Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Carbon accounting & the mixed farm

May 2022

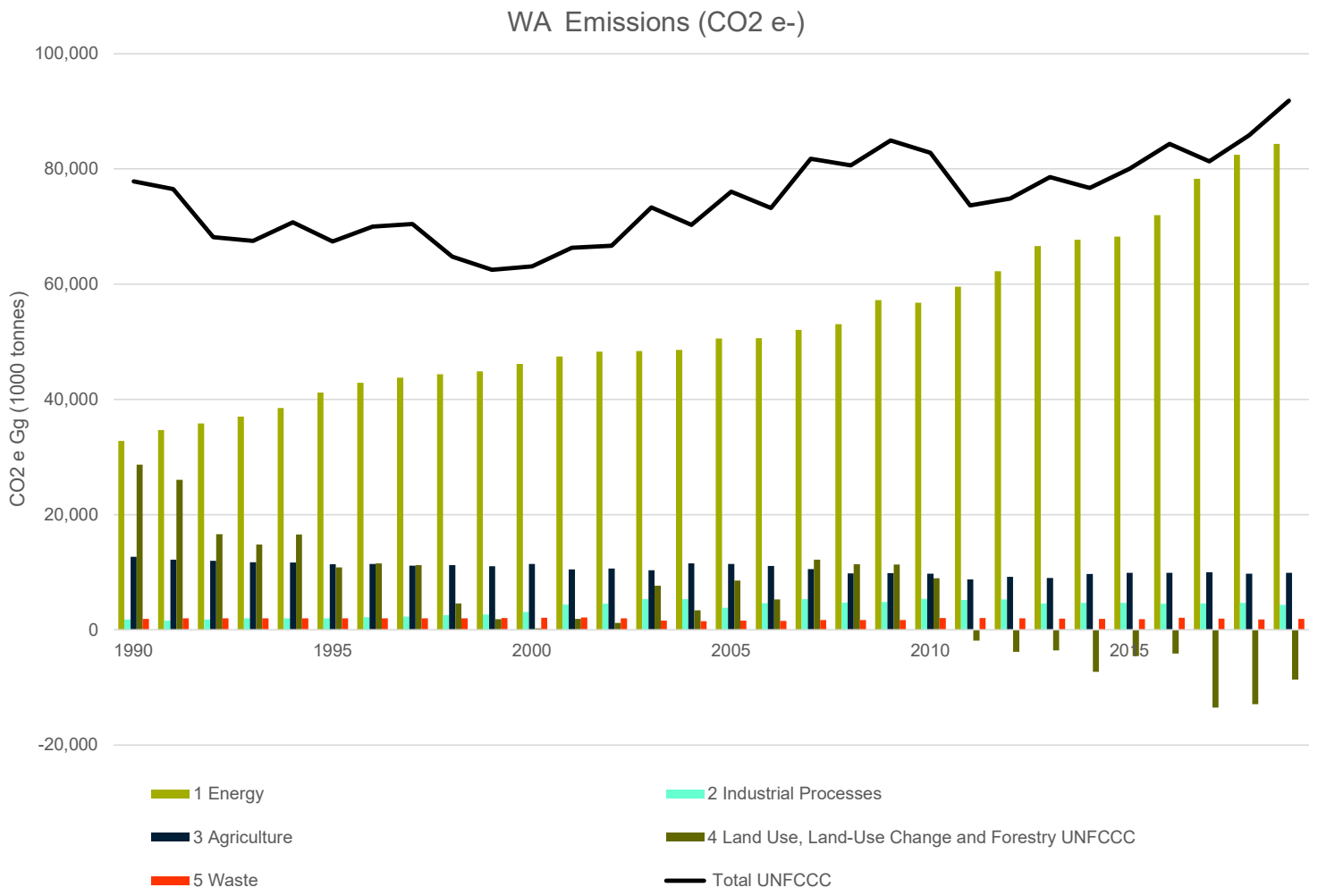
HOW DO WE MEASURE CARBON EMISSIONS?

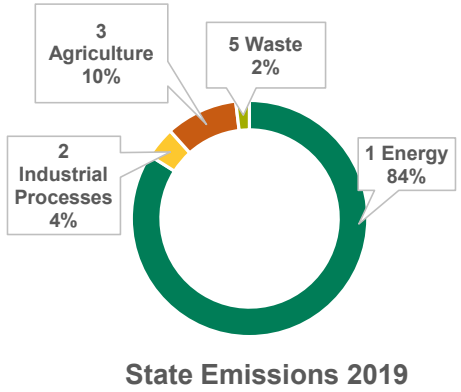
Global Warming Potential (GWP) Values - Not all gases are the same

1 tonne of CO2	=	1 tonne of CO2 e-
1 tonne of CH4	=	28 tonnes of CO2 e-
1 tonne of N20	=	265 tonnes of CO2 e-

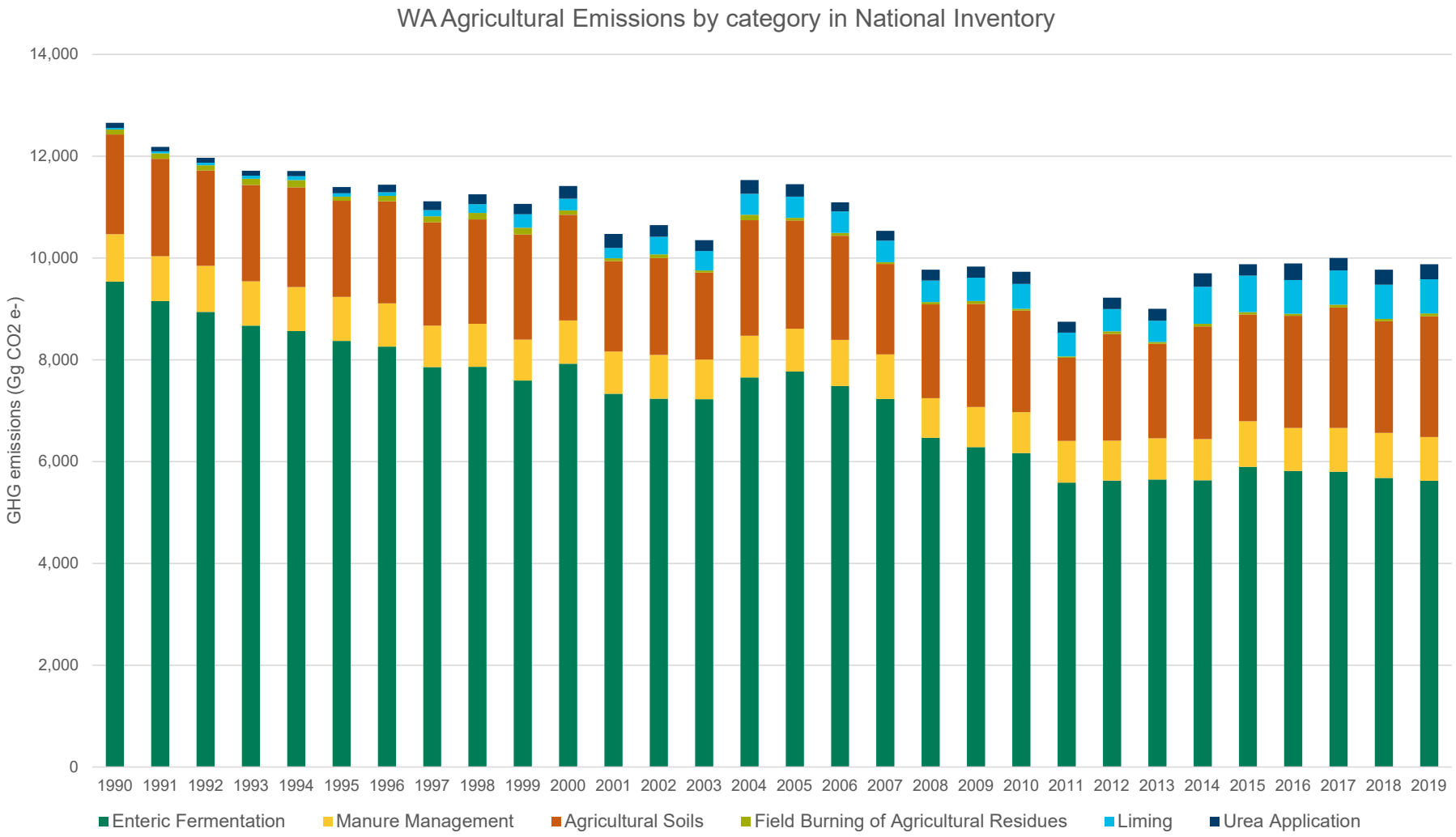
Emissions are measured in different ways

