Understanding emissions – making sense at the farm scale

Alison Kelly, Farm Emissions Specialist

AGRICULTURE VICTORIA

Supporting farmers to reduce emissions on farm

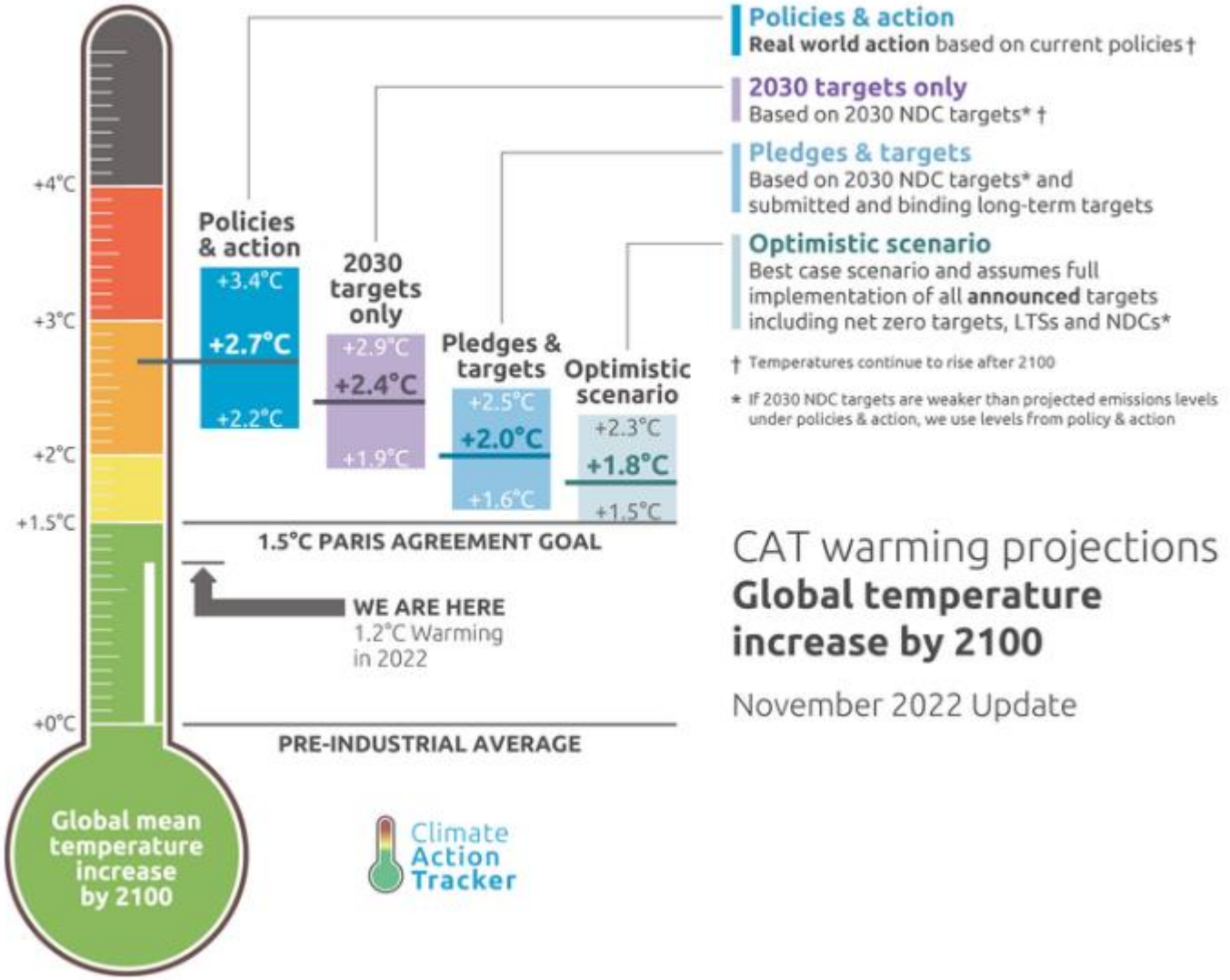
Quick exercise before we begin … questions to gauge the room's knowledge of the topic of carbon and emissions?

Why all the fuss about emissions?

The global challenge: Limiting global warming to prevent the worst impacts

Current global commitment (Paris Agreement) goal is limiting warming to 1.5 degrees

Current pledges and targets will not get us there



Source: https://climateactiontracker.org/

But what does that all mean for me and my farm?

There are two elements at play for agriculture:

1. **Demonstrating a reduction in emissions -** Markets and investors are pricing in emissions reduction to their activities – climate change is a material risk to businesses, so resources and effort are being directed to reducing this risk. Either through changes in financing criteria and/or purchasing power

2. **Responding to and adapting to a warmer climate -** Agricultural production will be impacted by continued warming of our climate – we have an interest in supporting actions to reduce warming

So what?

- Expect to be asked about your emissions (if not now, in time, KNOW YOUR NUMBER)
- Expect consumer interest in 'low-emission' product options (where possible, REDUCE YOUR EMISSIONS AND PROTECT ANY SINKS)

Where to start - Calculating emissions on your farm is possible now

- FarmPrint
  - CSIRO - initial focus on dryland broadacre cropping
  - Cradle-to-farm-gate approach
  - Still in development
- CoolFarm*
  - High level of detail
  - Good for international comparison
  - Not consistent with Australian NGGI method
- FarmGAS*
  - Comprehensive coverage of all industries
  - AFI - not current with inventory method
- **LOOC-C**
  - **Sequestration estimate**
  - **Selection of ERF methods**
  - **ERF methodology calculations**

- **GAF tools**
  - **UniMelb/PICCC - Excel based**
  - **Separate tools for Cropping, Livestock, Dairy, Feedlots, Sugar, Cotton etc**
  - **Recent upgrade to Climate Active format**
- DGAS
  - Dairy-specific tool, with D-GAF underneath
  - Includes pre-farm emissions
  - Recent upgrade to Climate Active format
- Zero30 Beef Farmer Carbon Tracker Tool
  - UNE - Web-based version of B-GAF
  - Climate Active format
- FullCam
  - Official carbon model for Australia
  - Tree and soil carbon only
  - Complex and spatial

