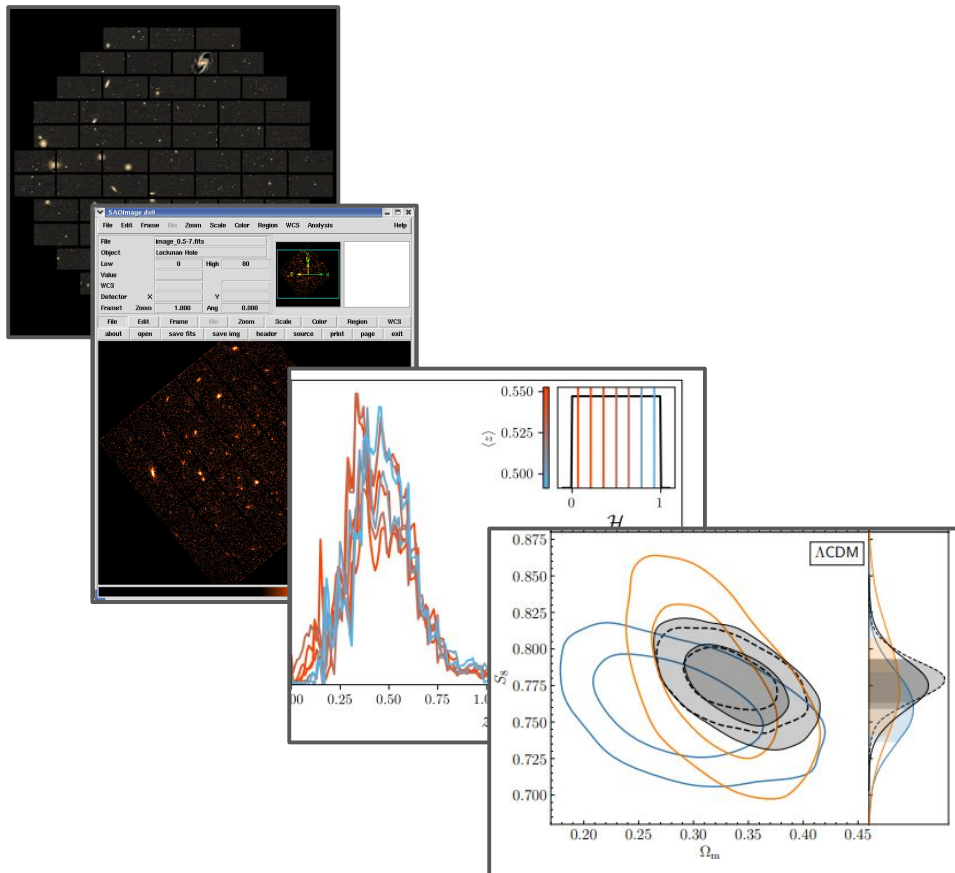


A vision for a trustable agrifood software ecosystem

From astrophysics to agrifood

Dr. Juan Pablo Cordero
Sustainable HEP
10/7/26

Once upon a time, in astrophysics...



cosmosis-developers / cosmosis-standard-library

<> Code Issues 10 Pull requests 8 Actions Projects

Files main

cosmosis-standard-library / number_density / nz_multirank / nz_multirank.py

joezuntz remove and move old modules 681ae13 · 3 years ago

260 lines (212 loc) · 9.3 KB

Code Blame

```
1 try:
2     from cosmosis.datablock import option_section
3 except:
4     option_section = "options"
5 import numpy as np
6 from scipy.optimize import linear_sum_assignment
7 #import matplotlib.pyplot as plt
8 from nz_gz import nz_to_gchi
9
10 try:
11     import astropy.io.fits as pyfits
12 except ImportError:
13     try:
14         import pyfits
15     except ImportError:
16         raise RuntimeError("You need astropy installed to use the module \
17             nz-multirank; try running: pip install astropy.")
18
19 def load_histogram_form(ext, bin, upsampling):
20     # Load the various z columns.
```

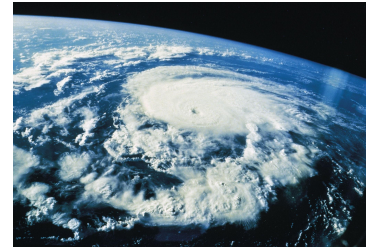
Contributors 31

+17 contributors

Years later, in a completely different field!



Astrophysics	Agrifood
Complicated	Complex
Relatively geographically agnostic	Localised challenges and research
Of interest to the public	Affects all lives, and many livelihoods
Irrelevant to most policy	Highly relevant
Well-defined field	Overlaps with many fields
Not urgent	Urgent
Accessible and transparent literature - reproducible*	Closed, opaque - hard to reproduce



People



Infrastructure



Products



Livestock



Land



Impacts



Woodland and natural
habitats

169.3 Mha

Non-agricultural

97.6 Mha

Arable land

98.1 Mha

Semi-natural and
improved pasture

48.0 Mha



Source:

Eurostat
Land Cover
Statistics (2022)