- National/state emission inventories - direct emissions by emission source and sector (eg energy, waste, agriculture)
- Life Cycle Assessment – usually from inception including all input through to sale of the product, including processing and transport.
- Business/farm Carbon Accounts include all levels of emissions to the point of export from the farm gate.





National GHG Inventory data ageis.climatechange.gov.au



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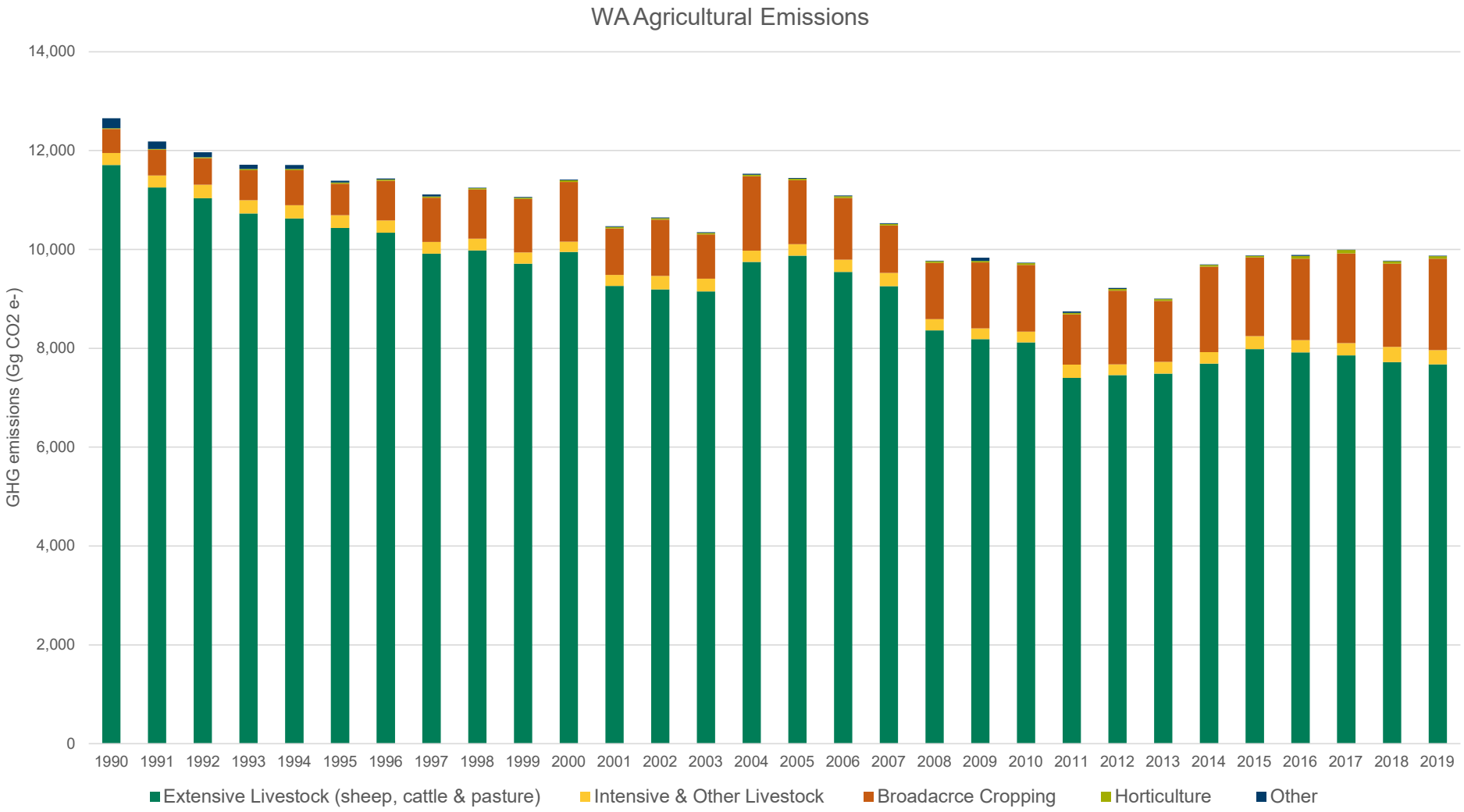
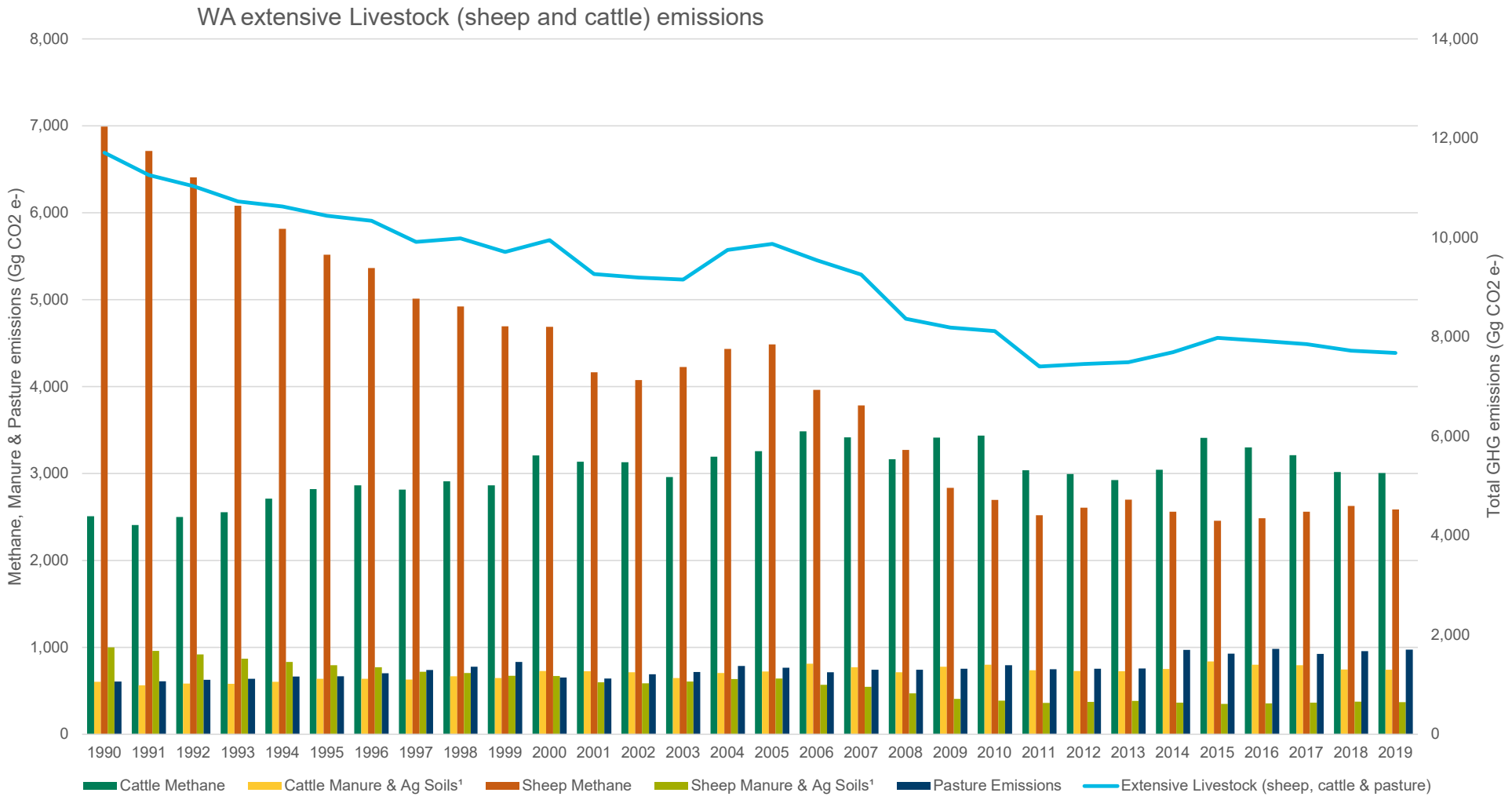
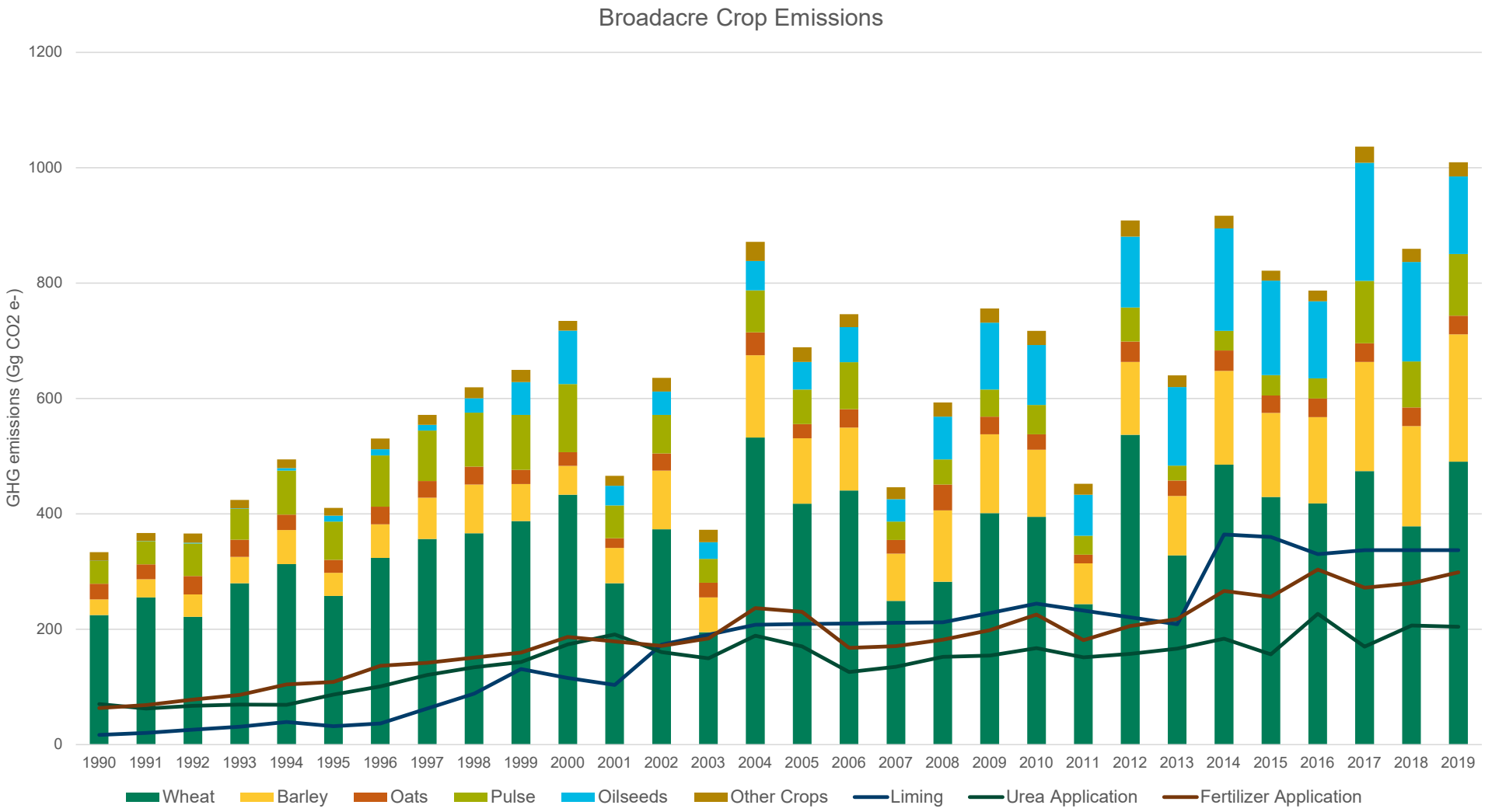

