ADAS
HORTICULTURE

CARBON ACCOUNTING IN HORTICULTURE

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Overview of carbon accounting

Why:

- To ensure sustainability of the industry against the carbon metric.
- To adhere to the requirements of assurance schemes and retailers.
- To understand the impact of different elements of the production system and supply chain on carbon emissions (and removals).
- To encourage resource use efficiency and waste reduction, where possible.
- To identify where adaptations could be appropriate.

"One of the changing roles of the CGA is to steer the Cucumber Industry towards technological advancement combined with environmental sustainability. The two targets are inextricably linked…"

Overview of carbon accounting

How:

- Decide whether the whole operation or only part of the operation is being included in the calculations.
- Measure & monitor at appropriate levels of granularity to allow for accurate modelling of crop production, associated supply chains and inputs.
- Select carbon auditing methodology and use year-after-year to monitor change.
- Identify areas where emissions originate and take steps to reduce before offsetting the remainder (if aiming for neutrality).

Overview of carbon accounting

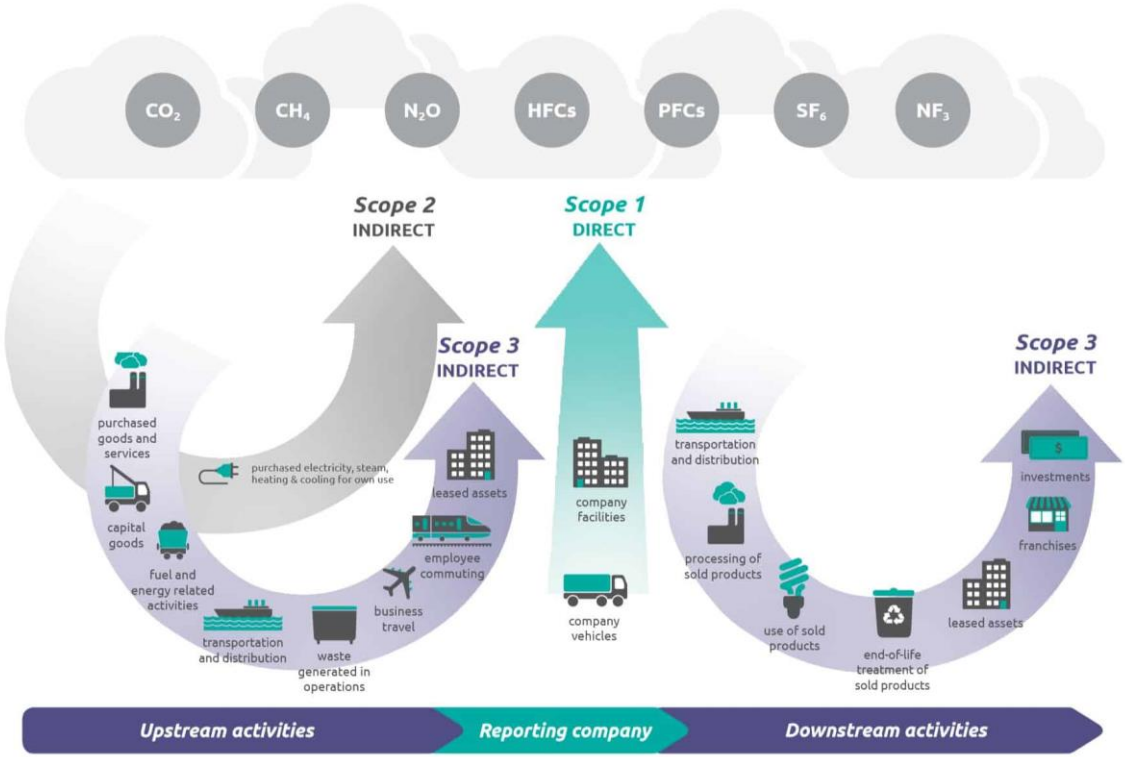
What:

- Based on LCA approaches, carbon calculators are designed to simplify calculations and make them accessible to more users.
- Calculators are built around emission factors (direct & modelled).
- Inclusions, exclusions and assumptions, in each calculator, can give the same grower different results based on the calculator used.
- Results are pegged to marketable yield.