Woodland and natural
habitats

3.3 Mha

Semi-natural and
improved pasture

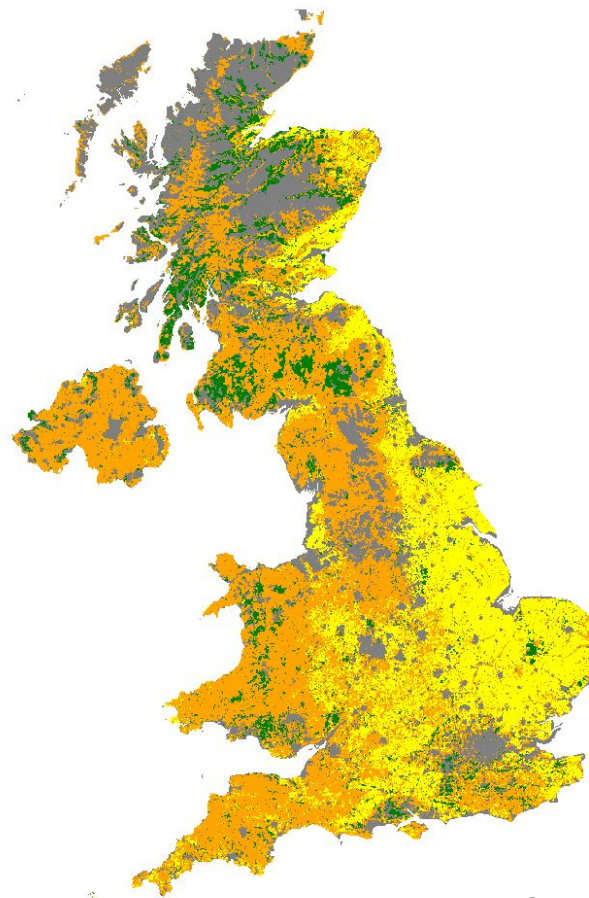
9.9 Mha

Non-agricultural

6.6 Mha

Arable land

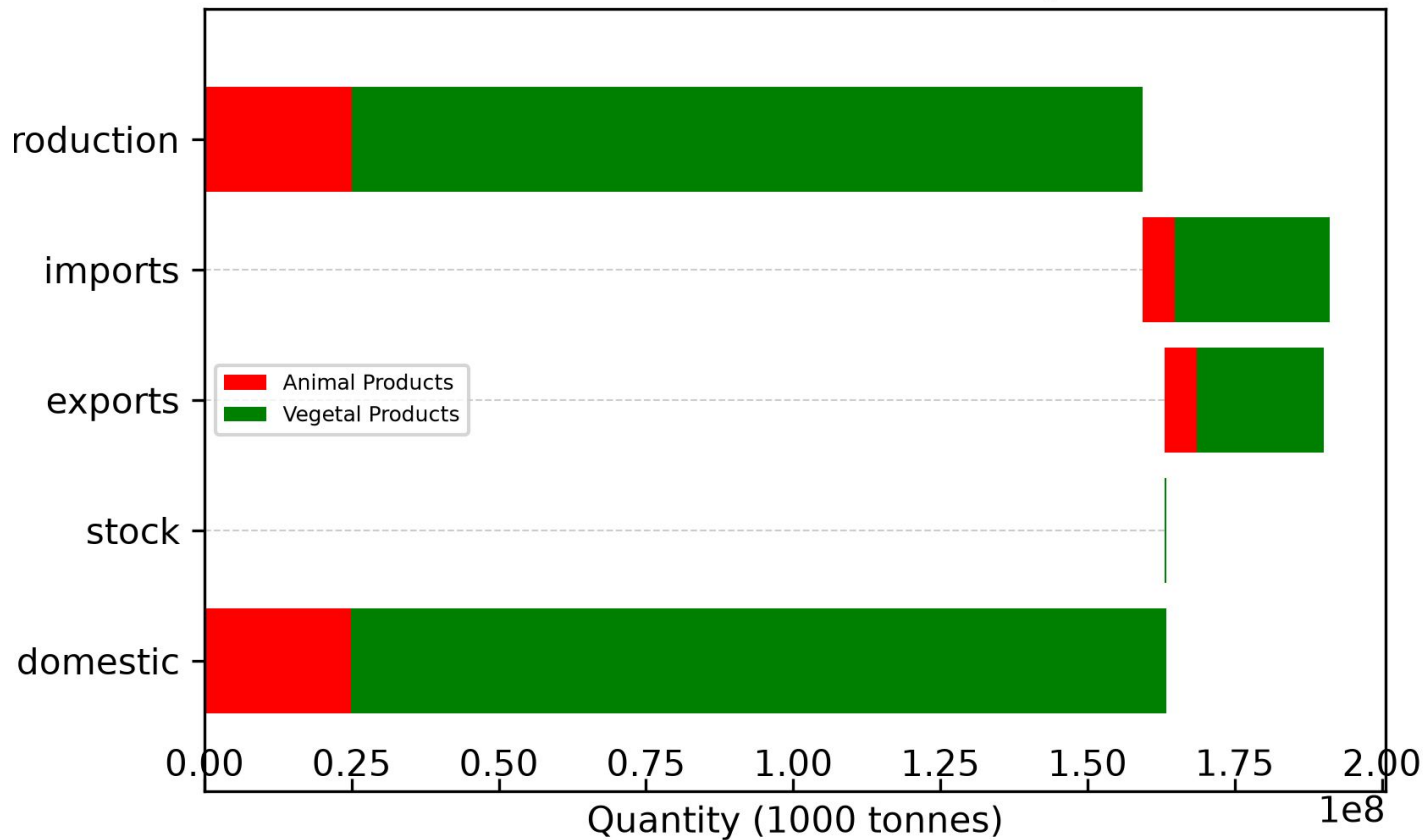
5.2 Mha



Source:

UKCEH Land Cover
Maps (2023)