WA Agricultural Emissions
GHG emissions (Gg CO2 e-)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Extensive Livestock (sheep, cattle & pasture)
Intensive & Other Livestock
Broadacrce Cropping
Horticulture
Other


WA extensive Livestock (sheep and cattle) emissions
Methane, Manure & Pasture emissions (Gg CO2 e-)
Total GHG emissions (Gg CO2 e-)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Cattle Methane
Cattle Manure & Ag Soils¹
Sheep Methane
Sheep Manure & Ag Soils¹
Pasture Emissions
Extensive Livestock (sheep, cattle & pasture)


Broadacre Crop Emissions
GHG emissions (Gg CO2 e-)
1200
1000
800
600
400
200
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Wheat
Barley
Oats
Pulse
Oilseeds
Other Crops
Liming
Urea Application
Fertilizer Application

Agricultural Soils

Agricultural soils made up of:

*Indirect soil emissions involve nitrogen that is removed from agricultural soils via volatilisation, leaching, runoff, or harvest of crop biomass.

*Direct soil emissions include microbial nitrification and denitrification of fertiliser and manure nitrogen that remains in agricultural soils.

Liming and urea application takes into account the loss of CO_2 that was fixed during the manufacturing process or dissolution process. The NGHI estimates the application of lime across “cropland” and “grassland”.

Urea, $CO(NH_2)_2$, manufactured via the reaction of ammonia (NH_3) and carbon dioxide (CO_2) at high pressure and temperature.