Australian Dairy Carbon Calculator

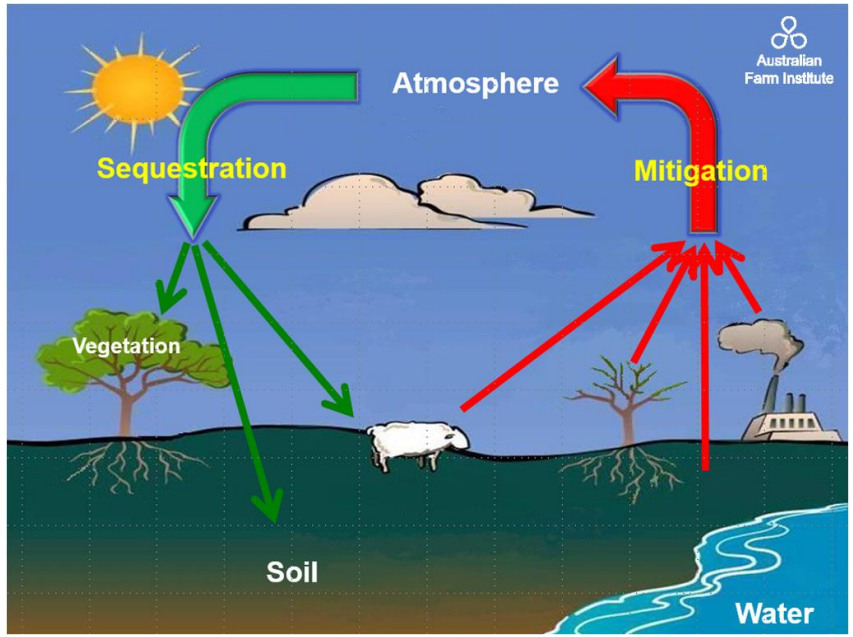
Tips before starting – know your purpose, choose the most appropriate tool/approach for what you need, ensure you have the appropriate data/records, seek advice

Rule of thumb: Estimates are ‘generally right, but specifically wrong’. Allow for +/- 20% accuracy.

Where to start – a basic understanding of the farm carbon (and emissions) cycle is needed

Carbon Sinks

Trees &
Vegetation
Soil carbon
Biochar



Emissions

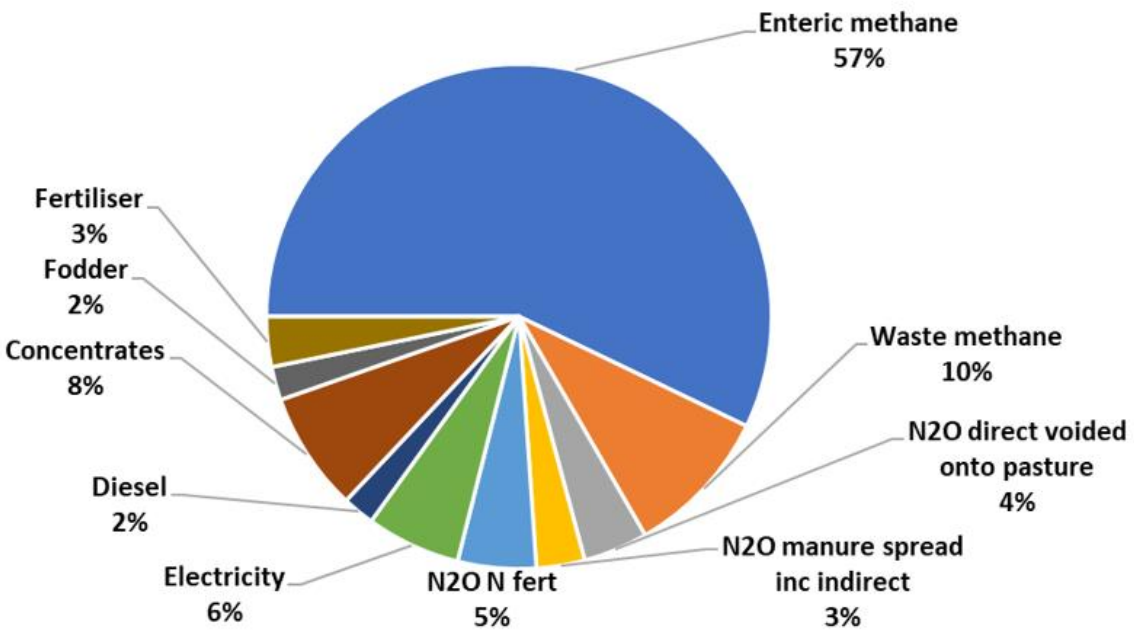
Methane (ruminant livestock, effluent)
Nitrous oxide (soils, fertiliser, livestock)
Carbon emissions via fossil fuels

