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**Soil Wealth**  
NURTURING CROPS



**Integrated  
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PROTECTING CROPS

# THE CARBON SERIES

## Part 4: Carbon accounting and the Emissions Reduction Fund

**This four-part Carbon Series from the Soil Wealth ICP project breaks down the practicalities of carbon farming for vegetable growers and soil carbon management.**

### KEY MESSAGES

- ✓ **Carbon accounting, or greenhouse gas accounting, refers to the processes used to estimate the carbon dioxide equivalent (CO<sub>2</sub>-eq) an organisation emits on an annual basis.**
- ✓ **For vegetable growers, a carbon account can include greenhouse gas emissions and carbon sequestered in vegetation and soils on-farm.**
- ✓ **The standard practice when calculating emissions and sequestration on-farm is to report emissions as either 'direct' or 'indirect', which indicates where the emissions arise on-farm or off-farm (e.g. via fertiliser production and how they relate to the business). This can be achieved using a range of online calculators.**
- ✓ **The Emissions Reduction Fund (ERF) provides Australian businesses (including agricultural businesses) with the opportunity to earn Australian carbon credit units (ACCUs) for every tonne of carbon dioxide equivalent a business stores or avoids emitting through adopting new practices and technologies. ACCUs can be sold to the government or on the secondary private market to generate additional income streams.**



## ABOUT THE CARBON SERIES

This four-part Carbon Series from the Soil Wealth ICP project breaks down the practicalities of carbon farming for vegetable growers and looks more closely at soil carbon management. It provides links to further information and project resources on the following topics:

- **Part 1: Carbon farming and its relevance to Australian vegetable growers**
- **Part 2: Soil carbon and carbon sequestration**
- **Part 3: Carbon emissions in vegetable production**
- **Part 4: Carbon accounting and the Emissions Reduction Fund.**

Additional resources were produced including a [podcast on certified carbon neutral sweet corn](#) developed by Mulgowie Farming Company in Queensland and a webinar recording of [Carbon management on vegetable farms – emissions, sequestration and beyond](#).

The Carbon Series has been produced to help Australian vegetable growers to:

- Make decisions to manage soil carbon for increased productivity
- Calculate current emissions and assess the potential for emission reductions within their business
- Assess the viability of participating in an official carbon credit scheme
- Consider carbon neutrality as a path to differentiate products and their business on the market.

Part 4 of The Carbon Series discusses carbon accounting and the Emissions Reduction Fund, including how carbon farming practices can be measured and monitored.



## WHAT IS CARBON ACCOUNTING?

Carbon accounting, or greenhouse gas accounting, refers to the processes used to estimate the carbon dioxide equivalent (CO<sub>2</sub>-eq) an organisation emits on an annual basis. CO<sub>2</sub>-eq is a unit used to describe the global warming potential of various greenhouse gases compared to that of carbon dioxide.

A carbon account relevant to vegetable production includes two key elements:

### 1. Greenhouse gas emissions

- Carbon dioxide from fossil fuels required for energy use, transport and inputs such as fertiliser and supplementary feed
- Direct and indirect emissions of nitrous oxide from fertiliser application.

### 2. Carbon sequestered in vegetation and soils on-farm

- Carbon that has been removed from the atmosphere through sequestration in vegetation and soils, or emitted into the atmosphere through, for example, vegetation clearing or soil disturbance/degradation.
- In many cases growers will see the best return on their investment from their poorest soils or if they have previously not made much effort to store soil carbon.

Carbon neutral farming aims for net zero emissions. Many businesses are unable to reduce their emissions sufficiently to achieve carbon neutrality. In these cases, neutrality can be achieved by purchasing 'offsets' through a carbon market. If a farming business sells ACCUs it will be more difficult for the business to offset its own emissions and to move towards neutrality.

## CALCULATING EMISSIONS AND SEQUESTRATION

Standards developed by the [Greenhouse Gas Protocol](#) govern the reporting and accounting of greenhouse gas emissions. The standard practice when calculating emissions and sequestration on-farm is to report

emissions as either 'direct' or 'indirect', which indicates where the emissions arise on-farm and how they relate to the business (Table 1).