Calculation standards and structure

Greenhouse Gas	100 Year Time Period			20 Year Time Period		
	AR4 2007	AR5 2014	AR6 2021	AR4 2007	AR5 2014	AR6 2021
CO_2	1	1	1	1	1	1
CH_4 fossil origin	25	28	29.8	72	84	82.5
CH_4 non fossil origin			27.2			80.8
N_2O	298	265	273	289	264	273

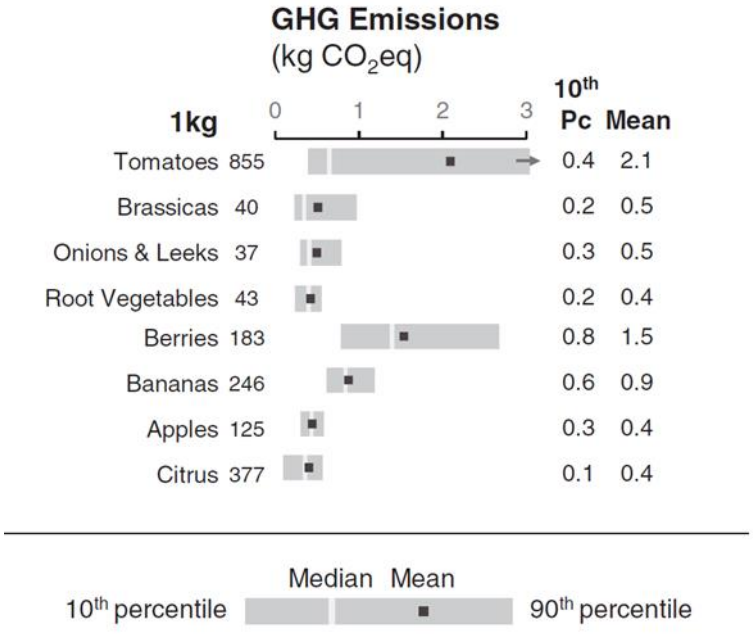
Calculation standards and structure

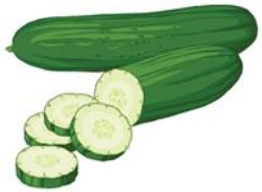


Methodologies & standards

- Guidance and standards may or may not be adhered to in their entirety, and will depend on their appropriateness for specific use cases.
- There may be methodological incompatibilities between standards, which force developers to determine priorities for their user base.
- Standards and guidance commonly used include:
  - IPCC methodologies
  - GHG protocol
  - PAS2050 and PAS 2050-1
  - Various ISO's (e.g. 14040, 14044, 14064 series, 14067:2018, etc.)

Crop production emissions values





1.68 - 3.79 kg CO_2e / kg

0.90 - 1.66 kg CO_2e / kg

1.30 – 2.91 kg CO_2e / kg

Source: Poore et al., Science 360, 987–992 (2018)

Carbon audit data requirements

- Crop, resource and process specific data
- Well-defined boundaries of the calculation are needed
- Do you have enough visibility to ensure robustness
- Disparities in production practices should be segregated, e.g. different crop species, cultivars with different yield:input, alternative waste streams
- Seasonal variations for AYR cropping should be evaluated separately
- Should be based on product as supplied, i.e. include storage, pack house operations and packaging materials
- Attribute farm-level systems & processes to crop(s) appropriately

