# A Review of Ecosystem Service Market Opportunities for Livestock Producers

*Prepared for*

**Department of Agriculture and Fisheries**

Project AS10309_4122

From Method to Market "Unlocking Service Opportunities for Livestock Producers"

Agri Escondo Pty Ltd

the university for the real world QUT

# Contents

**Tables** ..... **3**
**Figures** ..... **4**
Acronyms ..... 6
Foreword ..... 8
Executive Summary ..... 9
1. Introduction ..... 28
2. Overview of red meat production ..... 30
**2.1 Australia's red meat sector** ..... **30**
**2.2 Red meat production in Queensland** ..... **31**
**2.3 The Feedlot sector** ..... **32**
**2.4 Greenhouse gas emissions** ..... **34**
3 Introduction to valuing ecosystem services ..... 36
**3.1 Valuing ecosystem services** ..... **38**
3.1.1 Development of markets for carbon credits ..... 41
3.1.2 Ecosystem services markets in Australia ..... 43
**3.2 Premium pricing for goods with ecosystem services** ..... **45**
4 Market mechanisms ..... 46
**4.1 Ecosystem services markets** ..... **46**
**4.2 Carbon markets – an overview** ..... **50**
4.2.1 Global carbon markets ..... 51
4.2.2 Carbon markets in Australia ..... 54
**4.3 Price premiums as a market mechanism** ..... **61**
4.3.1 Consumer perspectives ..... 61
4.3.2 Footprints and labels ..... 63
5. Methods for markets in credits or certified products ..... 64
**5.1 Emissions Reduction Fund** ..... **65**
5.1.1 Structure and Governance ..... 65
5.1.2 ERF results and status of projects ..... 66
5.1.3 ERF and CSF going forward ..... 69
5.1.4 ERF Methods ..... 70
5.1.5 Participating in the ERF ..... 73
5.1.6 Status of ERF projects ..... 74
5.1.7 Future method development ..... 76
**5.2 Land Restoration Fund** ..... **77**
5.2.1 Purpose and structure of the LRF ..... 77
5.2.2 LRF Priorities and Co-benefits Standard ..... 78
**5.3 Reef Credit Scheme** ..... **80**
**5.4 Climate Active Carbon Neutral** ..... **81**
**5.5 Farm Biodiversity Certification Scheme** ..... **82**
6. Supporting services and metrics ..... 83
**6.1 Service Providers, Aggregators and Auditors** ..... **84**
6.1.1 Engaging a 'carbon service provider' ..... 84
6.1.2 Carbon service providers with land sector experience ..... 86

**6.2 Metrics for quantifying carbon or ecosystem services credits ..... 88**
6.2.1 System of Environment-Economic Accounting ..... 88
6.2.2 Accounting for Nature ..... 89
6.2.3 Reef credits ..... 91
6.2.4 Pasturefed Cattle Assurance System ..... 92
6.2.6 BioCondition Framework ..... 93
6.2.6 IUCN Environmental Offsets ..... 94
6.2.7 Footprint tools and standards ..... 94
7. Industry targets and incentives ..... 98
**7.1 Drivers of industry engagement in a 'low-carbon-economy' ..... 98**
**7.2 Australian red meat industry environmental goals ..... 99**
7.2.1 CN30 target ..... 99
7.2.2 Australian Beef Sustainability Framework ..... 101
**7.3 Livestock Product and Market Initiatives ..... 103**
7.3.1 McDonald's ..... 103
7.3.2 Major Supermarkets ..... 105
8. Opportunities and barriers for participation ..... 106
**8.1 Opportunities for livestock producers ..... 106**
**8.2 Barriers to participation in ecosystem service markets ..... 108**
**8.3 Opportunities and barriers for specific methods ..... 110**
8.3.1 General barriers to method uptake ..... 110
8.3.2 Opportunities for current ERF methods with co-benefits ..... 111
9. Conclusions and Recommendations ..... 120
**9.1 Summary Points ..... 120**
**9.2 Recommendations ..... 122**
References ..... 125
Appendices ..... 134
**Appendix 1. Glossary ..... 134**
**Appendix 2. Note on accounting for short-lived greenhouse gases ..... 137**
**Appendix 3. Emissions Reduction Fund Offset Integrity Standards ..... 138**

# Tables

Table 1 Greenhouse gas emissions (Mt CO2-e) from agriculture by sub-sector in 1990 and 2017 (Data source: DEE 2019a). ..... 35
Table 2. Greenhouse gas emissions (Mt $CO_2$-e) from the red meat sector (beef cattle, sheep meat and goats) (Mayberry et al. 2020). ..... 36
Table 3. Change in the volume and price of emissions abatement traded in 2017 and 2018 in global markets. (Source: Donofrio et al. 2019, State of the Voluntary Carbon Markets 2019). ..... 52
Table 4. ERF methods of most relevance to livestock producers in Queensland. ..... 72
Table 5. Proposed Indicators to be assessed at the two assurance levels (High; Medium) in the Land Restoration Fund Native Vegetation Monitoring Method (Butler 2020). ..... 91
Table 6. Status of Queensland ERF projects under method types most relevant to ruminant livestock production. ..... 112
Table 7. Estimated NPV (AU$) at 5% discount rate over 100 years, consistent with the permanence period of ERF sequestration projects. Modeled scenarios are for environmental plantings on a 50 ha grazing property on the Atherton Tableland. Scenarios shown are for 3 carbon credit prices ($20, $50, $100); 2 reforestation densities (200, 1000 trees/ha); three reforestation options (C only – all 50 ha planted to trees; Mixed – 10 ha planted to trees and 40 ha grazed by cattle; Cattle only – no reforestation). Source: Adapted from van Oosterzee et al. 2020; Table 4). ..... 114
Table 8. Examples of factors that may affect the likelihood of soil carbon sequestration in agricultural land. 118