**Table 1: Approach to calculate greenhouse gas emissions on-farm**

EMISSION TYPE	SCOPE	DEFINITION <sup>1</sup>	SOURCES IN VEGETABLE PRODUCTION
Direct	<b>Scope 1:</b> Direct greenhouse gas emissions	Emissions that occur from sources that are owned or controlled by the business	<ul style="list-style-type: none"> <li>On-farm machinery and vehicles</li> <li>Fuel combustion</li> <li>Application of nitrous fertiliser</li> </ul>
	<b>Scope 2:</b> Electricity indirect greenhouse gas emissions	Emissions that occur from the generation of electricity consumed by the business	<ul style="list-style-type: none"> <li>Electricity that is purchased or otherwise brought into the organisational boundary of the business</li> </ul>
Indirect	<b>Scope 3:</b> Other indirect greenhouse gas emissions	Emissions that are a consequence of the activities of the business, but occur from sources not owned or controlled by the business	<p><b>Upstream (pre-farm emissions)</b></p> <ul style="list-style-type: none"> <li>Off-farm production of fertiliser and other inputs</li> <li>Transportation of inputs to farm</li> <li>Electricity use of agricultural technology data service platforms/providers</li> </ul> <p><b>Downstream (post-farm emissions)</b></p> <ul style="list-style-type: none"> <li>Post-farm processing</li> <li>Transportation to market</li> <li>Use of sold products and services (including emissions from disposal)</li> </ul>

<sup>1</sup> [The Greenhouse Gas Protocol, A corporate accounting and reporting standard - World Business Council for Sustainable Development](#)

Many vegetable growing operations are primarily interested in on-farm emissions as these are generated directly by the business.

A carbon footprint or lifecycle assessment requires scope one, two and three emissions to be included.

This is required for carbon neutral certification under systems such as the [Australian Government Climate Active program](#).



Online calculators are available to help growers estimate their carbon balance – i.e. if they are carbon negative, neutral or positive (Table 2). If you are calculating emissions for a farm that includes livestock,

you will need to use a calculator that includes livestock, or use two calculators and combine the data without doubling up on measurements.

**Table 2: A selection of online greenhouse gas calculators**

CALCULATOR	DESCRIPTION
<b>Full Carbon Accounting Model (FullCAM)</b>	<p>The Full Carbon Accounting Model is a calculation tool for modelling Australia's greenhouse gas emissions from the land sector.</p> <p>Emissions data (including from the land sector) can be found in the <a href="#">Australian Greenhouse Emissions Information System</a>.</p> <p>At the time of writing, tree and soil carbon can be estimated using FullCAM as it incorporates biological and management processes that impact carbon stocks and the flow of carbon in agricultural systems. FullCAM predicts biomass, litter and soil carbon pools, and accounts for human-induced land use change practices and changes in major greenhouse gas emissions.</p> <p>FullCAM is also used to generate abatement estimates for vegetation methodology determinations (methods) under the Emissions Reduction Fund.</p>
<b>Hortcarboninfo</b>	<p>Hortcarboninfo is a web tool which can be used to calculate greenhouse gas emissions from most horticultural growing operations.</p> <p>The emission factors used in this tool are updated each year from the <a href="#">National Greenhouse Accounts (NGA) Factors</a> (August 2021). The NGA Factors provide methods that help companies and individuals estimate greenhouse gas emissions.</p> <p>The NGA Factors should not be used to meet reporting requirements under the <a href="#">National Greenhouse and Energy Reporting (NGER) Act 2007</a>. Further information on reporting under NGER can be found on the <a href="#">Clean Energy Regulator's website</a>.</p>
<b>Landscape options and opportunities for carbon abatement calculator (LOOC-C)</b>	<p>This tool created by CSIRO allows you to quickly assess options on the land for certain projects offered under the Emissions Reduction Fund.</p> <p>Producers can use the map interface to select a potential project area and help start the conversation of carbon abatement options for your business.</p> <p>Using paddock location and user-provided land use and land management information, LOOC-C estimates greenhouse gas abatement via an emission factor database and greenhouse gas emission models (e.g. FullCAM). The result is a list of eligible carbon project types and estimates of Australian Carbon Credit Units that a project may generate.</p>



## THE EMISSIONS REDUCTION FUND

In Australia, the [Emissions Reduction Fund](#) is administered by the Clean Energy Regulator and provides businesses (including agricultural businesses) with the opportunity to earn Australian carbon credit units (ACCUs) for every tonne of carbon dioxide equivalent a business stores or avoids emitting through adopting new practices and technologies.

ACCUs can be sold to the government or on the secondary private market to generate additional income streams under an approved 'project'.