Crop specific data

PLANT MATERIAL

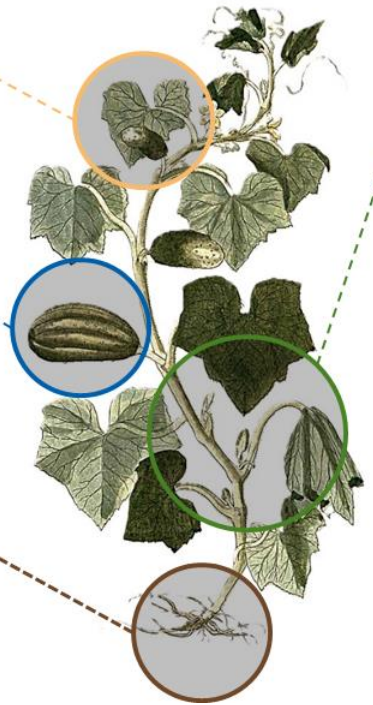
- Seeds or plants (including medium)
- Where these are being sourced (to calculate transport)

HARVESTED PRODUCE

- Marketable yield (can include value addition or surplus schemes)
- Waste produce & disposal route

BELOW GROUND BIOMASS

- Calculated by standard ratios
- Waste streams (grouped with growing media)



ABOVE GROUND BIOMASS

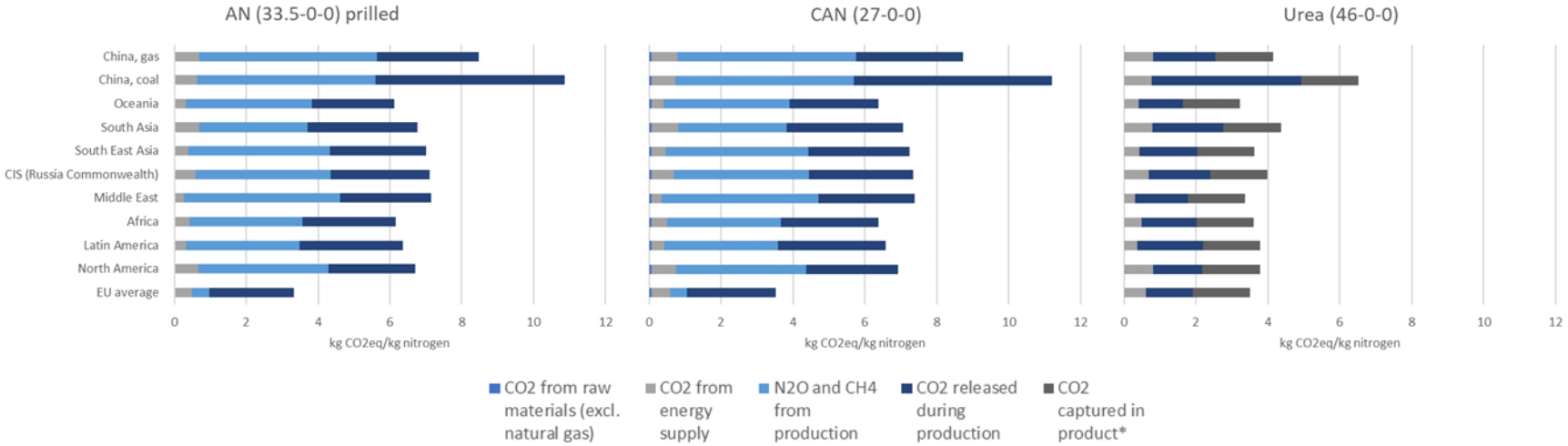
- Fresh Weight (cuttings & crop removal) / Harvest Index
- Waste streams

WASTE

- Waste from all parts of the plant need disposal
- Disposal method (and resources consumed) are included
- Disposal method determines how GHGs are emitted & in what form