Upstream emissions via inputs

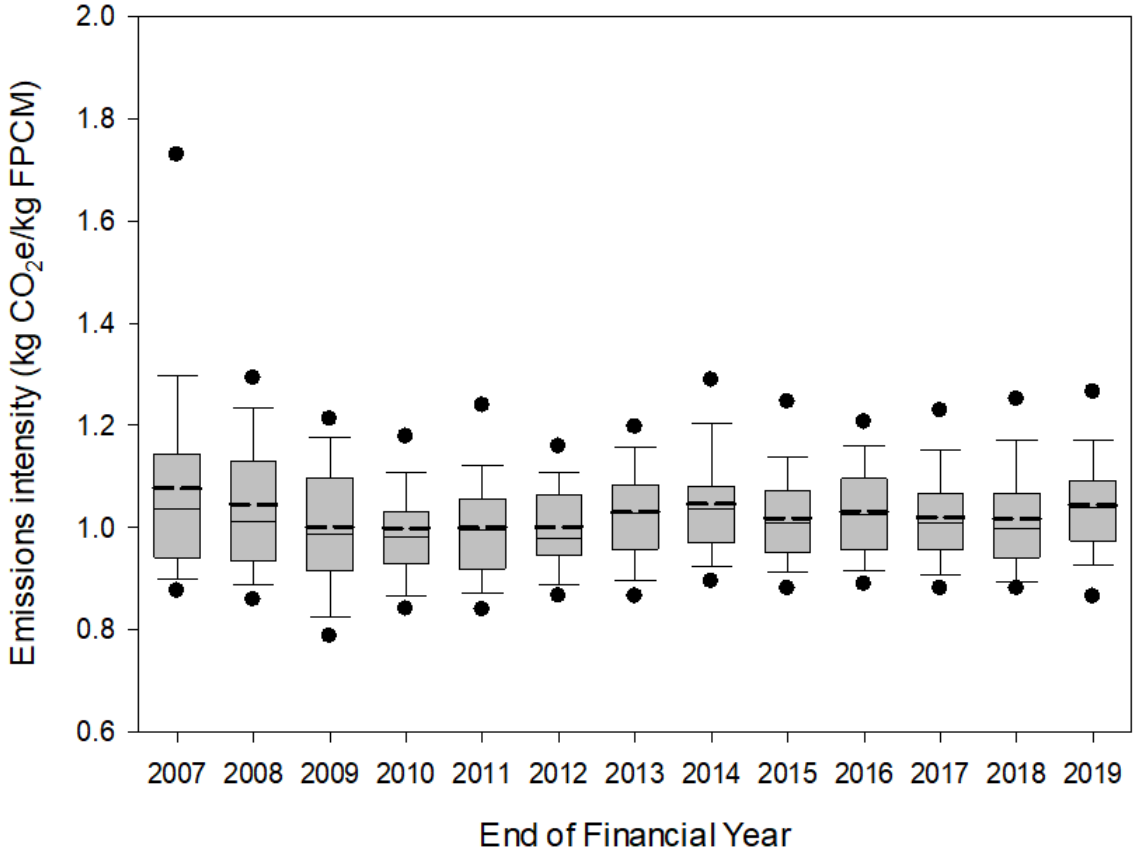
- Lots of ‘short term’ carbon cycling in and out b/n farm and atmosphere (grass, grains, crops, animals etc)
- Farms have a “stock” of existing carbon, with a ‘flux’ of annual gains and losses.
- Global warming potential – a common approach for expressing all GHG emissions (as carbon dioxide equivalents) over a long time period.

We are not starting from zero knowledge. Dairy already has emissions data, benchmarks and tools available to support farmers

Sources of emissions – typical dairy



Trend in emissions intensity



Source: DairyBase full dataset analysis

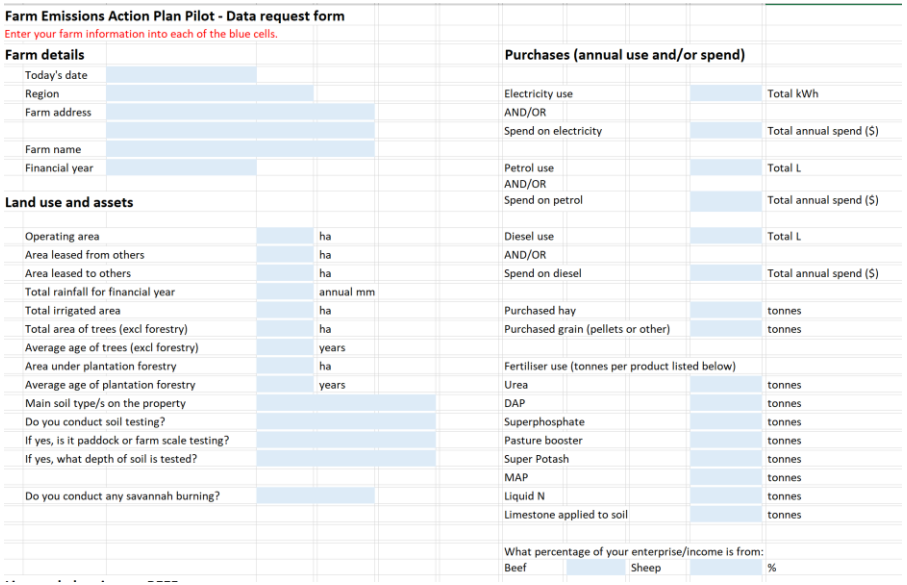
Know your number Step 1 – purpose and tool selection

- **Know your 'end point' (purpose). Are you making the emissions estimate available for:**
  - Access to a market or supply chain
  - Access to capital
  - To comply with carbon farming scheme – baseline or ongoing reporting.

- **Calculators exist to help you do this – both for estimating emissions and sinks. Ensure you use the right tool for the right purpose.** Many are free and downloadable.
  - e.g. Australian Dairy Carbon Calculator
  - Ensure most up to date version is being used

Image: Australian Dairy Carbon Calculator – DairyBase Carbon Emission Report (example)

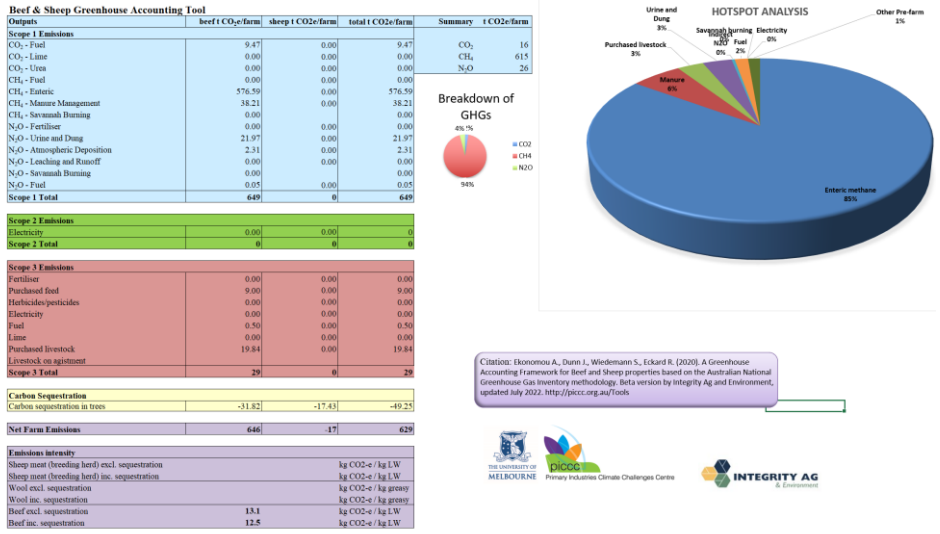
Know your number Step 2 – scope and annual context



Farm Emissions Action Plan Pilot - Data request form

Enter your farm information into each of the blue cells.