Food balance sheet - Europe

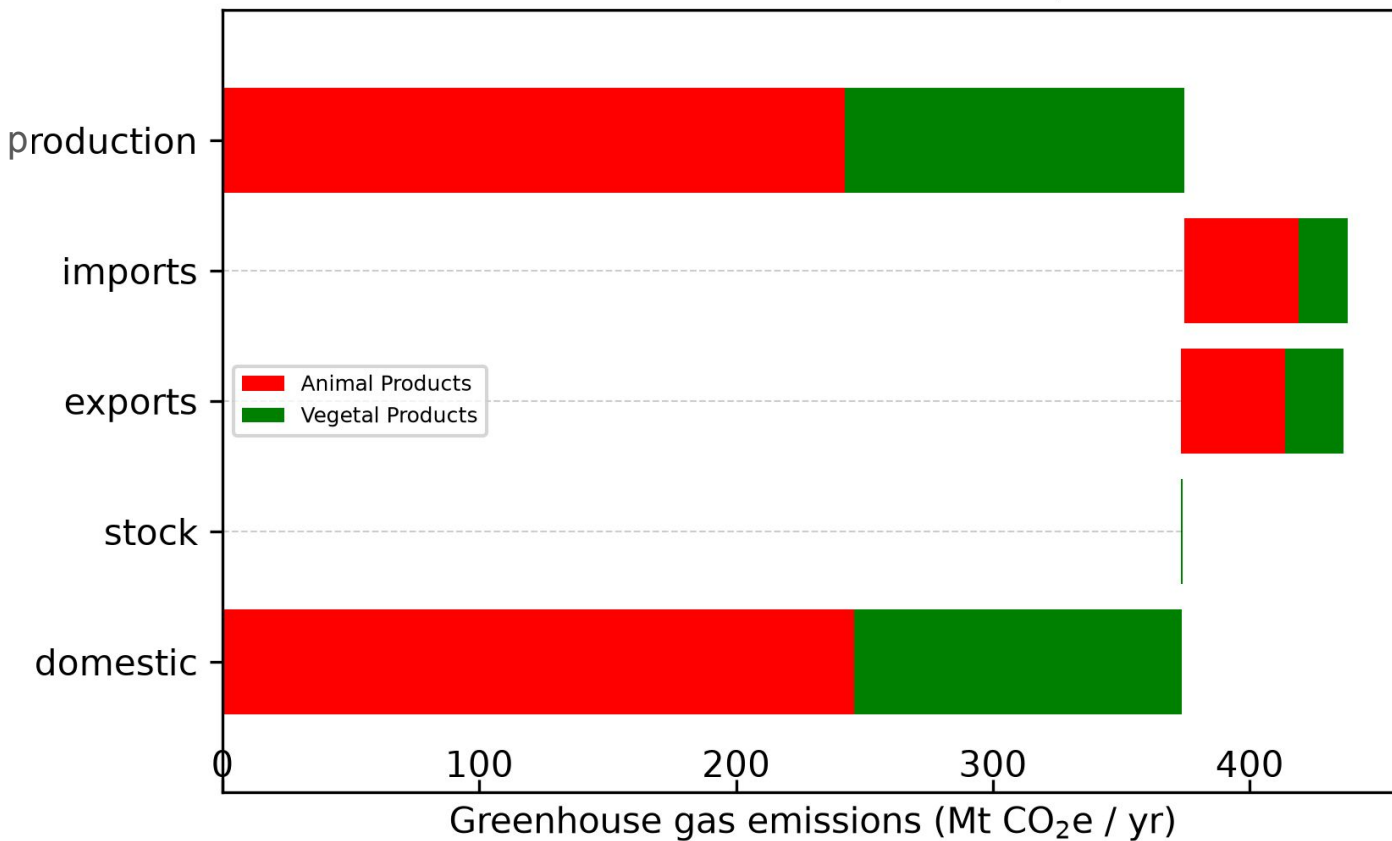


Sources:
FAOSTAT Food
Balance Sheets
(2023)

UK 2035 Nationally
Determined
Contribution report
(2025)

Poore & Nemecek
(2018)