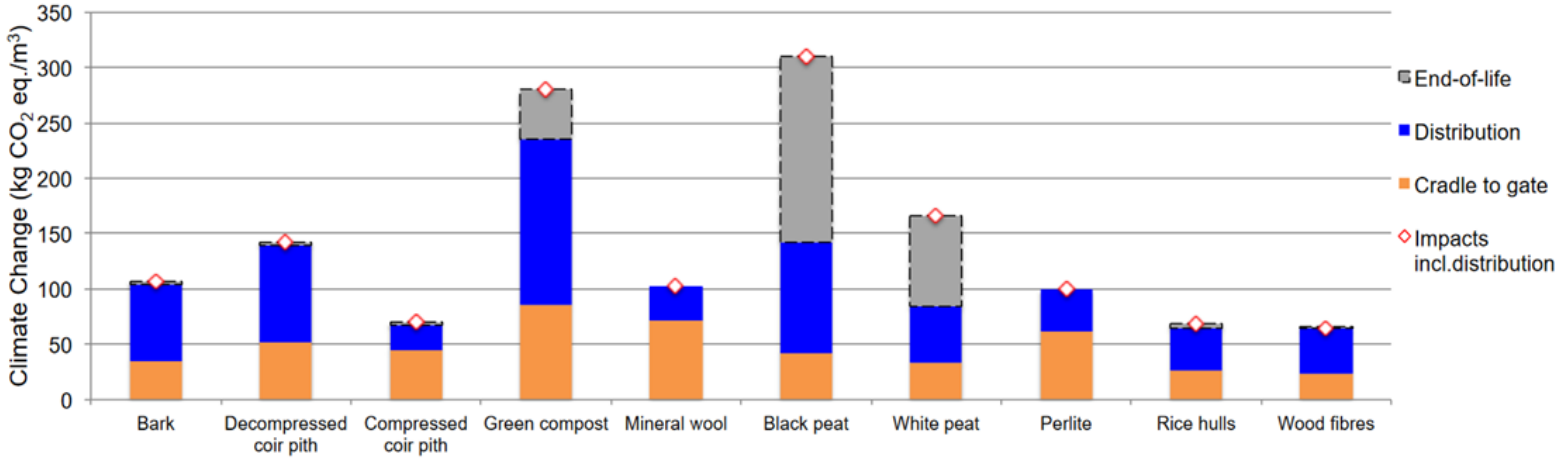
Resource specific data

Fertiliser production



- Fertiliser choice and country of production impacts embodied emissions
- CO_2 captured during production of Urea is released when applied