Farm details			Purchases (annual use and/or spend)		
Today's date					
Region			Electricity use		Total kWh
Farm address			AND/OR		
			Spend on electricity		Total annual spend ($)
Farm name					
Financial year			Petrol use		Total L
			AND/OR		
Land use and assets			Spend on petrol		Total annual spend ($)
Operating area		ha	Diesel use		Total L
Area leased from others		ha	AND/OR		
Area leased to others		ha	Spend on diesel		Total annual spend ($)
Total rainfall for financial year		annual mm			
Total irrigated area		ha	Purchased hay		tonnes
Total area of trees (excl forestry)		ha	Purchased grain (pellets or other)		tonnes
Average age of trees (excl forestry)		years			
Area under plantation forestry		ha	Fertiliser use (tonnes per product listed below)		
Average age of plantation forestry		years	Urea		tonnes
Main soil type/s on the property			DAP		tonnes
Do you conduct soil testing?			Superphosphate		tonnes
If yes, is it paddock or farm scale testing?			Pasture booster		tonnes
If yes, what depth of soil is tested?			Super Potash		tonnes
			MAP		tonnes
Do you conduct any savannah burning?			Liquid N		tonnes
			Limestone applied to soil		tonnes
			What percentage of your enterprise/income is from:		
			Beef	Sheep	%



Beef & Sheep Greenhouse Accounting Tool

Outputs	beef t CO_2e/farm	sheep t CO2e/farm	total t CO2e/farm
Scope 1 Emissions			
CO_2 - Fuel	9.47	0.00	9.47
CO_2 - Lime	0.00	0.00	0.00
CO_2 - Urea	0.00	0.00	0.00
CH_4 - Fuel	0.00	0.00	0.00
CH_4 - Enteric	576.59	0.00	576.59
CH_4 - Manure Management	38.21	0.00	38.21
CH_4 - Savannah Burning	0.00		0.00
N_2O - Fertiliser	0.00	0.00	0.00
N_2O - Urine and Dung	21.97	0.00	21.97
N_2O - Atmospheric Deposition	2.31	0.00	2.31
N_2O - Leaching and Runoff	0.00	0.00	0.00
N_2O - Savannah Burning	0.00		0.00
N_2O - Fuel	0.05	0.00	0.05
Scope 1 Total	**649**	**0**	**649**
Scope 2 Emissions			
Electricity	0.00	0.00	0
Scope 2 Total	**0**	**0**	**0**
Scope 3 Emissions			
Fertiliser	0.00	0.00	0.00
Purchased feed	9.00	0.00	9.00
Herbicides/pesticides	0.00	0.00	0.00
Electricity	0.00	0.00	0.00
Fuel	0.50	0.00	0.50
Lime	0.00	0.00	0.00
Purchased livestock	19.84	0.00	19.84
Livestock on agistment			
Scope 3 Total	**29**	**0**	**29**
Carbon Sequestration			
Carbon sequestration in trees	-31.82	-17.43	-49.25
Net Farm Emissions	**646**	**-17**	**629**
Emissions intensity			
Sheep meat (breeding herd) excl. sequestration			kg CO2-e / kg LW
Sheep meat (breeding herd) inc. sequestration			kg CO2-e / kg LW
Wool excl. sequestration			kg CO2-e / kg greasy
Wool inc. sequestration			kg CO2-e / kg greasy
Beef excl. sequestration		13.1	kg CO2-e / kg LW
Beef inc. sequestration		12.5	kg CO2-e / kg LW

Breakdown of GHGs

Citation: Ekonomou A., Dunn J., Wiedemann S., Eckard R. (2020). A Greenhouse Accounting Framework for Beef and Sheep properties based on the Australian National Greenhouse Gas Inventory methodology. Beta version by Integrity Ag and Environment, updated July 2022. http://piccc.org.au/Tools

- Select financial or calendar year that will be analysed (these tools use 12 month period for any emissions estimate). Note financial year might be easier for annual records, as estimates from total cost of inputs can be used (i.e. electricity bills can be used to estimate use)
- Ensure you understand the scope of the enterprise before beginning – include all properties, lease blocks, and contractors in the estimate.
- Consider the annual year being analysed – document any assumptions/anomalies that might have affected the estimate (e.g. destocking for drought, expansion of business that required purchase of additional stock)