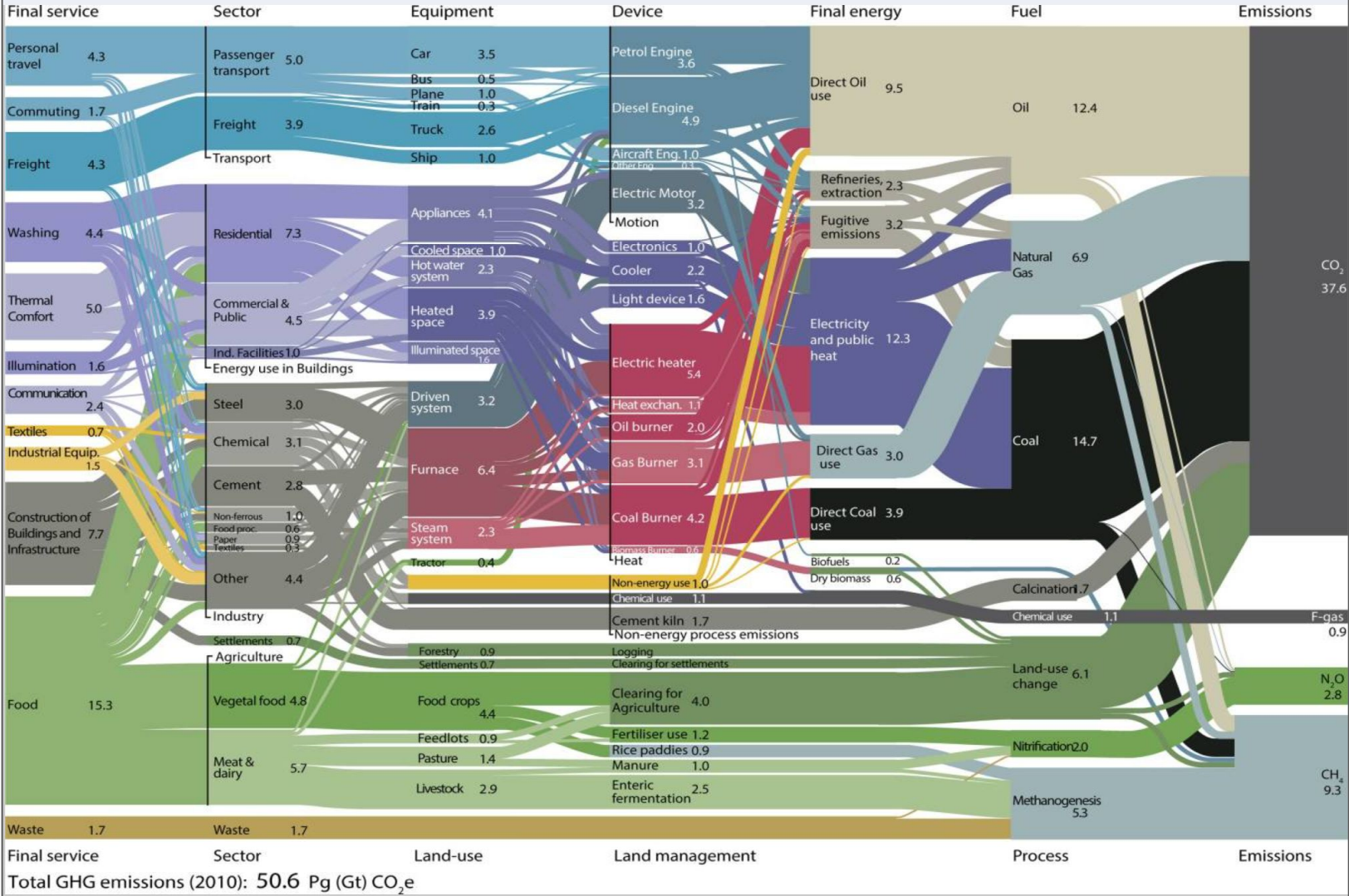
Emissions balance - Europe



Sources:
FAOSTAT Food
Balance Sheets
(2023)

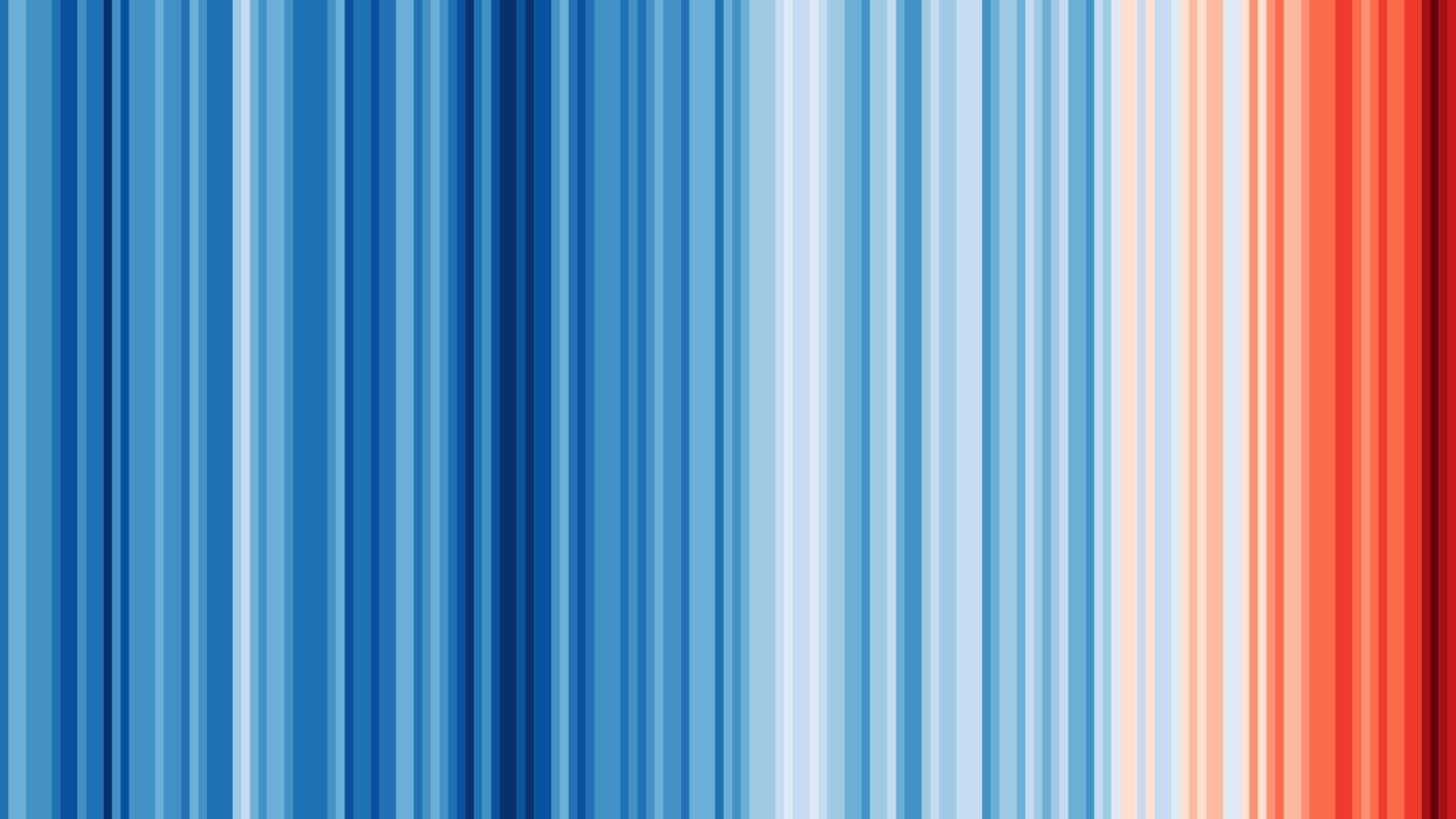
UK 2035 Nationally
Determined
Contribution report
(2025)

