOTAL	**1.26**	

6% increase in Carbon footprint

RESULTS

Carbon footprint (kg CO_2e/kg catch)



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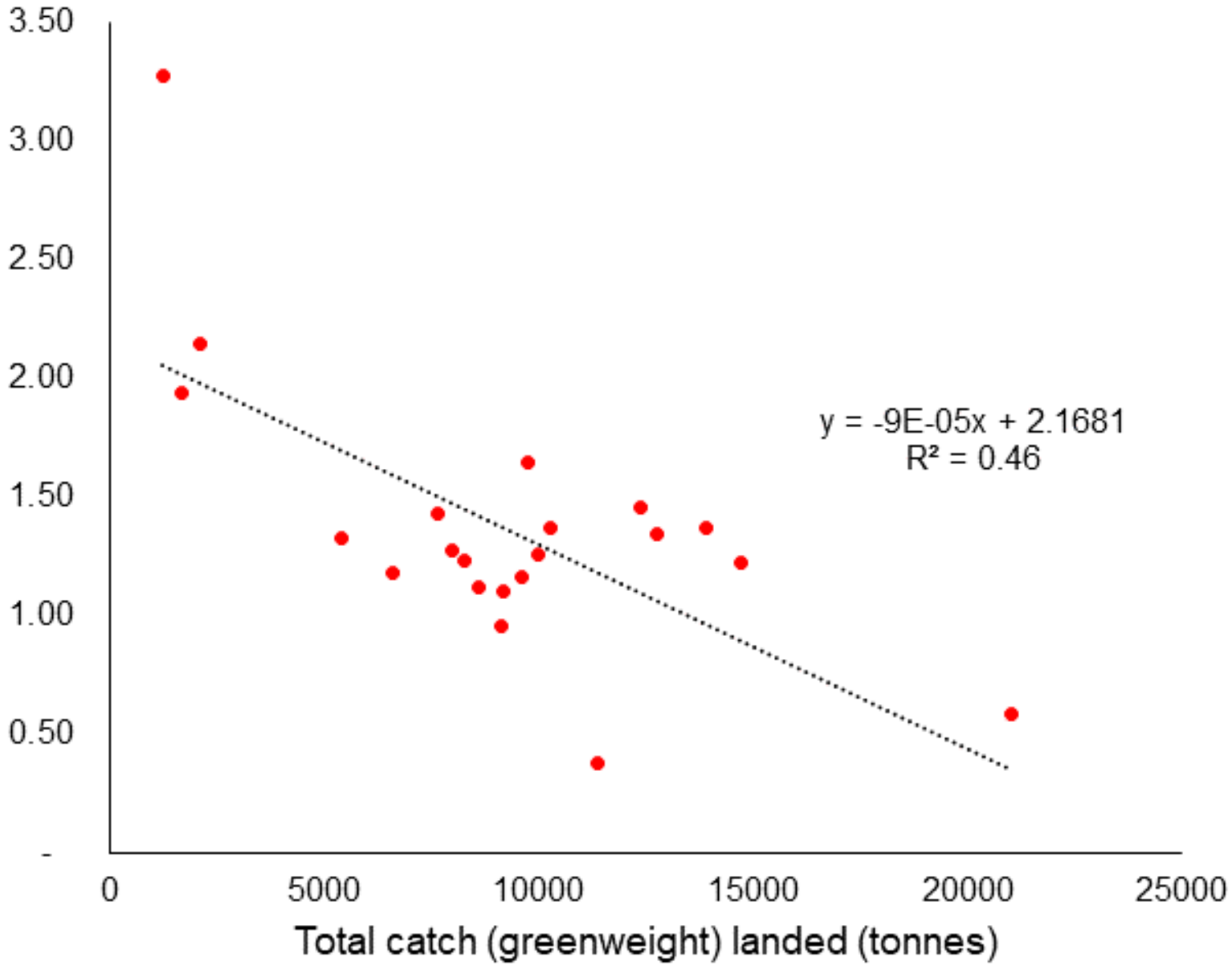
RESULTS

Carbon footprint (kg CO_2e/kg catch)