Emissions from fertiliser application are calculated in the NGHI at a standard rate. In 2019 the assumptions on application rates were:

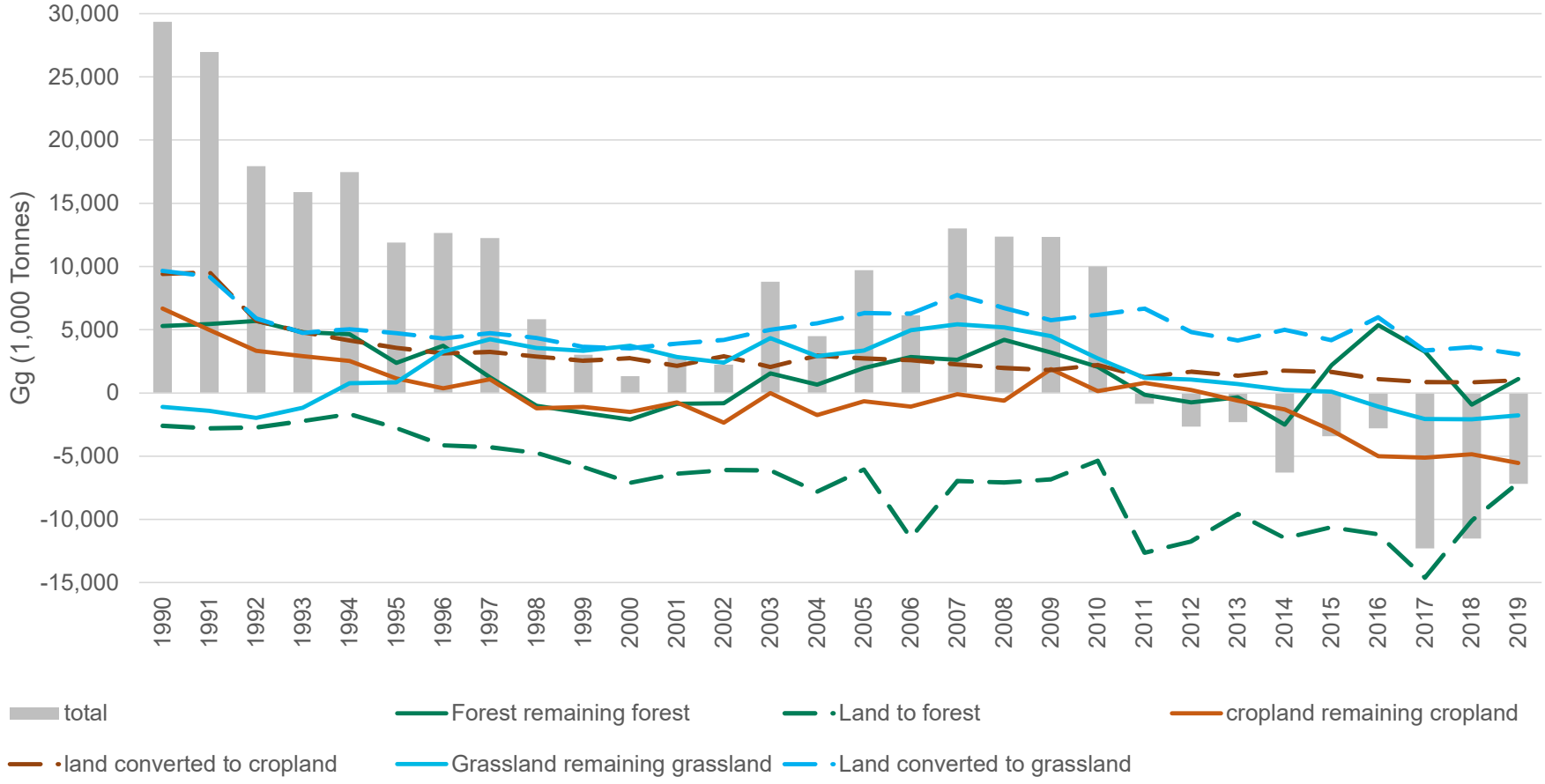
Irrigated crops and pastures: 80kg N/ha

Horticultural crops: 246 kg/ha

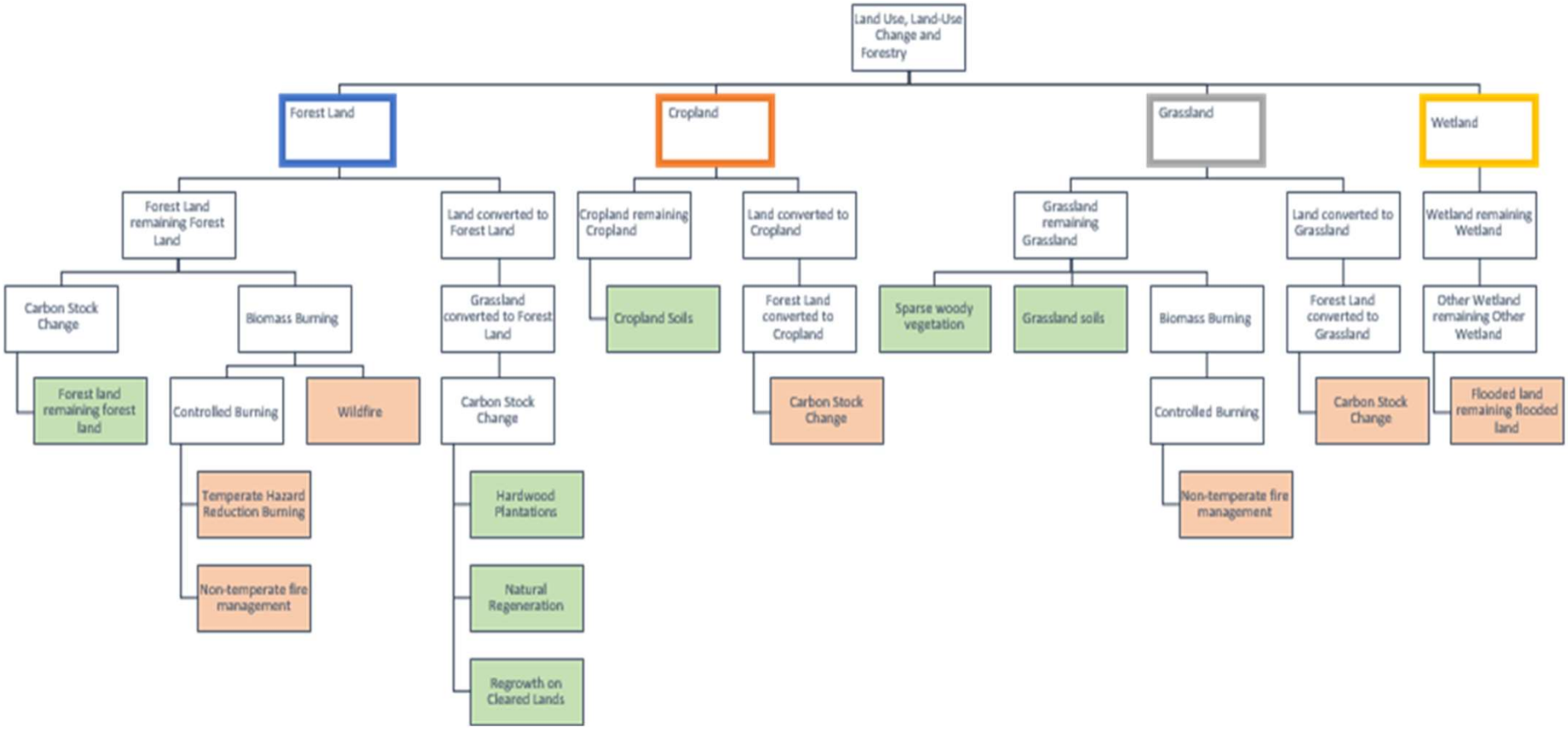
Vegetables: 125 kg/ha

With the remainder of the total fertiliser applied (from Fertiliser Australia) allocated to crops and pastures. The application of N fertiliser contributes to the estimation of emissions from booth direct and indirect nitrogen emissions.