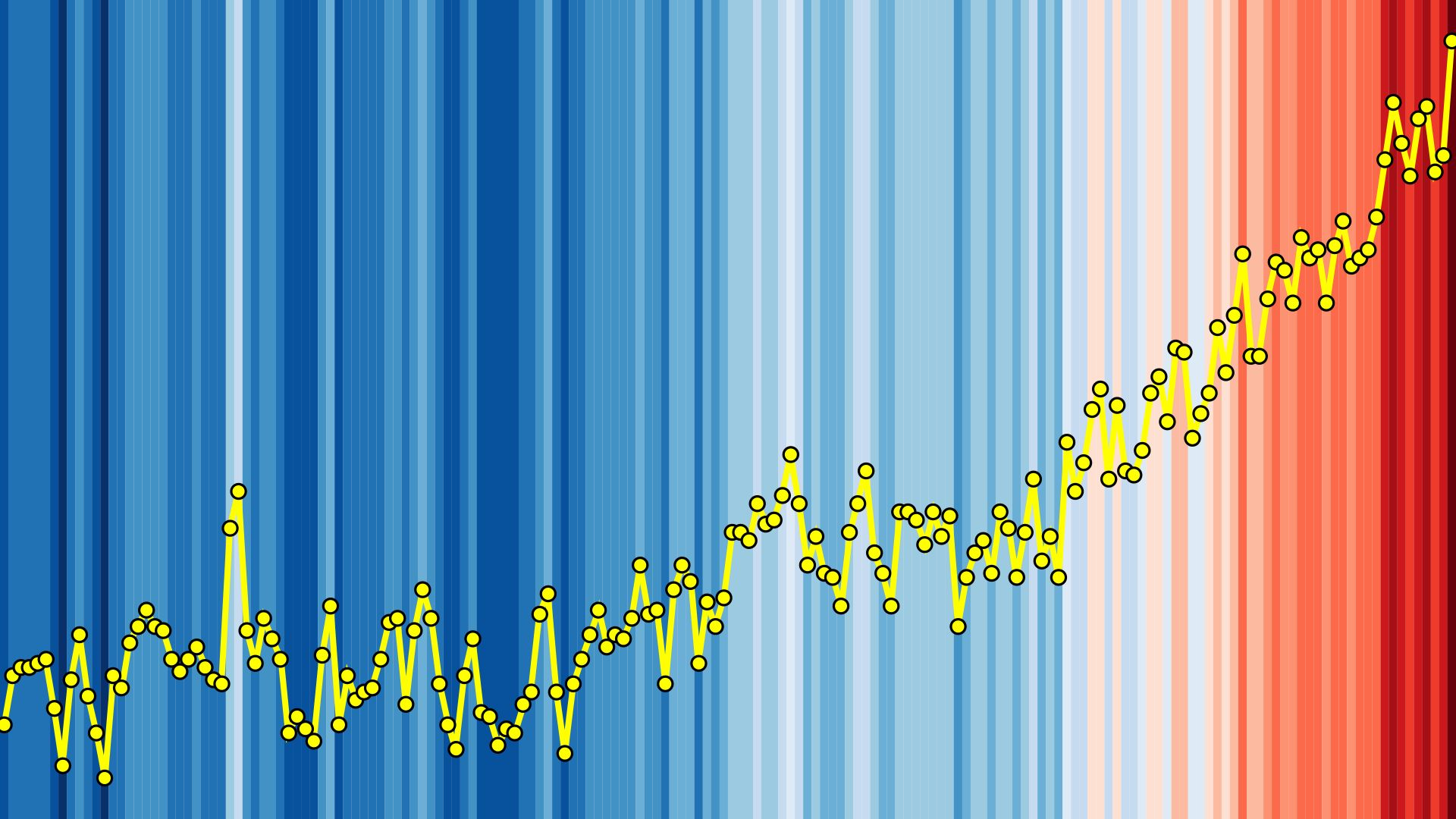
Poore & Nemecek
(2018)