Comparison with published studies

	L fuel/kg catch
Atlantic	0.44
Scandinavia	0.3-0.67
India	0.33-0.41
Japan	0.33-0.41
Scotland	
Spain	
Global fleet (2018)	0.53
This study	0.33 (0.11-0.64)

Comparison with published studies

	L fuel/kg catch	kg CO_2e/kg catch
Atlantic	0.44	
Scandinavia	0.3-0.67	
India	0.33-0.41	1.7
Japan	0.33-0.41	4.7
Scotland		0.45 (0.28-0.74)
Spain		1.25 (0.55-3.99)
Global fleet (2018)	0.53	2.3
This study	0.33 (0.11-0.64)	1.2 (0.4-3.3)

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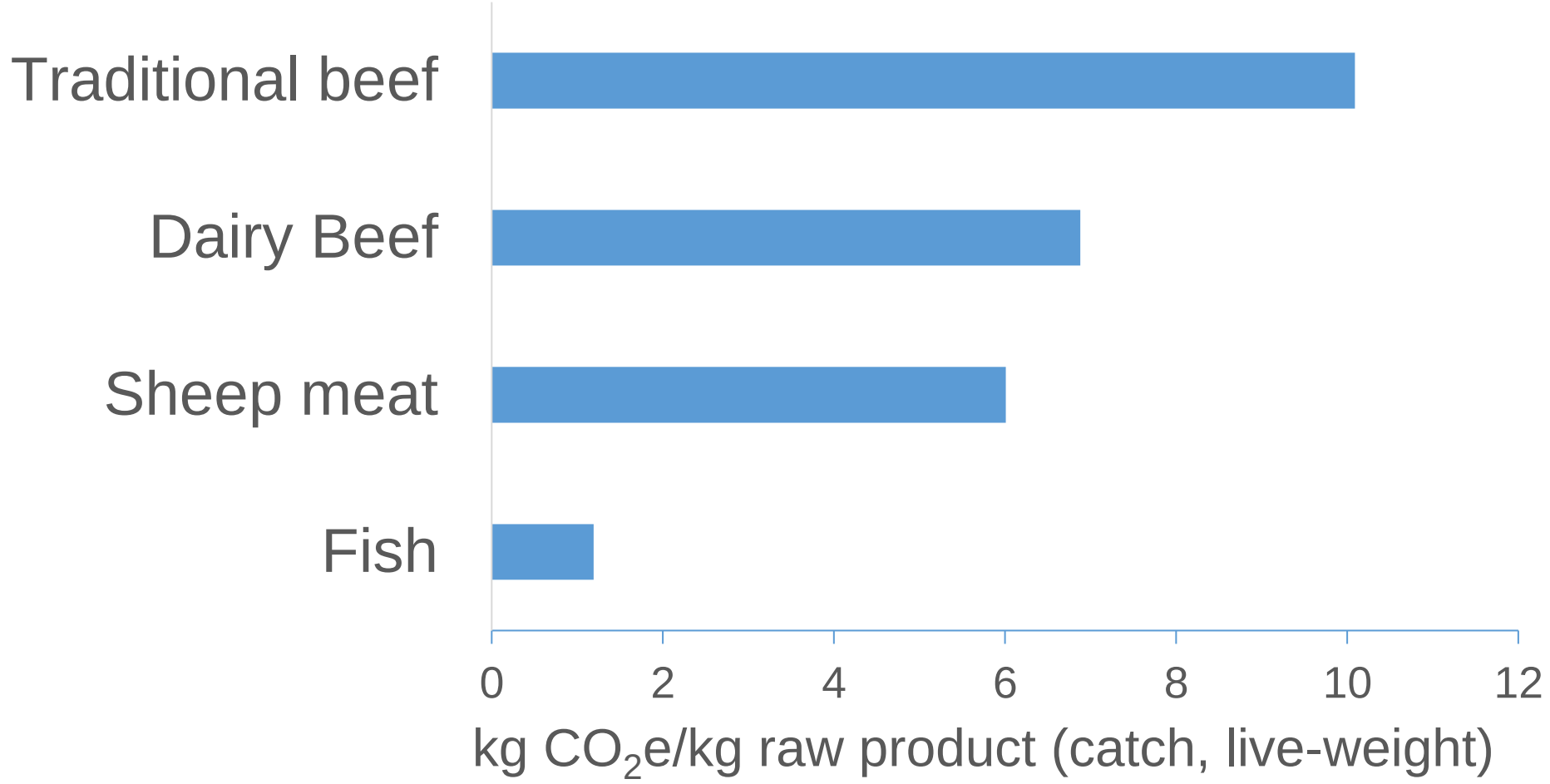
Comparison with NZ meat