Land Use Land USE Change (LULUC)



LULUCF sectors and categories



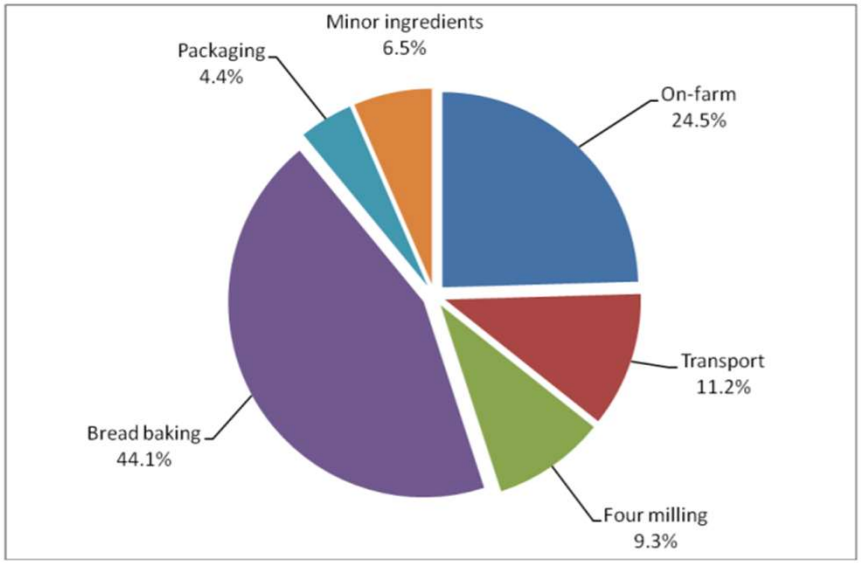
What is a Life Cycle Assessment (LCA)

- **LCA is a form of cradle-to-grave system analysis for a number of factors but often used for carbon and water impacts of a product**
- **Usually reported in terms of emissions intensity of product (carbon footprint)**
- **Can have any starting point or end point – depends on what the question is!**
  - All emissions pre and on-farm production to the point of processing
  - All emissions for a product at the consumer check out
  - Comparing impact of a range of pre-farmgate inputs

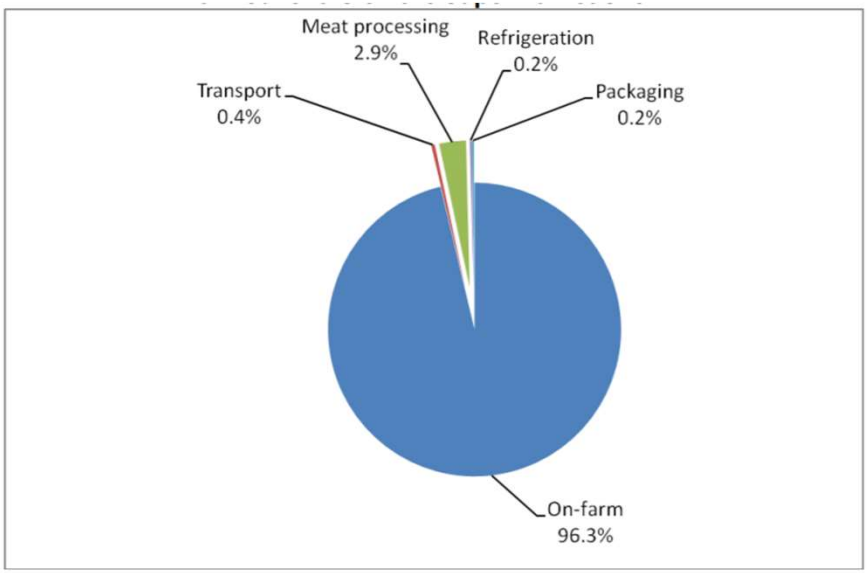
- **Have been done for many products over the years but many are using older emissions factors**

Relative contribution of the supply chain to the carbon footprint of fresh products on the supermarket shelf

Bread



Beef



Relative contribution of sectors or the supply chain to the carbon footprint of fresh bread on the supermarket shelf – Eady et al

Fresh food GHG emissions at the supermarket

Food Product	Carbon footprint (kg CO_2-e/kg product on supermarket shelf)
Bread	0.9
Tinned lentils	1.0
Beef, fresh boned meat	25.2
Lamb, fresh boned meat	19.4
Pork, fresh boned meat	6.3
Chicken, whole fresh	2.9
Whiskas Ocean Fish ®	1.3
Pedigree Meaty Bites ®	0.9

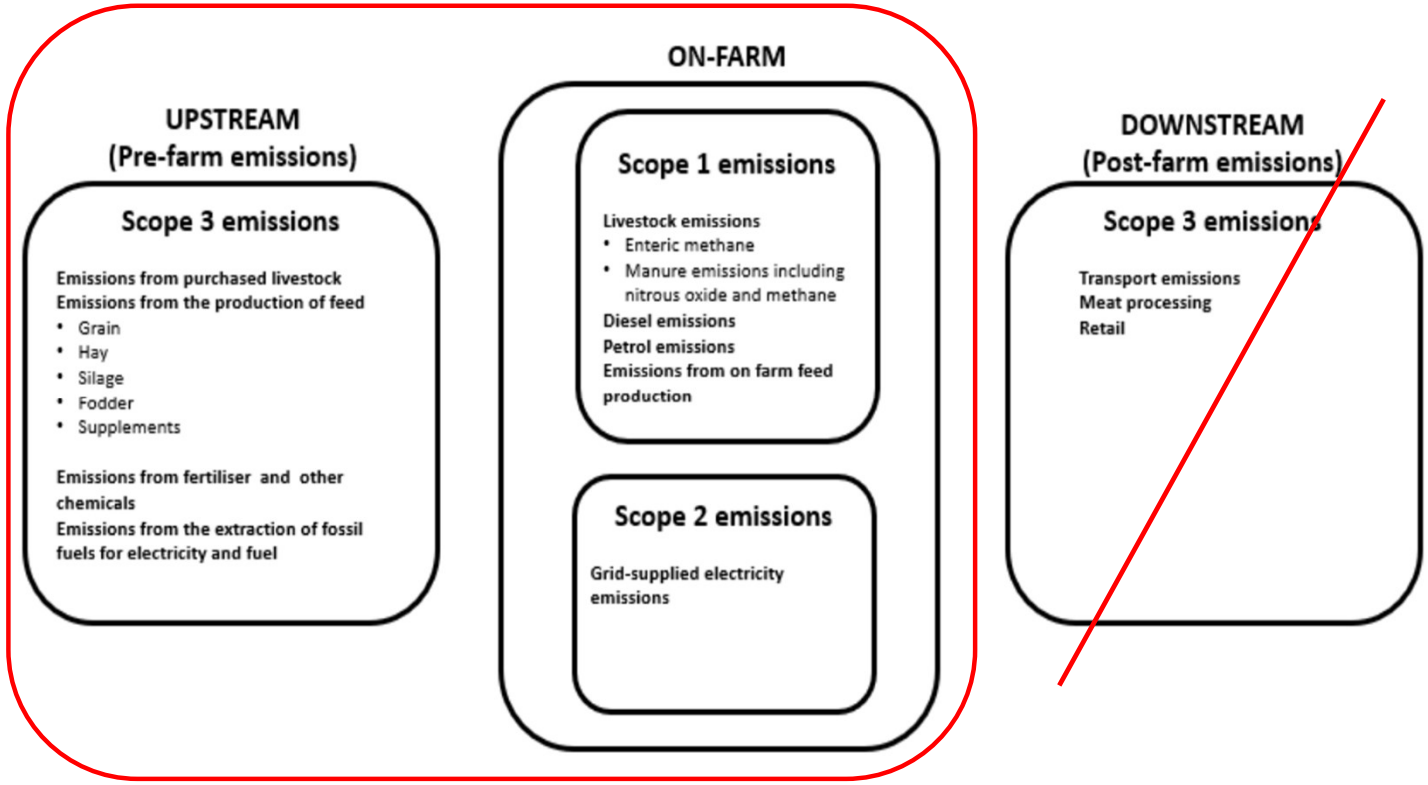
1. *Meat consumed converted to live weight assuming meat yield of 40%.*
2. *Hot slaughtered carcass weight converted to live weight assuming 1.4 kg CO2-e/t HSCW for processing and 53% dressing percentage.*
3. *Meat consumed converted to live weight assuming meat yield of 64%.*