Source:
Bajzelj et al 2013

Copyright © 2013
American Chemical
Society





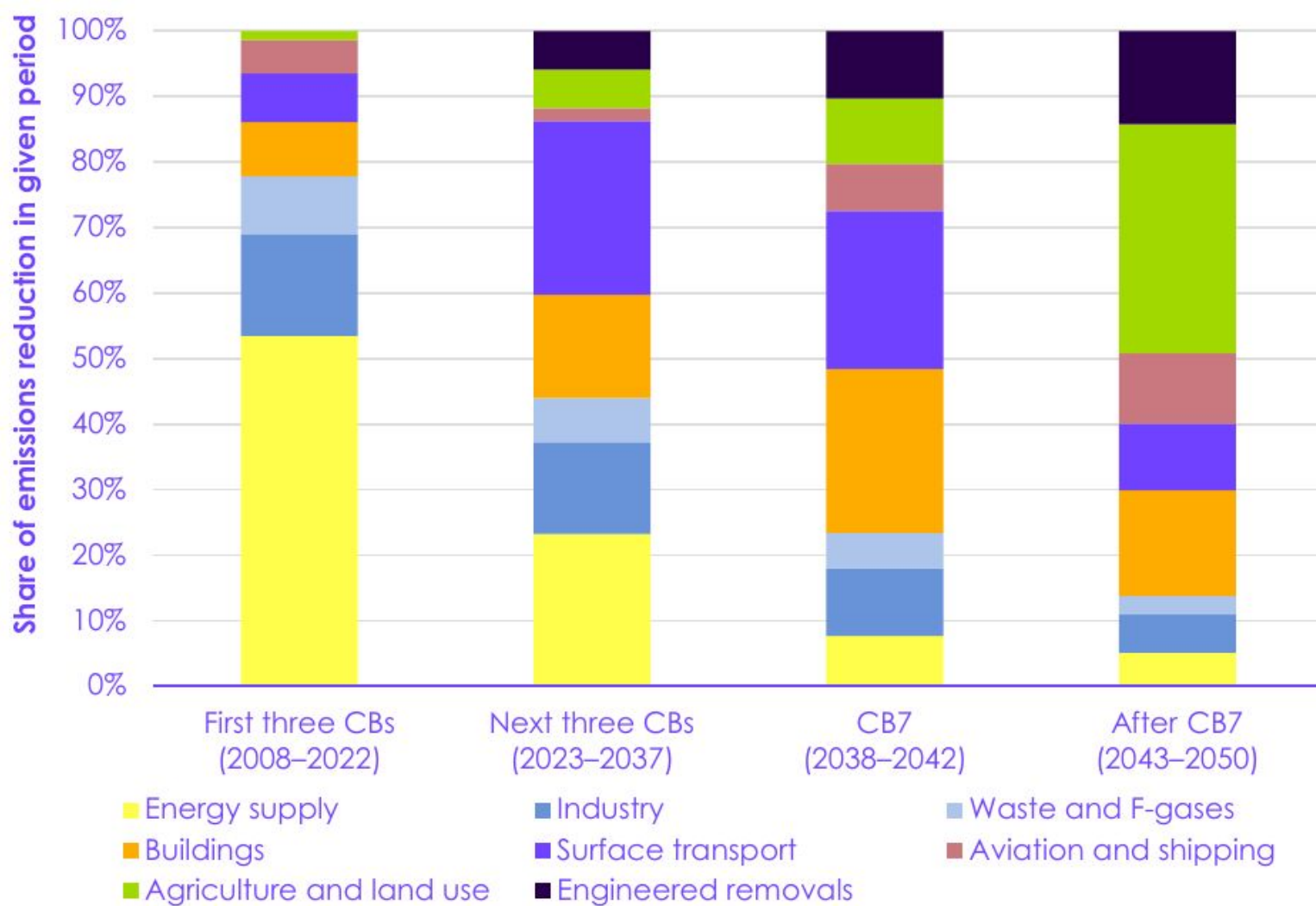


Climate Change Act 2008

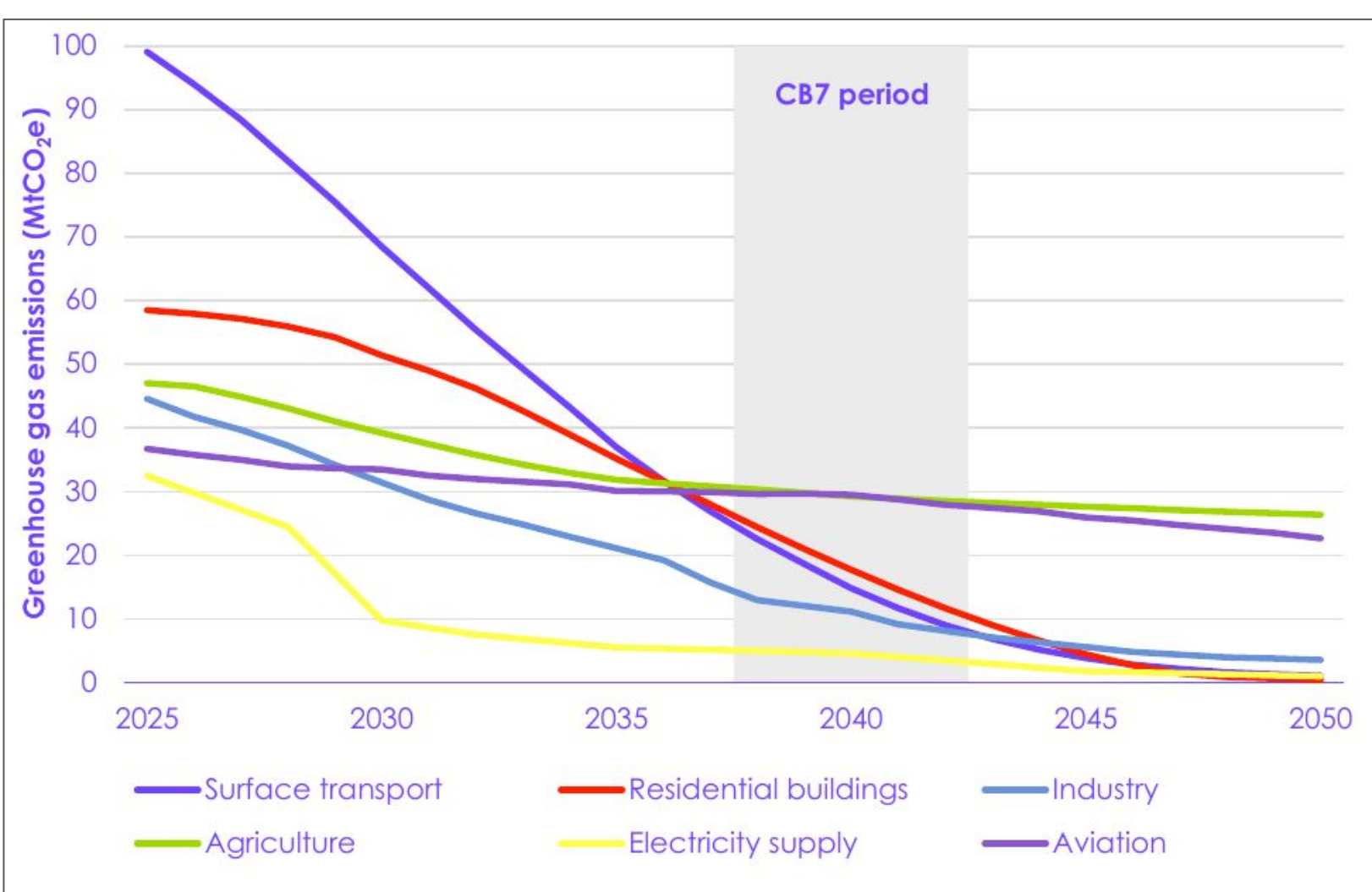


Paris
Climate
Agreement

- EU to achieve Net Zero by 2050, and negative emissions thereafter
- UK Net Zero by 2050 is a legal requirement (and 68% reduction wrt 1990 levels by 2030)
- Limit global warming to “well below” 2 degrees, and ideally below 1.5 degrees above pre-industrial levels
- Emissions plans only at state-level in the USA
- Other countries have stated intentions to reduce emissions but no legal framework has been established



Source:
The Seventh
Carbon Budget
(Climate Change
Committee, 2025)



Source:
The Seventh
Carbon Budget
(Climate Change
Committee, 2025)

Our vision for an agrifood software ecosystem



Oct. 24, 1961

G. K. CHRISTIANSEN
TOY BUILDING BRICK

3,005,282

Filed July 28, 1958

2 Sheets-Sheet 1

FIG. 1.

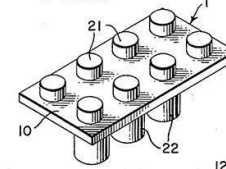


FIG. 2.

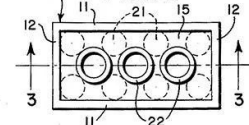


FIG. 3.

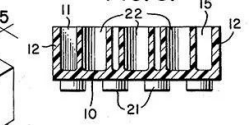


FIG. 4.

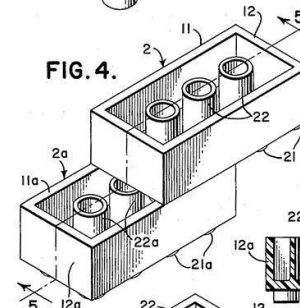


FIG. 5.

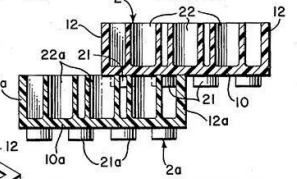


FIG. 6.

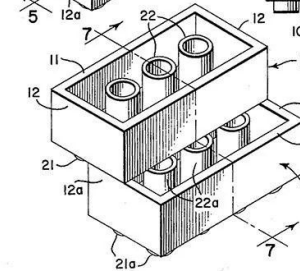
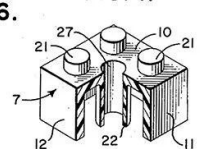


FIG. 7.



INVENTOR

Godtfred Kirk Christiansen

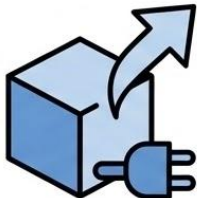