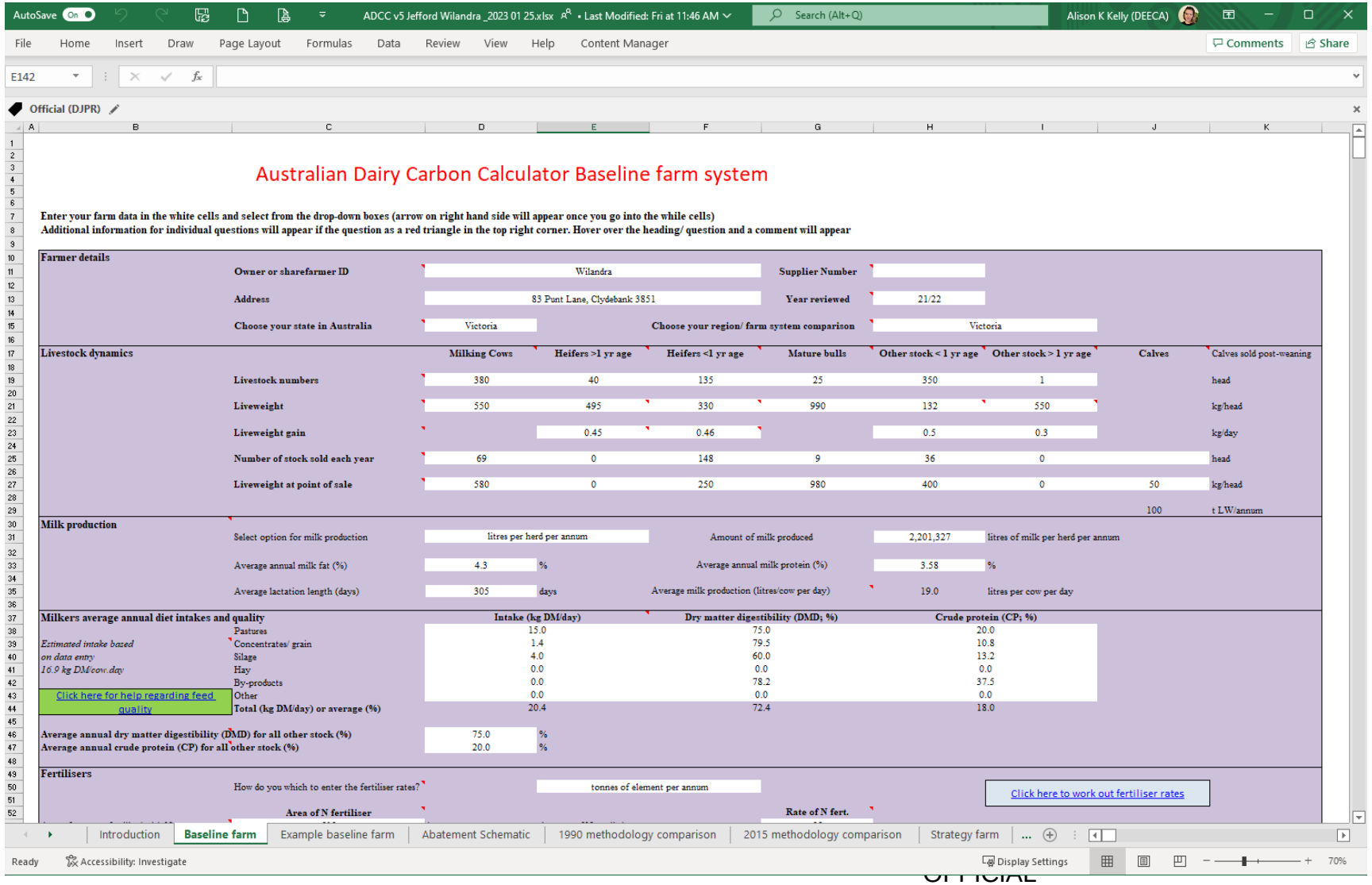
Know your number Step 3 – collect farm data for that year

- **Production data**
    - Milk: litres, fat/protein %, lactation length
    - Meat: livestock sold and LWT
    - Wool: greasy yield, #s shorn
    - Others: yield/product sold
- **Livestock** – numbers and LWT by stock class/season or year, calving %, sold/purchased
- **Supplementary feed** (grain, etc)
- **Inputs** – fertilisers, urea, lime, pesticides (where possible N content of products required, or default options) and % used across irrigated/non-irrigated pastures
- **Energy** – electricity, fuel, diesel use
- **Trees** – ha and average age

TIPS:

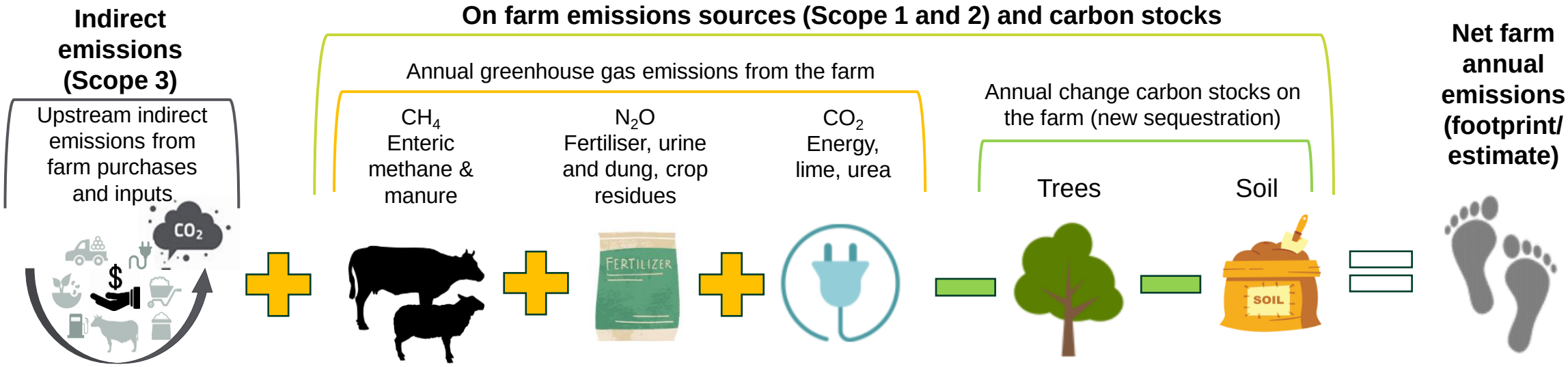
- Balance accuracy vs effort in collecting this info. If you do not have data, industry defaults can be used. Document these in a List of assumptions you record somewhere.
- Mixed enterprise – split inputs accordingly (and not in assumptions list)
- Tools generally do not ask for: hectares, rainfall, dam mgt or soil carbon information
- Helpful to collect / access the info before starting with any tools. E.g. what can be collected from existing sources, such as DairyBase to help you?

Know your number Step 4 – enter data into relevant tool



- Most tools have specified cells for entering the data, with instructions (start from the top)
- Read associated technical manuals for help
- Check data entry – results are only as good as the data that goes into them
- Save as you go!