Project : Life Cycle Analysis for WA beef and sheep industries

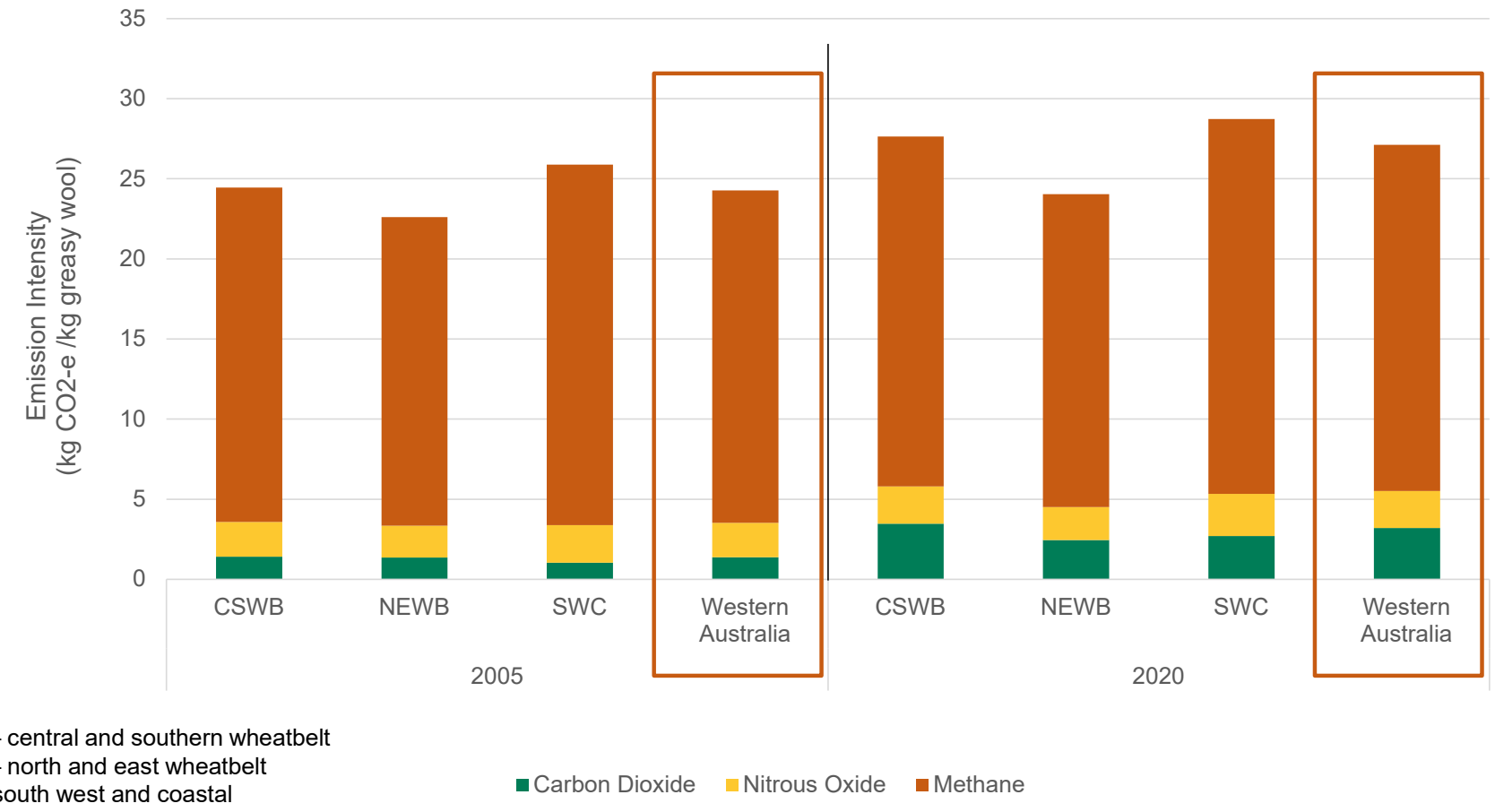
A Life Cycle Analysis (LCA) for carbon reports the full life-cycle GHG emissions associated with the product – sheepmeat and wool and beef.

1. Complete 2 Life Cycle Analyses (LCA) focused on greenhouse gas emissions (carbon footprint) for the West Australian sheep and beef industries
2. Provide an understanding of the relative contributions of the three regions for beef and enterprise types for sheep to the state's emissions.
3. Identify carbon impact hotspots associated with the West Australian industry and identify information requirements to track environmental performance over time.
4. Explore improvement options for production in Western Australia, allowing the Department to understand and potentially set targets to reduce impacts over time.
5. These have been done at a national level for beef and wool but we want build WA so the information is useful to DPIRD to plan and for industry to understand the relative contributions of enterprise type and what the impact is if it changes.
6. The Harvest Road project outcomes supports this work