'Methods' under the Emissions Reduction Fund set out the rules for estimating emission reductions from eligible activities, which usually involve a change to existing management practices on a farm through a specific project (i.e. additional activities to business as usual at the starting point). There are a range of methods available for agriculture both above ground (plants and vegetation) and below ground (managing soil carbon) which are available on the [Australian Department of Industry, Science, Energy and Resources website](#).

It is important to note that a project must be registered before you start making changes on-farm.

Previously, if several methods were considered in an operation/system, each method required separate project registration, monitoring, reporting and management. However, a new 'integrated land management' method will be introduced in 2022 to allow for multiple projects to occur on one piece of land, both above and below ground.

Methods and activities relevant to vegetable growers under the Emissions Reduction Fund are described in Table 3 and include links to their eligibility criteria, approved practices and how to apply them.

**Table 3: Methods and activities relevant to vegetable growers under the Emissions Reduction Fund**

TOPIC	METHODS AND ACTIVITIES
<b>Agriculture</b>	<ul style="list-style-type: none"> <li>• <a href="#">Estimating sequestration of carbon in soil using default values</a></li> <li>• <a href="#">Measurement of soil carbon sequestration in agricultural systems</a></li> <li>• <a href="#">Estimating soil organic carbon sequestration using measurement and models method</a></li> <li>• <a href="#">Understanding your soil carbon project</a></li> </ul>
<b>Energy efficiency</b>	<ul style="list-style-type: none"> <li>• <a href="#">Aggregated small energy users</a></li> <li>• <a href="#">Commercial and public lighting</a></li> <li>• <a href="#">Commercial building energy efficiency</a></li> <li>• <a href="#">High efficiency commercial appliances</a></li> <li>• <a href="#">Industrial electricity and fuel efficiency method</a></li> <li>• <a href="#">Industrial equipment upgrades</a></li> <li>• <a href="#">Refrigeration and ventilation fans</a></li> </ul>
<b>Facilities</b>	<ul style="list-style-type: none"> <li>• <a href="#">Facilities</a></li> </ul>
<b>Transport</b>	<ul style="list-style-type: none"> <li>• <a href="#">Aviation</a></li> <li>• <a href="#">Land and sea transport</a></li> </ul>
<b>Vegetation management</b>	<ul style="list-style-type: none"> <li>• <a href="#">Avoided clearing of native regrowth</a></li> <li>• <a href="#">Avoided deforestation 1.1</a></li> <li>• <a href="#">Human-induced regeneration of a permanent even-aged native forest</a></li> <li>• <a href="#">Measurement based methods for new farm forestry plantations</a></li> <li>• <a href="#">Plantation forestry</a></li> <li>• <a href="#">Reforestation and afforestation 2.0</a></li> <li>• <a href="#">Reforestation by environmental or Mallee plantings - FullCAM</a></li> <li>• <a href="#">Environmental Plantings pilot</a></li> <li>• <a href="#">Savanna fire management – emissions avoidance</a></li> <li>• <a href="#">Savanna fire management – sequestration and emissions avoidance</a></li> </ul>
<b>Waste and wastewater</b>	<ul style="list-style-type: none"> <li>• <a href="#">Alternative waste treatment</a></li> <li>• <a href="#">Source separated organic waste</a></li> </ul>

Participating in the Emissions Reduction Fund has potential profits, however the market can be volatile and there are costs associated with record-keeping and project reporting. Still, there are carbon service providers who specialise in this area and assist for a fee. It pays to understand and compare the fee structure of providers before entering into a relationship with one of them.

It is important to balance the benefits and challenges of participating in the Emissions Reduction Fund for a business. Considerations are compliance costs, time commitments, the complexity and requirements of projects, the likelihood of the planned outcomes being achieved, the degree of carbon storage possible, and whether potential income will exceed project establishment and running costs. Changes to the ERF by government can also have an impact.

Potential benefits with or without participating in an ERF project could include strong productivity gains through improved soil health, water holding capacity, cation exchange capacity and soil biological functions as well as biodiversity and ecosystem services, improved land value, new market opportunities and a diversified income stream.

### PILOT PROJECTS

As part of the Australian Government's Agriculture Biodiversity Stewardship Package, the Department of Agriculture, Water and the Environment is delivering two pilot projects: the Carbon + Biodiversity Pilot and the Enhancing Remnant Vegetation Pilot.

Both pilots are looking at ways to pay farmers for improving biodiversity on-farm.

The Carbon + Biodiversity pilot payments will be in addition to any earnings from carbon abatement through the Emissions Reduction Fund.