Know your number Step 5 - making sense of an emissions profile



- Using these terms (Scope 1, 2 and 3) ensures consistency with GHG inventory and accounting principles of capturing all GHG sources and sinks
- GHG emissions and carbon stocks need to be calculated on an annual basis. This means the annual flux of carbon is estimated (i.e. ‘new’ or ‘additional’ emissions and sequestration that has occurred in the 12 month period)
- Scope 1 and 2 (direct and indirect emissions on the farm) are within a farm enterprise’s ability to control.
- Farm context (farm boundary, ownership structure and phase of growth) all need to be considered, as they can impact on emissions/ sinks but that narrative may not be obvious in the figures.

Example - Victorian beef finishing business

Indirect emissions (Scope 3)

Upstream indirect emissions from farm purchases and inputs

On farm emissions sources (Scope 1 and 2) and carbon stocks

Annual greenhouse gas emissions from the farm

CH_4 Enteric methane & manure

N_2O Fertiliser, urine and dung, crop residues

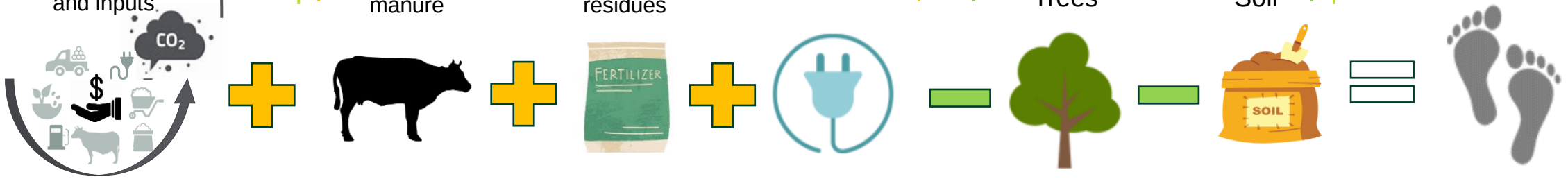
CO_2 Energy, lime, urea

Annual change carbon stocks on the farm (new sequestration)

Trees

Soil

Net farm annual emissions (footprint/ estimate)



On farm emissions and stocks only	1,171 t CO_2-e 90%	127 t CO_2-e 9.5 %	5 t CO_2-e ~0.5%	- 432 t CO_2-e 16% of property	- STABLE t CO_2-e [No annual change]	872 t CO_2-e
Now including Scope 3 …	2,873 t CO_2-e 69 %	1,171 t CO_2-e 28 %	127 t CO_2-e 3 %	5 t CO_2-e ~0.1 %	- 432 t CO_2-e 16% of property	- STABLE t CO_2-e [No annual change]	3,745 t CO_2-e

Example - Wilandra Dairy emissions profile 2021/22

Indirect emissions (Scope 3)

On farm emissions sources (Scope 1 and 2) and carbon stocks

Upstream indirect emissions from farm purchases and inputs

Annual greenhouse gas emissions from the farm

CH_4 Enteric methane

CH_4 Animal waste

N_2O Fertiliser, urine and dung, crop residues

CO_2 Energy, lime, urea

Annual change carbon stocks on the farm (new sequestration)

Trees

Soil

Net farm annual emissions (footprint/ estimate)

On farm emissions and stocks only	1,871 t CO_2-e 69 %	349 t CO_2-e 13 %	382 t CO_2-e 14 %	90 t CO_2-e 3 %	- 223 t CO_2-e - 8 % emissions (3% of property)	- N/A t CO_2-e STABLE	2,470 t CO_2-e
Now including Scope 3 …							
210 t CO_2-e 7 %	1,871 t CO_2-e 64 %	349 t CO_2-e 12 %	382 t CO_2-e 13 %	90 t CO_2-e 3 %	- 223 t CO_2-e - 8 % emissions (3% of property)	- N/A t CO_2-e STABLE	2,680 t CO_2-e

Source: AgVic On farm Emissions Action Plan Pilot 2022
Tool: Australian Dairy Carbon Calculator v5