Sheep System Boundaries for LCA



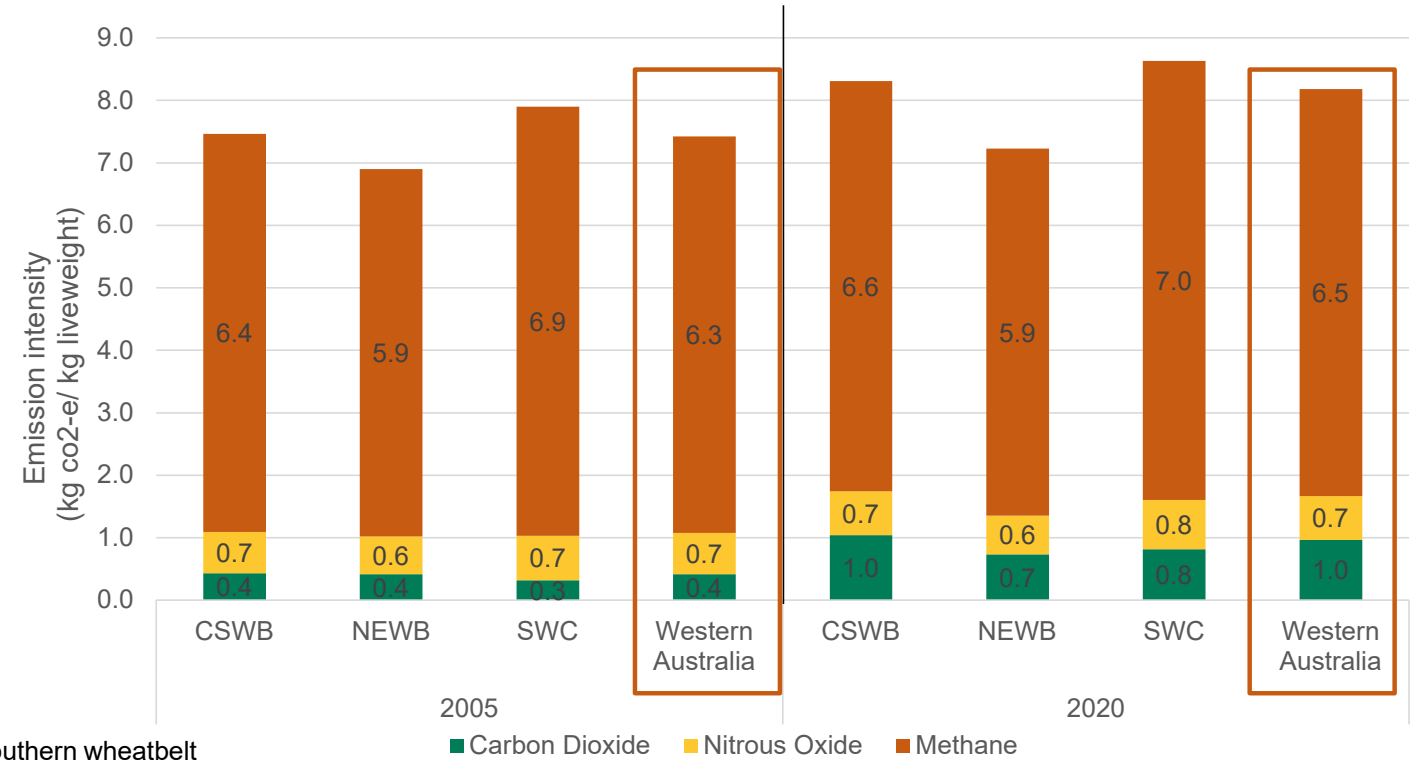
Greasy Wool Emission Intensity



CSWB – central and southern wheatbelt
NEWB – north and east wheatbelt
SWC – south west and coastal

Liveweight Emission Intensity

9% increase in GHG emission intensity for the WA sheep industry from FY 2005 (7.4 kg CO_2-e kg LW^{-1}) to 8.2 kg CO_2-e kg LW^{-1} in FY 2020



CSWB – central and southern wheatbelt
NEWB – north and east wheatbelt
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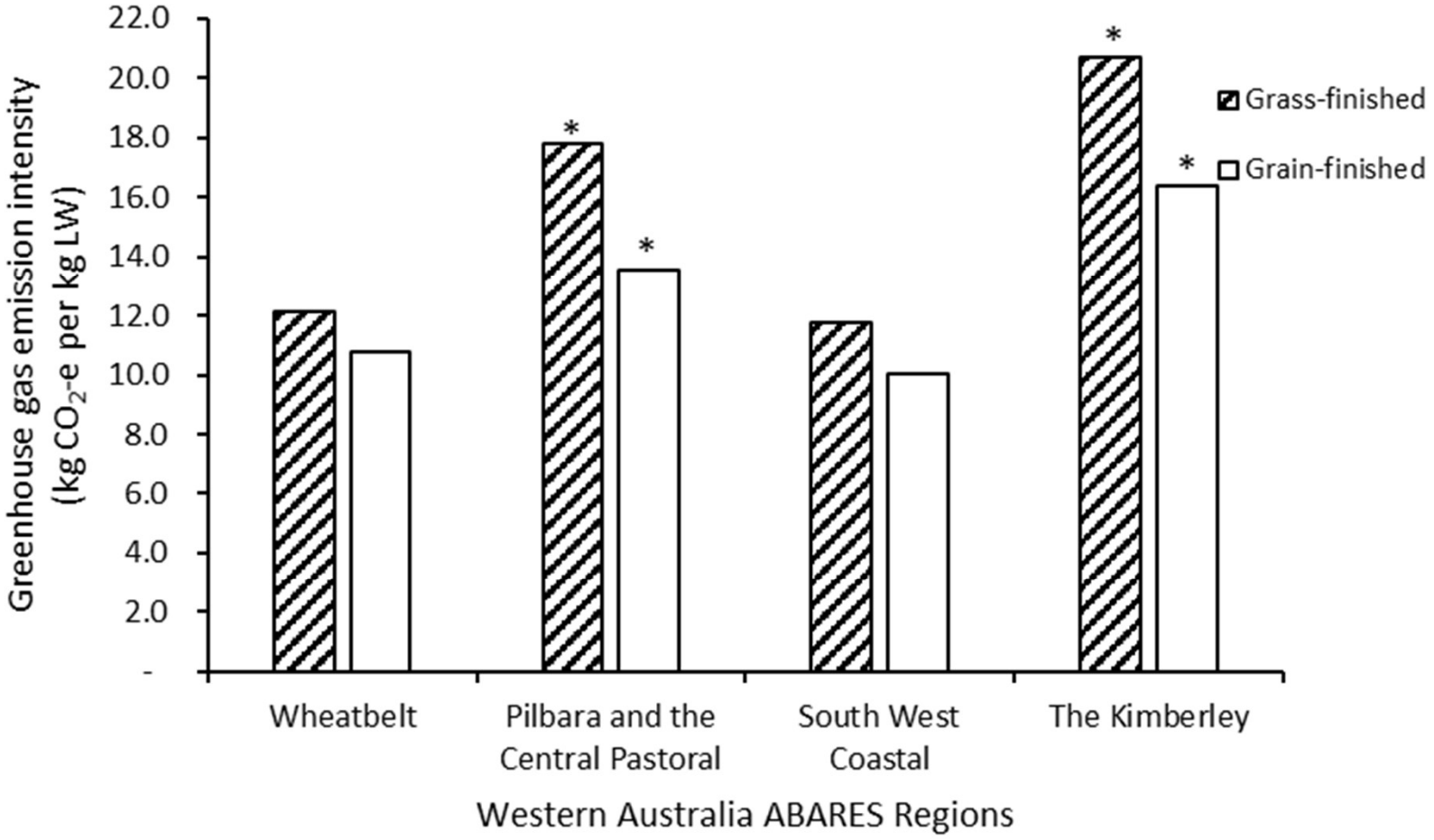
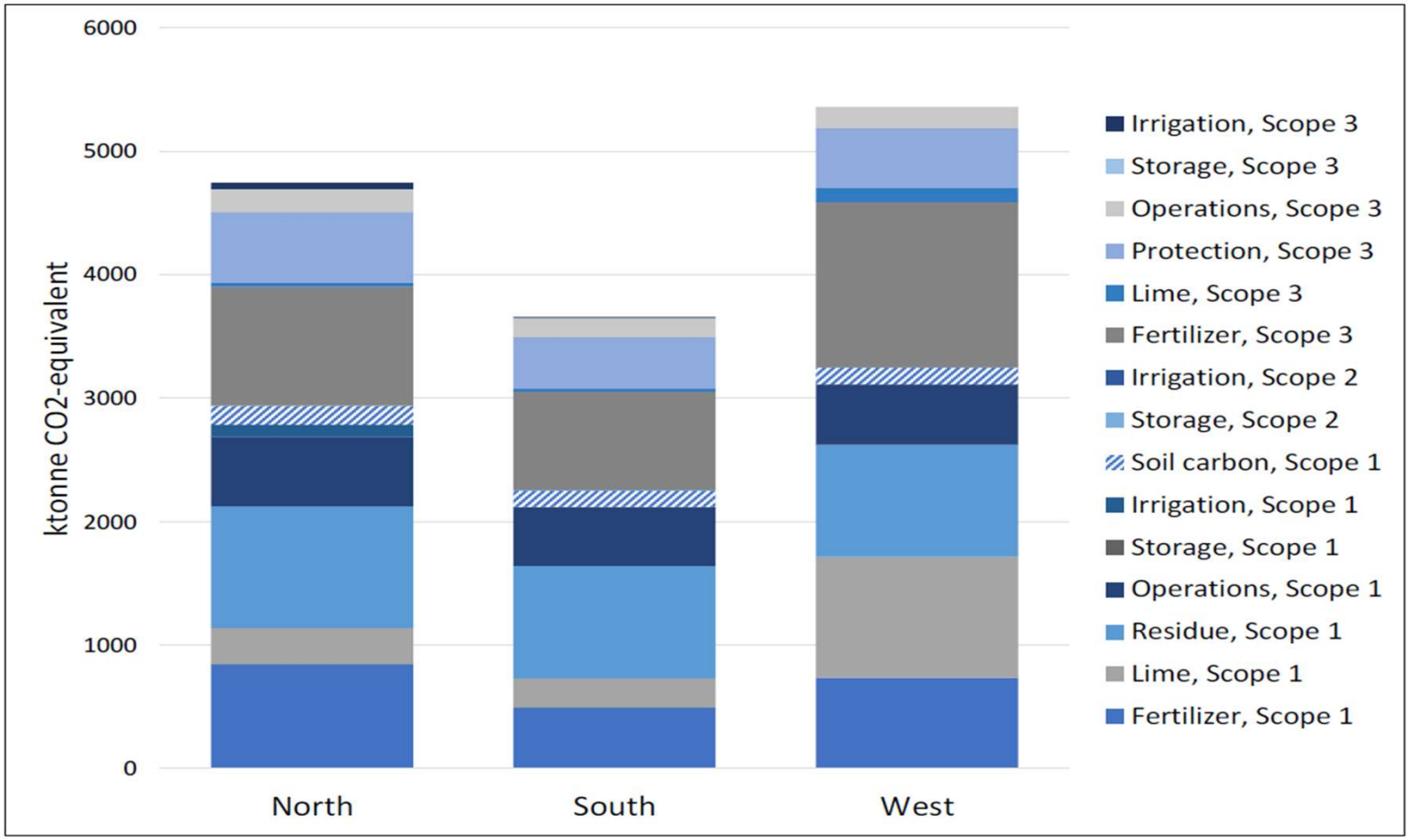
WA Sheep LCA : Productivity