Using same methodology:
- Cradle-to-'farm'-gate



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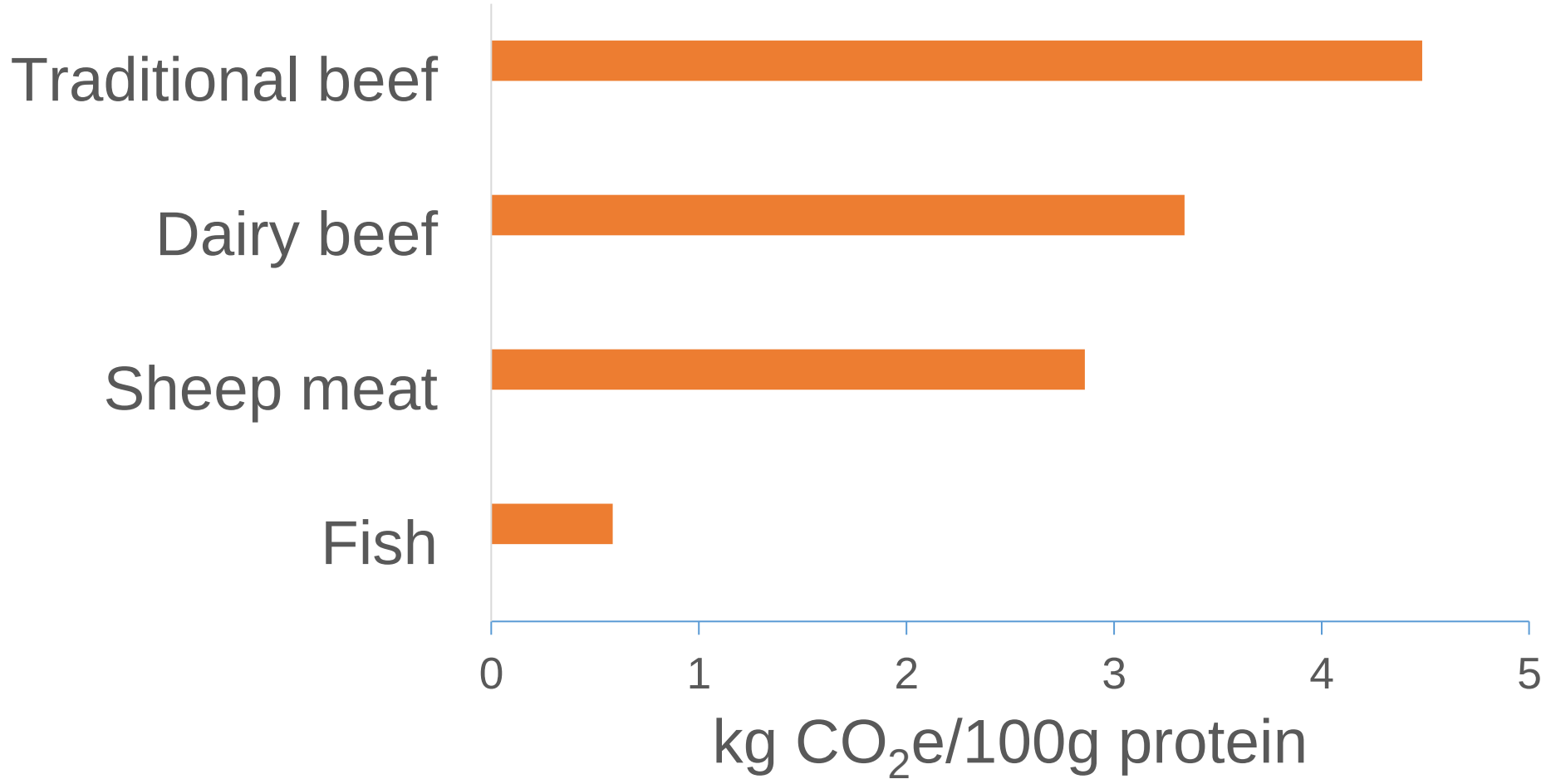