Know your number Step 6 – understand and compare

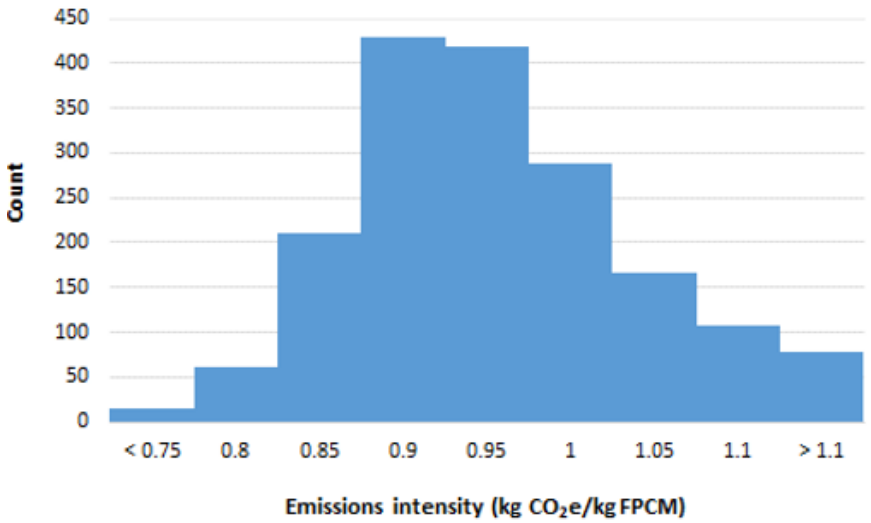
Wilandra Dairy 2021-22

GHG Emissions Intensity

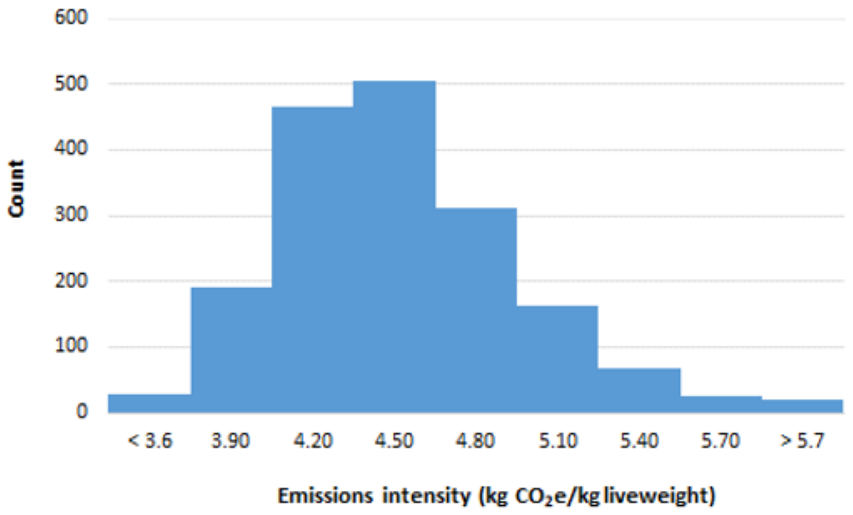
kg CO2e / kg FPCM	0.88
kg CO2e / kg MS	12.2
% of CO2 in Milk	79%
kg CO2e / kg Meat LW	5.64

Dairy Farm Monitor Program (DFMP) analysis

Milk – per kg FPCM



Meat – per kg LW



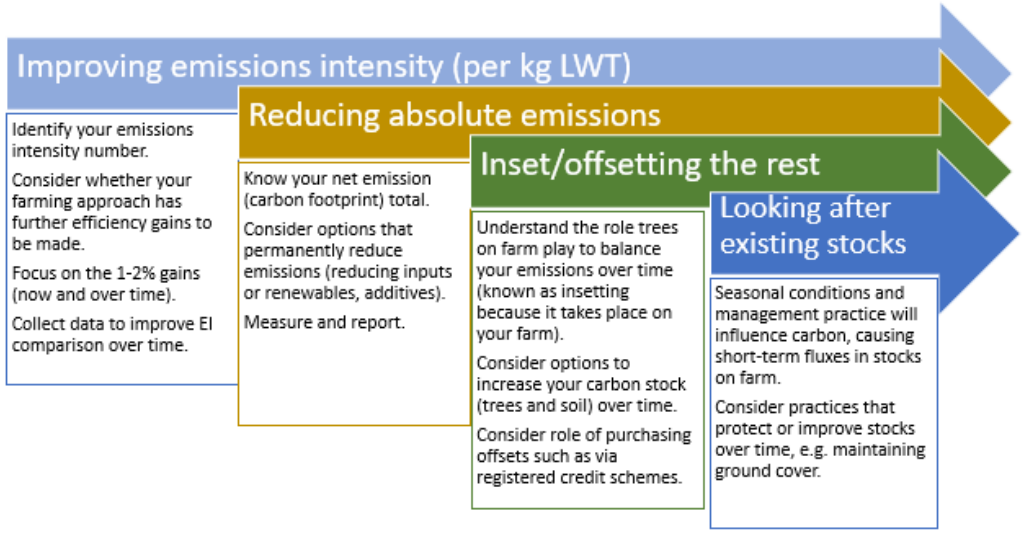
Regional averages FY 2021 (DFMP):
SE Vic: 0.91 per kg FPCM
Nth Vic: 0.88 per kg FPCM
SW Vic: 0.92 per kg FPCM

Meat: 4.2 per kg LW

Source: AgVic On farm Emissions Action Plan Pilot 2022
Tool: *ADCC v5*

Use emissions comparison for reflection and discussion

Pathway to emissions reduction



Net zero

Efficiency opportunities

Not very efficient vs Efficient / Best practice

High reproductive efficiency (6 wk in calf rate aim for 71%)

Herd testing to identify and cull unproductive animals (1kg MS/1 – 1.2 kg LW)

Replacement rates matched to business goals

Effluent management

Forage quality / digestibility

Forage / species mix (clover/grasses mix)e.g. legumes)

Matching nutrients to plant requirements (follow the 4 R's)

Matching feed requirements to pasture / fodder growth (3.5 – 4 t/cow of home grown feed)

Energy use – electricity

- Fuel / diesel

- Renewables

Farm trees, shade and shelter (no more room for trees vs fencelines/more to plant

Farm dams/waterway mgt

Consider options to act now: efficiency/ intensity focus in the short-term

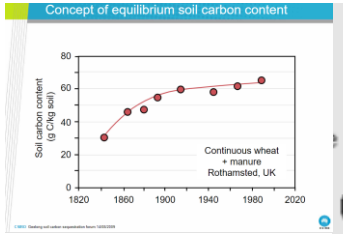
- **Consider options: improve efficiencies > reduce emissions > offset/inset where possible > maintain/ protect existing carbon on the farm**
- Consider the end objective and don't get hung up on creative accounting of emissions – e.g. 'what will the atmosphere 'feel' from this action?'
- Current industry targets and best practice support focus on emissions intensity now – options available depending on starting point
- R&D is active – watch this space for more options over time

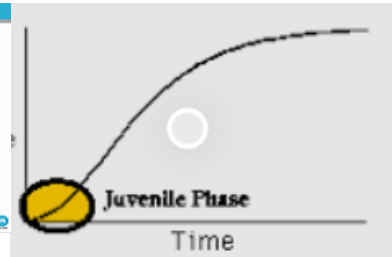
Do Now (some options so far)

- Data collection improvements – seasonal LWTs and livestock #s over time
- Livestock / herd efficiencies – identify unproductive animals earlier, quicker turnoff rates, reproductive efficiencies, etc
- Feed efficiencies – pasture / paddock / containment feeding options
- Reduce input use (energy, feed, fertilisers), where possible

A note on carbon sequestration and farming…

- Carbon ‘sequestration’ means ‘safely stored for the long term’
- Carbon in trees & soils = ‘on-farm’ benefits (shelter, soil nutrition, etc)
- Can offer income stream but only while in carbon accumulation phase
- Who wears the future risks? Esp in a warming climate…
  - ➢ ***If in doubt, check out “Questions to Ask” on our website***