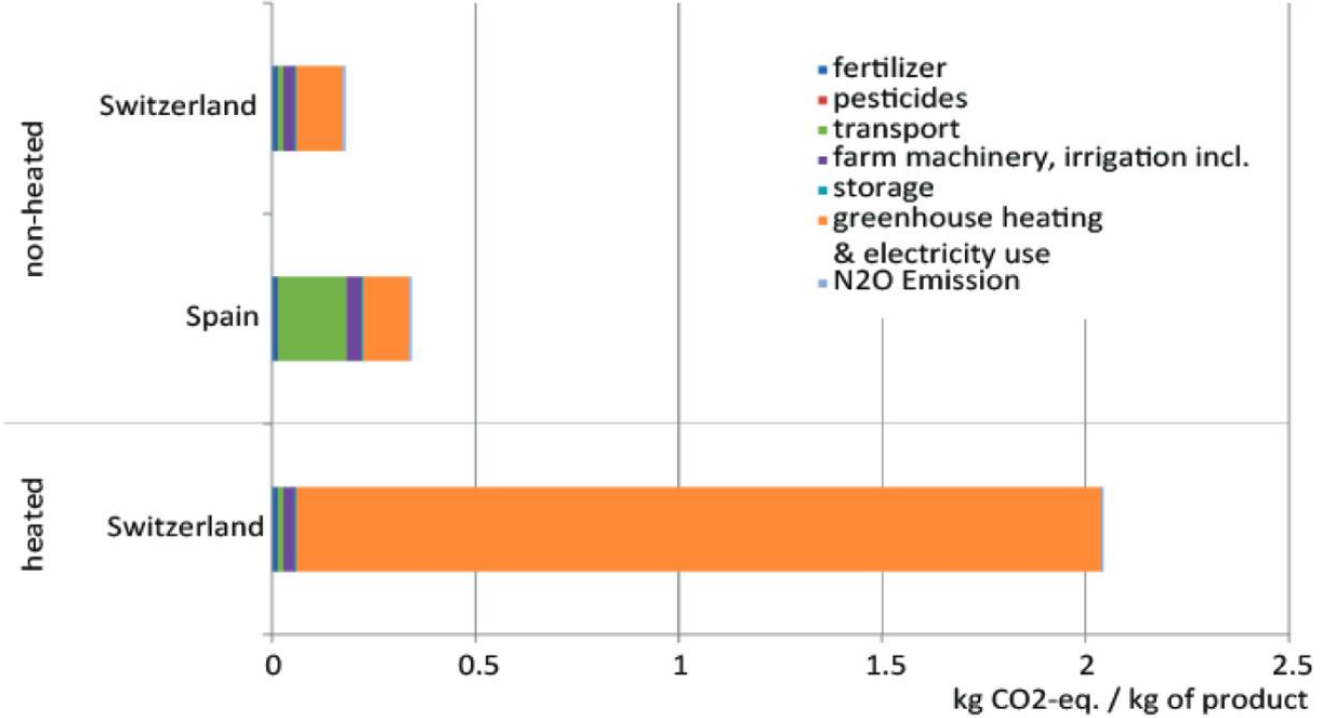
Growing media



- Above covers extraction, production & transport to Europe (i.e. embodied)