BY
Stevens, Davis, Muller & Mosher
ATTORNEYS



Open and documented

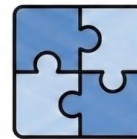


Reproducible



Extendable

Modular



Testable



Physics

- Astrophysics (**astro-ph** [new](#), [recent](#), [search](#)) Astrophysics of Galaxies; Cosmology; High Energy Astrophysical Phenomena; Instrumentation and Methods
- Condensed Matter (**cond-mat** [new](#), [recent](#), [search](#)) Disordered Systems and Nanoscale Physics; Other Condensed Matter; Quantum Gases; Soft Condensed Matter; Superconductivity
- General Relativity and Quantum Cosmology (**gr-qc** [new](#), [recent](#), [search](#))
- High Energy Physics - Experiment (**hep-ex** [new](#), [recent](#), [search](#))
- High Energy Physics - Lattice (**hep-lat** [new](#), [recent](#), [search](#))
- High Energy Physics - Phenomenology (**hep-ph** [new](#), [recent](#), [search](#))
- High Energy Physics - Theory (**hep-th** [new](#), [recent](#), [search](#))



ROOT

Data Analysis Framework



Many types of agrifood models too

- Subsystem evolution:
 - How much food crops produce
 - How much carbon can forest sequester
- Biophysical models:
 - How does a system evolves on small scales
 - What are the impacts of product X
- Systems/Integrated Assessment Models (IAMs)
 - How do systems respond to large scale transformations
 - How do humans react to these changes