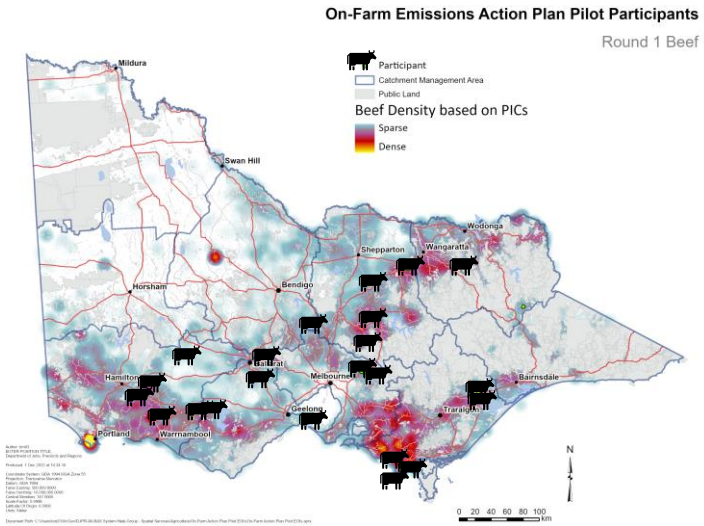
Once you know your number and benchmark … <u>CONSIDER YOUR OPTIONS/LIABILITIES BEFORE JUMPING INTO …</u>

- ➢ Demonstrating carbon neutrality to markets
  - Access to premium markets e.g. carbon neutral wool
  - Future compliance, meeting supply chain targets, trade barriers
- ➢ Trading carbon credits
  - Regulatory market
  - Voluntary markets

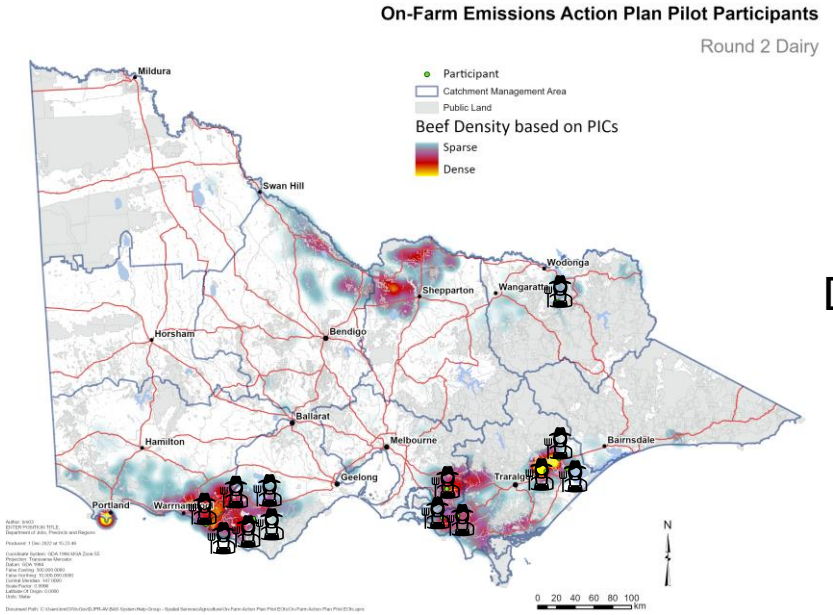
Support is available for Victorian farms through a new pilot

ON FARM EMISSIONS ACTION PLAN PILOT

- **Quick overview:** Support is available for 250 Victorian farmers to work with an expert to develop a tailored on-farm emissions action plan
  - Round 1 – 25 beef farmers (2022-23)
  - Rounds 2 – 13 dairy (2022-23)
  - Round 3 – 16 sheep tbc (EOI process now)
  - Rounds 4-9 (2023+) – other sectors
- **Pilot participation:** Each round will call for farmer participants over the next 2 years.
- If interested – get in touch!



Beef



Dairy

Early learnings - What are we hearing so far?

"No reason (for us) to change, but we are worried about future access to markets. For example, we want to plant more trees, but how can it help if we are not ever going to be paid more for (doing) it?"

"We want to build a sustainable business, as caretakers for the land. Our initial focus is on emissions intensity, while enteric methane reduction is not possible at small scale. But our goal long term is to reduce absolute emissions."

"Ongoing, this process tells us that (in terms of emissions numbers) we should focus on only comparing ourselves to ourselves."

- **Positive feedback to date** – grateful to have a real person to visit them and talk about this issue
- **ALL asked about feed additives.** Issue of how relevant these were in pasture-based systems and for small-scale farmers.
- **Scale of the enteric methane problem was a concern.** Wanted advice on short-lived gas metric too…
- **Action planning process helpful** – some already had some actions in mind when we started on action planning worksheet
- **Want local/tailored (to farming system) comparisons and benchmarks**, to help makes sense of emissions

Advice at farm scale…

- **Start with knowing your number:** There is increasing supply chain and market interest in GHG emissions. Access emissions calculators to understand your farm's emissions.
- **Look for emissions goals and actions that suit your business now and begin:** Start, benchmark, learn, find wins as you go (eg efficiencies that allow for 3-4% reduction per annum)
- **Farm business data, now and ongoing:** if not already, consider the value of good record keeping for emissions over time (for both emissions intensity and net reductions) to baseline, benchmark and identify trends
- **Compare yourself to yourself:** Be cautious with comparisons (compare apples to apples) and collect data over time to identify trends.
- **Access resources** to support initial actions.

Selling carbon from trees and soils

On this page

- What to consider
- Your rights and responsibilities
- More information

Alison Kelly
Farm Emissions Specialist
Alison.Kelly@agriculture.vic.gov.au

Thanks to producers, AgVic colleagues and Richard Eckard (Uni Melb) for insights captured in this presentation

Resources available now:

AgVic here: https://agriculture.vic.gov.au/climate-and-weather/understanding-carbon-and-emissions
Dairy Australia: https://www.dairyaustralia.com.au/land-water-and-climate/climate
MLA: www.mla.com.au/cn30
Uni Melb tools here: https://www.piccc.org.au/resources/Tools