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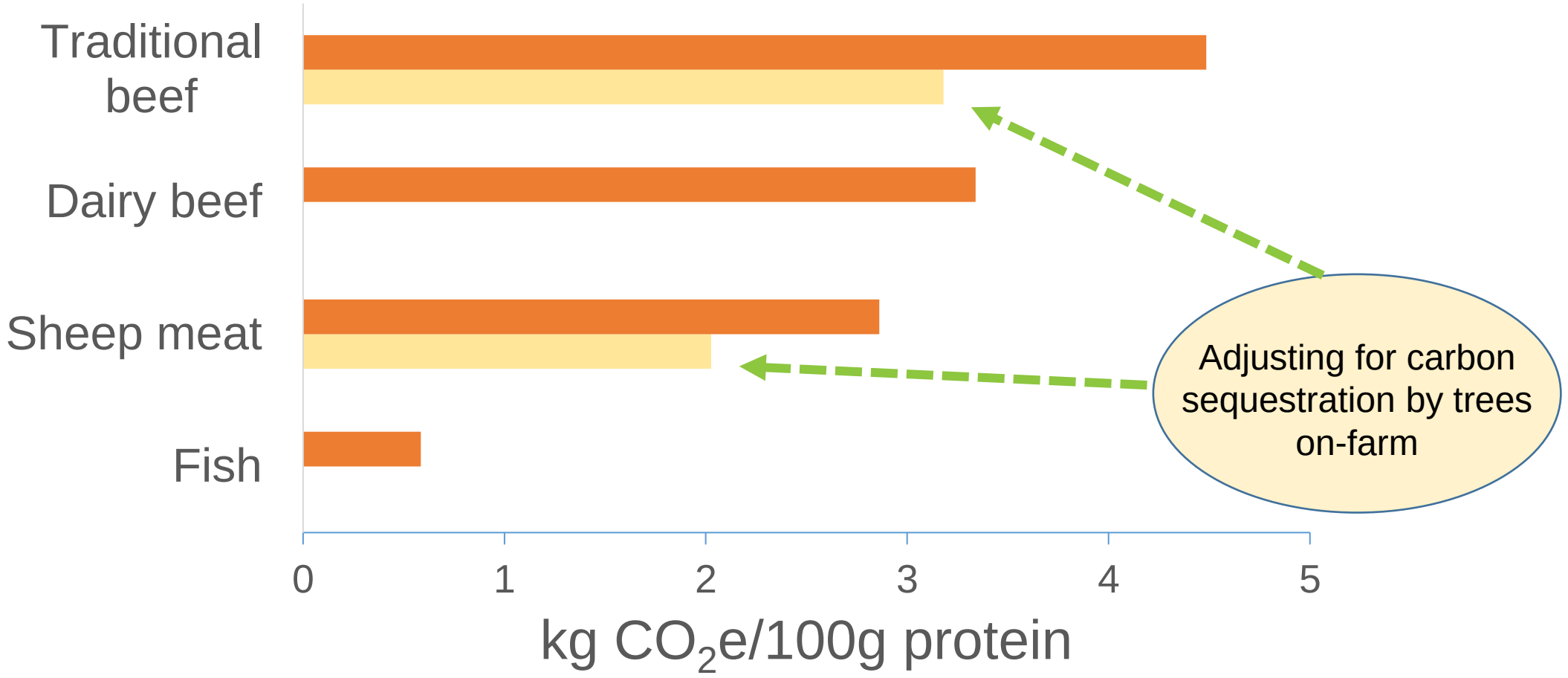