- Flock productivity and breeding objectives have changed in the WA sheep industry over the past 15 years. Most notable is a substantial shift from wool to lamb production.
- No meaningful change in protein output from the flock between 2005 to 2020. There were multiple drivers for this: lamb marking rates improved and turnoff weight of lambs increased but wool cut per head decreased, counteracting any improvement in overall productivity
- Declining wool production led to a higher proportion of the impacts being allocated to sheep meat
- The reduction in wool cut was related to
  - a reduction in wether numbers, which declined 37% of the total WA flock.
  - lower fibre diameter, and therefore lower wool cut from 20.5um in 2005 to 19.2um in 2020
  - increase in lamb marking rate from 82.7 to 87.6% contributed to lower wool cut from breeding ewes
- The increase in liveweight production was demonstrated by sheep and lamb carcase weight. Hot standard carcase weight (HSCW) increased 8% in lambs, and 22% in sheep.

Beef Cattle LCA (2022)



Grain LCA (2022)



CSIRO 2022 Svenstre et al

On farm Carbon Accounting

- **A Carbon Account gives a business an account of the GHG emissions for that business and should include:**
  - Scope 1 - emissions that occur on site e.g. enteric methane, CO_2 from diesel
  - Scope 2 - electricity emissions
  - Scope 3 – emissions associated with purchased inputs
- **It gives an emissions value for the farm, emissions intensity of product (up to leaving the farm gate) and can give a value per hectare or per animal if required.**

- **This is the most valuable step you can take – it is a benchmark, valuable for scenario testing, and setting direction of your business plan**
  - Benchmark – see how your efficiency and overall emissions stack up with others in a similar production environment
  - Scenario testing- identifying hotspots of emissions and then seeing how changing practices will influence your carbon account
  - Inform your business plan – as a serious grower with an eye to future markets or as someone wanting some good cash to continue farming without participating (or making it harder to participate in) markets for low GHG products in the future.

- **A carbon account can be unofficial – use an on-line tool to see where you're at**
- **A carbon account can be official – have a consultant conduct an account and consider options of generating carbon credits – either to keep for your own business or to sell**

Revegetation and sequestration

Planting oil mallees or mixed eucalypts at Merredin, gives 7.2 tCO2-e per ha/year over a 25 year period.

Total farm emissions for the 100% cropping example in the eastern Wheatbelt were 2184 t CO_2 e- per annum.

It would take an ~ 305ha of revegetation to completely off-set the farm emissions.

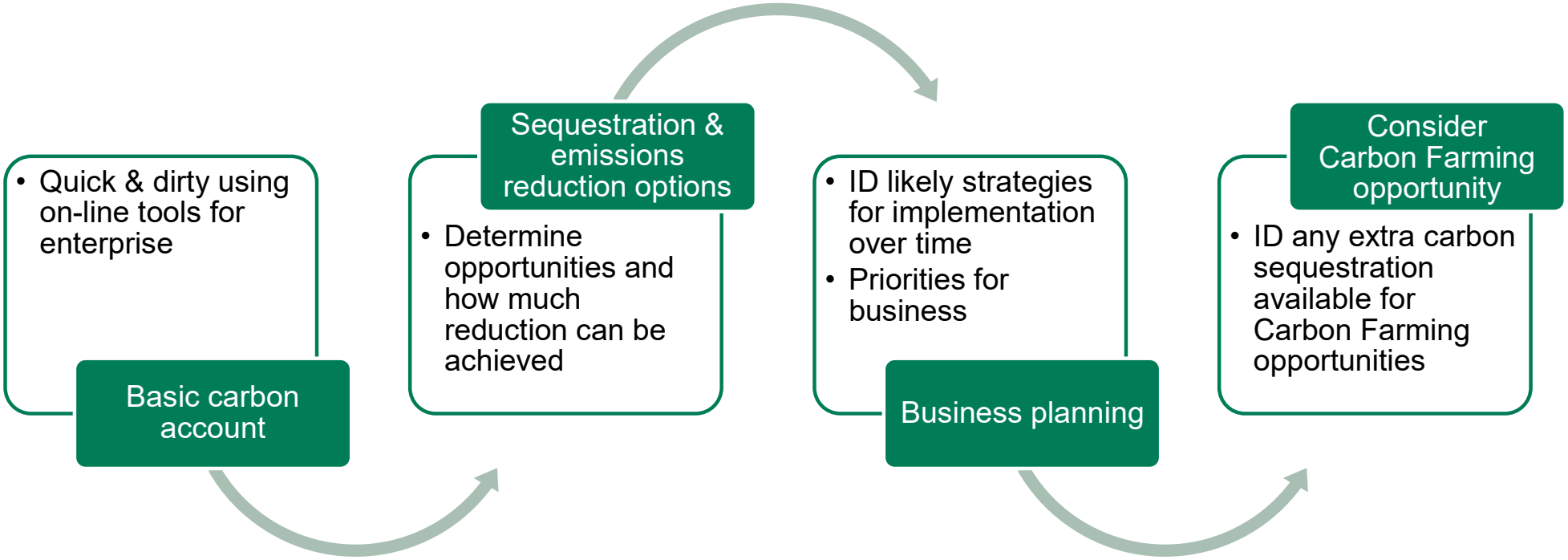
The farm has 4900ha of arable land out of a total 5100ha. Assuming little vegetation exists on farm already, would need to plant:

- 120ha of arable land and
- 180ha of non-arable land

to off-set all emissions.

Additional benefits come with planting vegetation on farm

Process to achieve carbon neutral



Thank you

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For other information: agric.wa.gov.au//climate-change/livestock-and-carbon