- Waste streams can be medium specific & limited for some

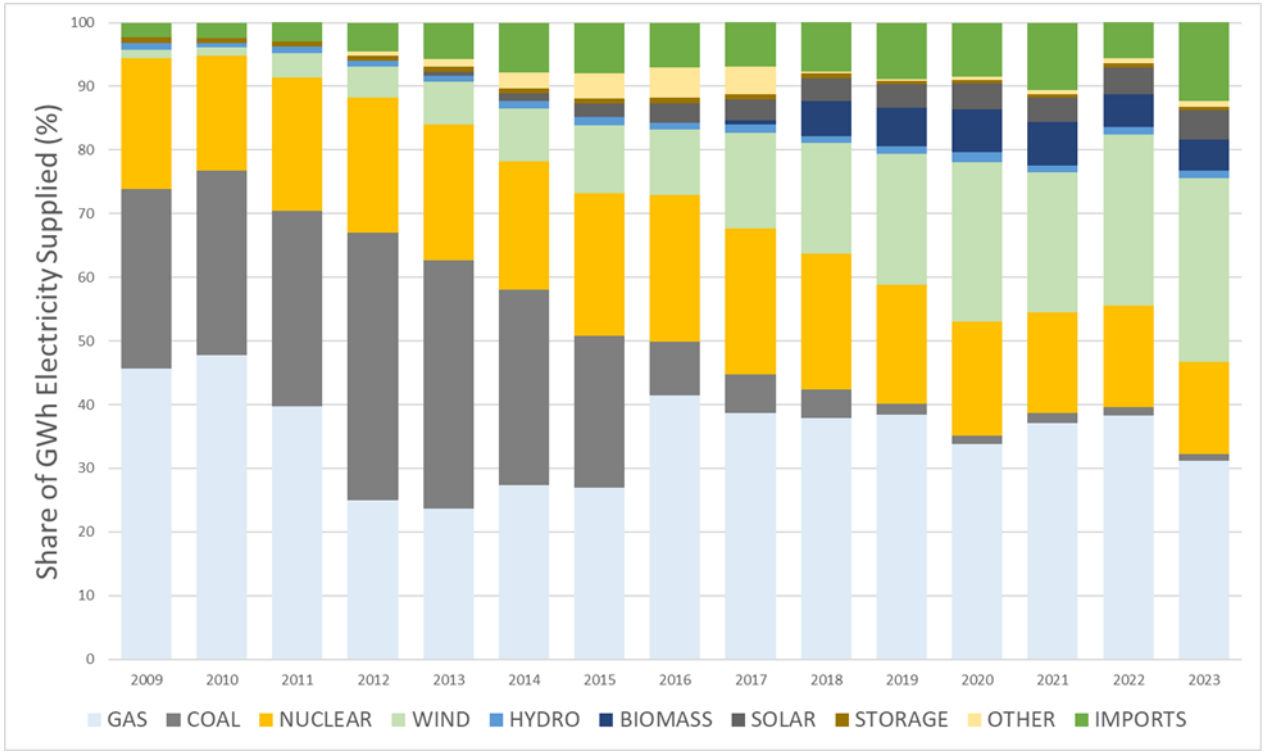
Source: Comparative Life Cycle Assessment of growing media