### Carbon neutral as an alternative option

While the ERF leads much of the conversation on carbon farming, there are other pathways for farmers to estimate emission and sequestration and capitalise on improved management. Climate Active is a Australian Government partnership and accreditation pathway and there are many more voluntary schemes including, but not limited to:

- The [Gold Standard](#) and [Verified Carbon Standard](#) are global frameworks, that direct carbon offset capital into climate, environment and development projects. The frameworks have their own accreditation systems through the creation and issuance of Voluntary Emission Reduction (VER) units and Verified Carbon Units (VCUs).
- [Carbon Friendly](#) is an Australian company that has developed an independent accreditation, verified by third party auditing body AUS-QUAL. The company works with farmers, including vegetable growers, to calculate their carbon footprint and achieve certified carbon neutral status, not by buying offset but by management practice change recognition.

Table 4 on page 7 outlines the pros, cons and potential benefits to different carbon farming activities.

### FOOD FOR THOUGHT

While the Carbon Series provides a high-level overview of carbon farming in Australia and how it can apply to vegetable growers, particularly through improved soil carbon management practices, this space continues to change and evolve.

Carbon farming is a possible option for many Australian vegetable growers, however the practicalities of implementing this approach on-farm will depend on the individual circumstances of each business and its goals.

Managing soil carbon – a key player in overall soil health – can increase productivity and reduce the cost of production with the added benefit of reducing greenhouse gas emissions. There may also be marketing benefits for a business and the creation of a more resilient farm from a climate and consumer perspective.



**Table 4: Assessing carbon farming options**

ACTIVITY	PROS	CONS	CO-BENEFITS
<b>Participating in the Emissions Reduction Fund</b>	<ul style="list-style-type: none"> <li>Potential additional income stream</li> <li>Potential marketing benefits</li> </ul>	<ul style="list-style-type: none"> <li>It may be difficult to increase soil carbon, especially if already high</li> <li>Associated costs (e.g. establishment, monitoring, auditing, reporting)</li> <li>Need to report on each project individually at the moment</li> <li>Cannot use ACCUs towards own carbon neutrality if/ once they are sold</li> </ul>	<ul style="list-style-type: none"> <li>Productivity gains through improved soil and/or cost savings (energy, water etc.)</li> <li>Environmental plantings can help to improve water quality, reduce salinity, provide shade and shelter for beneficial insects and livestock</li> </ul>
<b>Being carbon neutral</b>	<ul style="list-style-type: none"> <li>Potential marketing benefits</li> </ul>	<ul style="list-style-type: none"> <li>Associated costs with carbon accounting</li> </ul>	<ul style="list-style-type: none"> <li>While this depends on the activities undertaken, potential benefits include improved soil and/or cost savings (energy, water etc.)</li> </ul>
<b>Certifying as carbon neutral</b>	<ul style="list-style-type: none"> <li>Potential marketing benefits</li> </ul>	<ul style="list-style-type: none"> <li>Associated costs with carbon accounting, certification, auditing and purchasing offsets</li> </ul>	<ul style="list-style-type: none"> <li>Productivity gains through improved soil and/or cost savings (energy, water etc.)</li> </ul>
<b>Buying offsets</b>	<ul style="list-style-type: none"> <li>Assists in lowering business carbon footprint if unable to reduce emissions sufficiently to achieve carbon neutrality</li> </ul>	<ul style="list-style-type: none"> <li>Associated costs</li> </ul>	<ul style="list-style-type: none"> <li>Investment in other projects that have environmental/ social/ economic benefits</li> </ul>

Understanding the source and amount of emissions on-farm is the first step to help vegetable growers unearth the opportunities available to them in carbon farming, including participation in relevant programs with financial incentives to reduce emissions and sequester carbon.

Generally, high emissions mean that there are opportunities to increase efficiencies in the business as well as productivity. Emission are a useful indicator to monitor changes.

While there may not always be direct financial benefits from reducing greenhouse gas emissions and carbon sequestration, there can be co-benefits around increased resilience and sustainability including increased biodiversity and water use efficiency, and reduced waste, pesticide and fertiliser use.

To make an informed decision about carbon farming,

vegetable growers will need to consider their individual business goals and production circumstances – from the scale of the business to opportunity costs of changing farming practices – and keep on top of changes in the sector as they arise.

### CATCH UP ON THE CARBON SERIES

- **Part 1: Carbon farming and its relevance to Australian vegetable growers**
- **Part 2: Soil carbon and carbon sequestration**
- **Part 3: Carbon emissions in vegetable production**