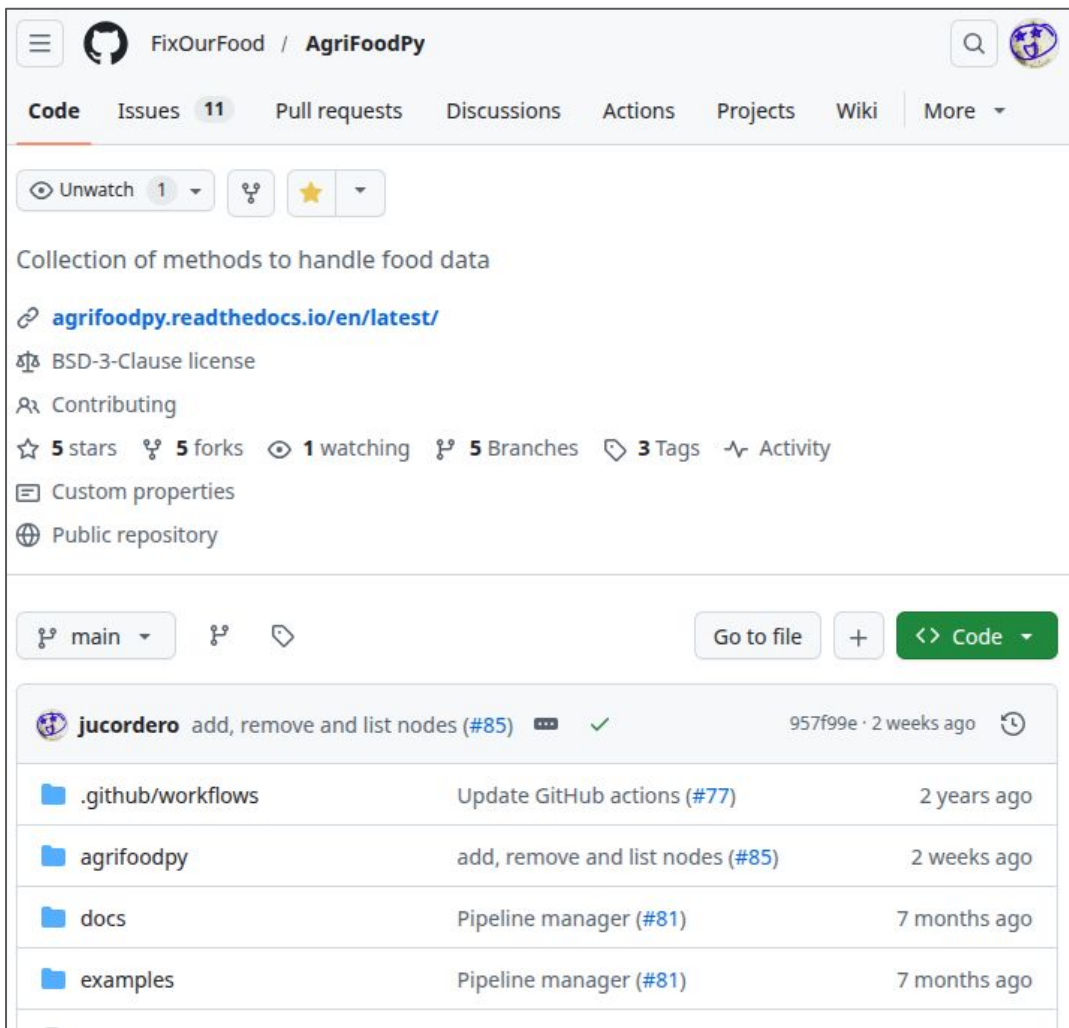


MAGICC



Astrophysics	Agrifood
Shared file formats*	Non-standard, undocumented. Many different formats
Open source*	Mostly closed*
Community validation	Little or no validation
Common benchmarking	Scenario dependent baseline
Spatial agnosticism	Very dependent on context

- Policymakers see conflicting numbers
- Reproducibility is limited
- Trust is limited
- Models become political instruments



AgriFoodPy

Collection of land use,
impact, food supply and
socioeconomic models

Preprocessed open datasets
on a ready to crunch format

Pipeline manager for end to
end simulations

Documented, extensible,
modular, testable,
reproducible



futurefoodcalculator.org/expert-calculator



Select a scenario ▼

Consumption ▼

Land use ▼

Livestock ▼

Arable ▼

Technology and innovation ▼

Scenario settings ▼

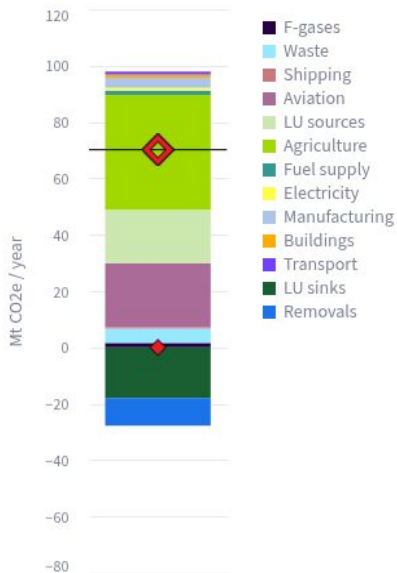
Submit slider positions ▼

Reset all
sliders

Clear cache

--- Developed with funding from
[FixOurFood.](#)

UK Emissions balance



☐ Show agriculture and land use only

Total emissions

70.16 Mt CO₂e / year

↓ -0.00 Mt CO₂e / year

Self-sufficiency

67.37 %

↓ -4.65 %

The UK is more dependent on imports than today



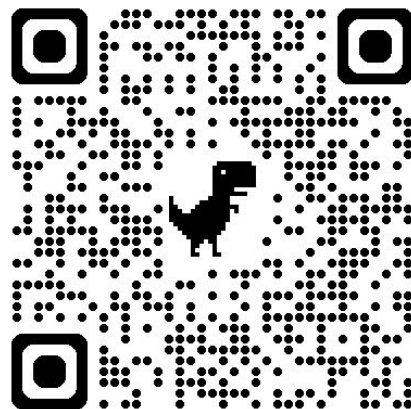
Food production per capita



Domestic use per capita

Production and consumption

Herd size	Dairy herd	Beef herd
9.15M	3.48M	5.67M
↓ -867.62	↓ -329.88	↓ -537.74
Poultry heads	Pig heads	Sheep flock
177...	4.72M	31....
↓ -16.87k	↓ -447.02	↓ -2.94k



Interactive tools
for quick policy
assessment