Cucumber emissions



Source: https://pubs.acs.org/doi/10.1021/es2030577

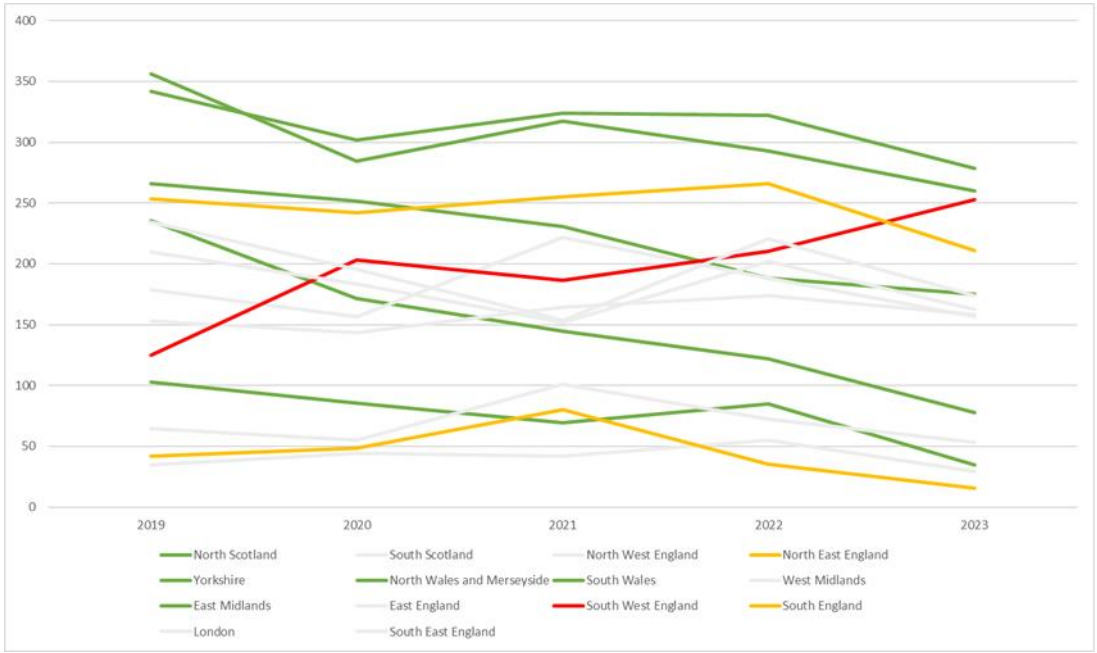
GB energy mix

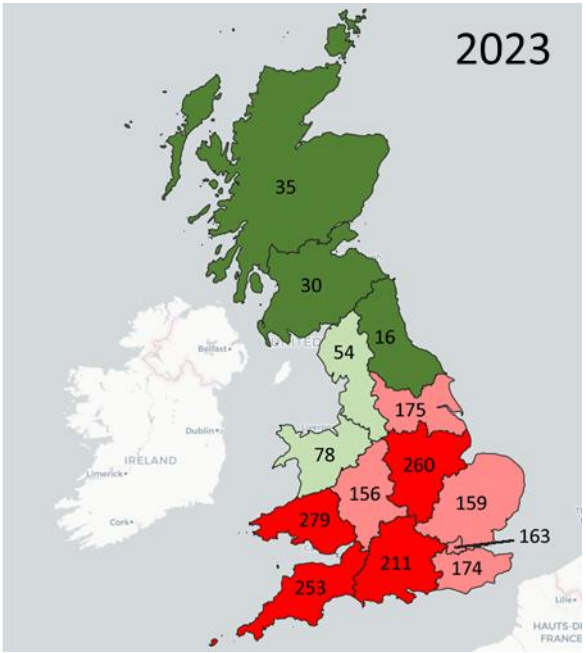


Fuel Type	Carbon Intensity gCO_2/kWh
Biomass[i]	120
Coal	937
Gas (Combined Cycle)	394
Gas (Open Cycle)	651
Hydro	0
Nuclear	0
Oil	935
Other	300
Solar	0
Wind	0
Pumped Storage	0
French Imports	~ 53
Dutch Imports	~ 474
Belgium Imports	~ 179
Irish Imports	~ 458

Data Source: NESO

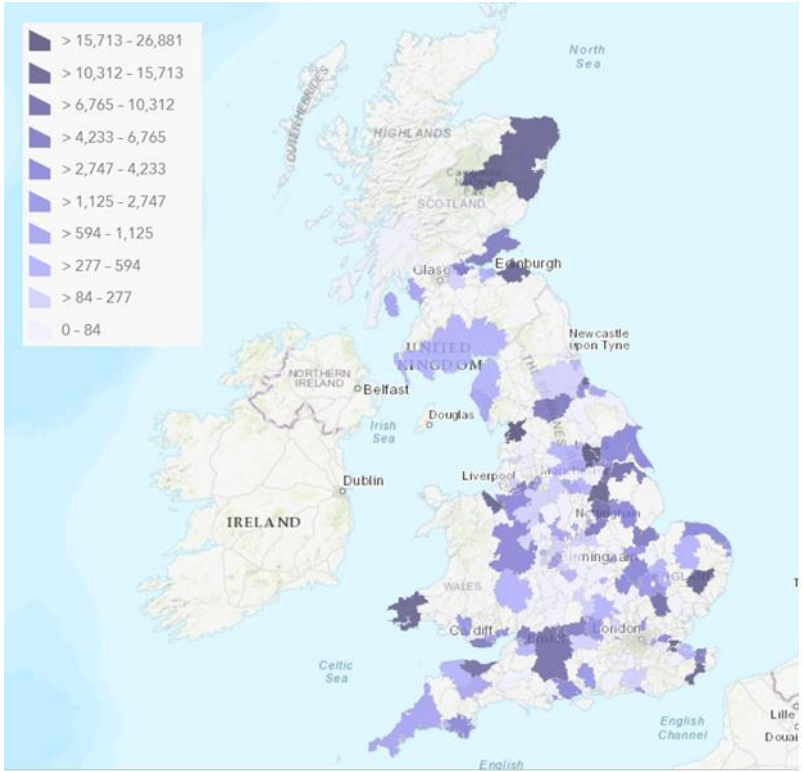
Annual av. carbon intensity by DNO region