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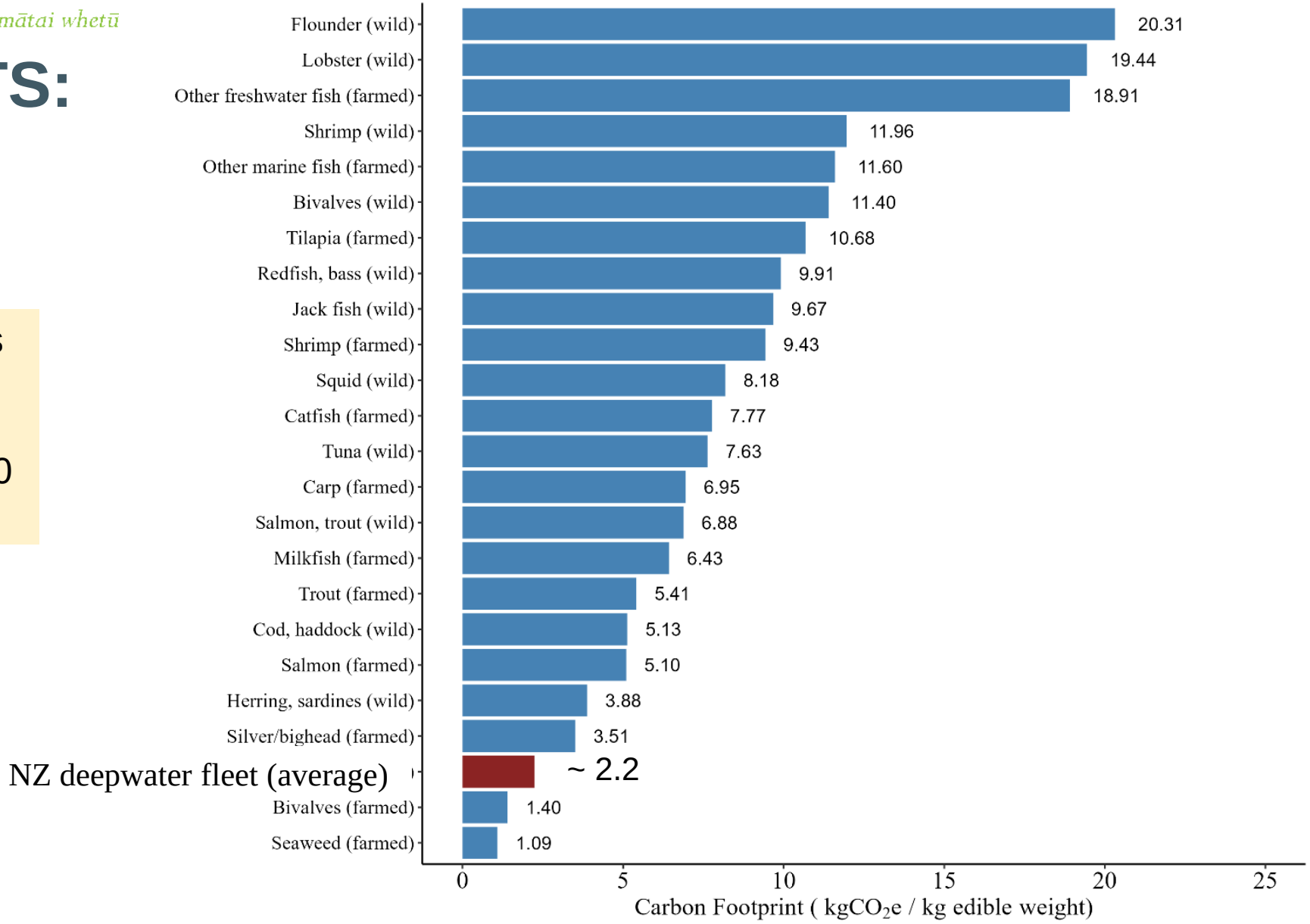
RESULTS:

Meta-analysis from over 1000 records and over 2690 fish-farms



Gephart et al., 2021

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Learnings from this study for carbon footprint of fish from the deepwater fisheries fleet:

- Fuel use is main driver (~ 92-96% of total)
- A comprehensive LCA requires more primary data
- Carbon footprint of deepwater fleet fish is similar to, or at the lower end of range, for different fish types from published studies
- Carbon footprint of deepwater fleet fish is less than for other NZ and international red-meat products (per 100 g protein)

Product Environmental Footprint (PEF)

Multiple environmental impacts:

- Climate Change
- Fossil energy depletion
- Eutrophication (freshwater & marine)
- Water scarcity footprint
- Ecotoxicity (freshwater & marine)
- Human health (cancer & non-cancer)