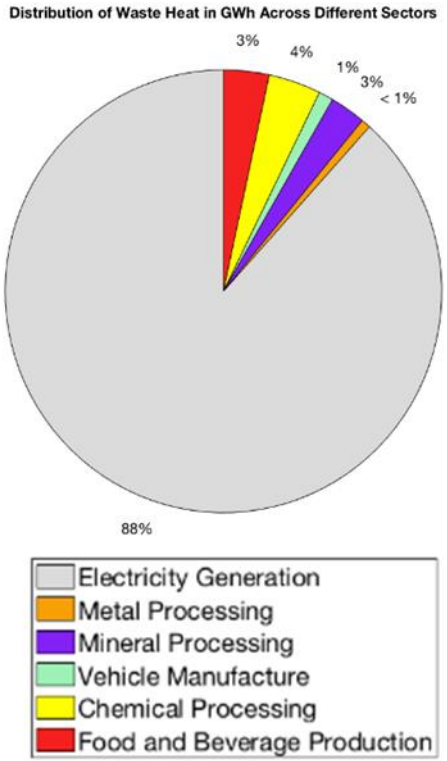




Data Source: NESO; **Units:** gCO_2/kWh

Estimated GB waste heat



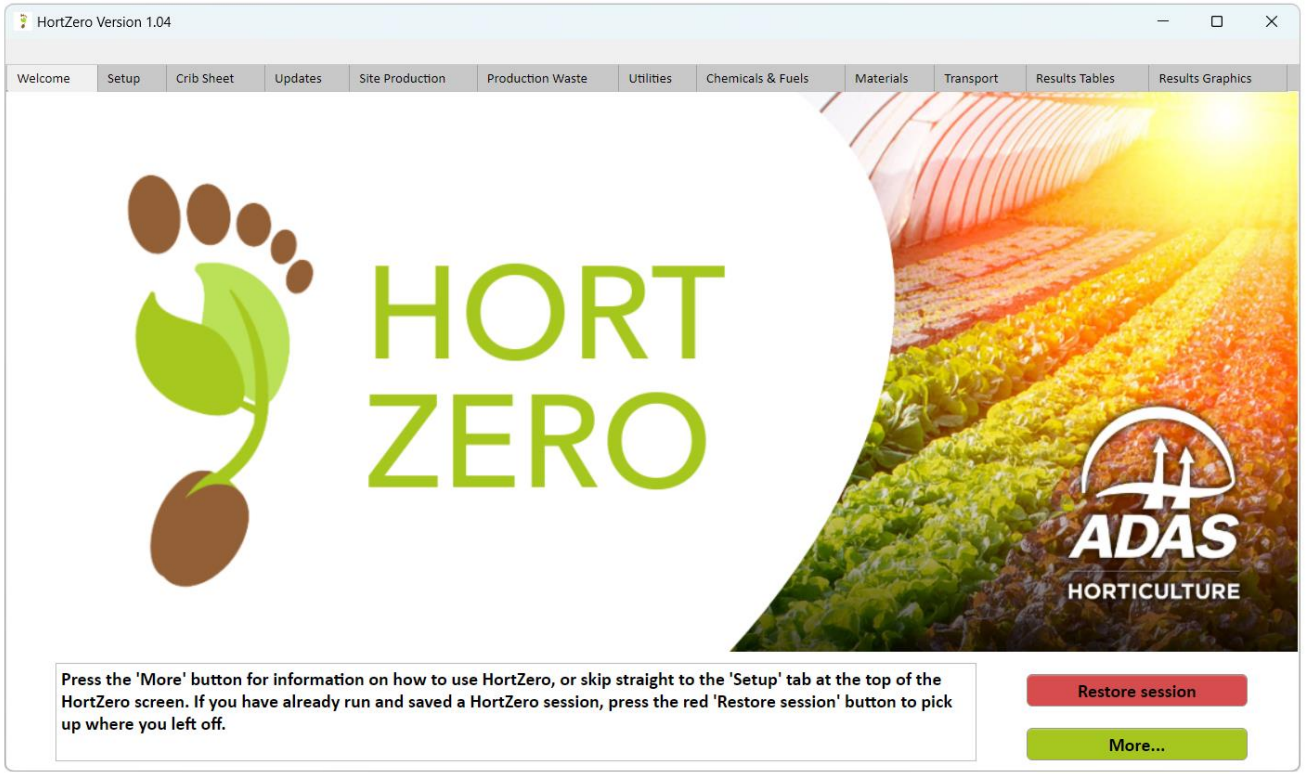


Source: Durham Energy Institute, Durham University; **Units:** GWh

Emissions reductions - cumulative impacts

- Combination of potential quick wins (e.g. fertiliser selection, recycled & recyclable materials), equipment selection and maintenance, and thorough understanding the origin of emissions and farm operations.
- Emissions can only be reduced and not eliminated.
- Reductions, where practical, should be combined with on-farm activities which capture and store carbon (explore SFI, and similar mechanisms).
- Where neutrality is the goal, consider offsetting unavoidable emissions. Review schemes under the Woodland Carbon Code (WCC) and the Peatland Carbon Code on the UK Land Carbon Registry

How to measure emissions

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