# Figures

Figure 1. National beef cattle herd with projections by MLA to financial year 2022-23 (MLA, April 2020). ..... 30
Figure 2. (A) Australian sheep flock by state (2018); (B) Australian goat slaughter by state (2018) (Source: ABS 2019). ..... 30
Figure 3. Red meat and livestock industry turnover by state in 2017-18 (Source: MLA 2019). ..... 31
Figure 4. Red meat export volume by state of production (2017-18) (Source: MLA 2019). ..... 31
Figure 5. Australian cattle herd by state (Source: ABS 2019). ..... 32
Figure 6. (A) Australian sheep flock by state (2018); (B) Australian goat slaughter by state (2018) (Source: ABS 2019). ..... 32
Figure 7. Location of feedlots in Australia. ..... 33
Figure 8. Number of cattle on feed by state, 1996 to 2020. (Source: ALFA/MLA 2020). ..... 33
Figure 9. Australia's agricultural emissions in 2017 (Data source: DEE 2019a). ..... 34
Figure 10. Enteric emissions (A) by livestock type in 2017 and (B) by year from 1990 to 2017 (Data source: DEE 2019a). ..... 35
Figure 11. Summary of types of ecosystems services (Roxburgh et al. 2020). ..... 40
Figure 12. Framework for the Natural Capital Approach illustrating how the quality, quantity and location of natural capital assets influence delivery of ES and benefits for society. (Source: DEFRA (2020) based on Natural England https://www.gov.uk/government/organisations/natural-england) ..... 40
Figure 13. Growth in the number of published studies up to the end of 2019 analysed for the use of an ES matrix approach to assess ES (Source: Campagne et al. 2020). ('Supply' includes assessment of capacity, potential or supply; 'Flow/use' is an assessment of flow of ES from nature to society; 'Demand' is society demand). ..... 47
Figure 14. Conceptual framework to assess and quantify landscapes' capacities to provide ecosystem services (A) and its adaptation to an ES matrix model illustrating the use of expert based estimations, physical quantifications or empirical model results to attribute the capacity to supply ES to land use/land cover (B). (A – Reproduced from Burkhold et al. 2009; with dashed and dotted lines indicating the components presented in their paper; B – Reproduced from Jacobs et al. 2015). ..... 48
Figure 15. Issuance volumes of credits in the voluntary carbon markets (kt CO2-e) by sector and type of market mechanism for 2015 – 2019. (Source: World Bank Group 2020) ..... 49
Figure 16. Summary of global carbon pricing systems in 2019 (World Bank Group 2020). ..... 52
Figure 17. Growth in the percentage of global equity shares held by 'Eco-friendly' funds from 2000 to 2019 (A) and sustainable investment(B). ..... 53
Figure 18. ACCU price at around $16 remains well below that of the carbon credit price in most countries, with the EUA remaining firm, equivalent to over AUD $47 per tonne in the first quarter of 2020, despite the impacts of COVID-19 (CMI Media Release 15 July 2020). ..... 54
Figure 19. Daily ACCU spot price from Sep 2018 to Feb 2020, showing responsiveness to supply and demand related to Safeguard Mechanism management (Source of Figure: Reputex Energy 2020). ..... 56
Figure 20. ACCU spot price over period from 1 October 2019 to May 2020. (http://econews.com.au/) (Accessed 15 May 2020). ..... 56
Figure 21. Emergence of demand for ACCUs from 2015 to 2019 by source of interest (Source: CER 2019). ..... 58
Figure 22. Breakdown in offsets used for annual emissions reductions under the Climate Active Program (Source: Climate Active presentation to the CMI 14 August 2020). ..... 59
Figure 23. Number of certifications for achievement of carbon neutrality under the government backed Climate Active program (Source: Climate Active presentation to the CMI 14 August 2020). ..... 60
Figure 24. Total ACCUs transferred to the Commonwealth each financial year under contracts with the CER (A) and total number delivered under contracts (B). (Source: CER http://www.cleanenergyregulator.gov.au/. Note the CER shows combined data for 2014-15 and 2015-16 and this has been arbitrarily split equally across the two years) (A), and proportion of contracted abatement delivered up to March 2020). ..... 67
Figure 25. Number of new project registrations by method type for each quarter from Q2 2018 to Q2 2020, showing that vegetation methods have a continued, but possibly declining, dominance. (Source: CER 2020d).

.....68
Figure 26. Total number of ACCUs issued per method type by location, Q2 2020 and scheme to-date (Source: CER 2020d).....68
Figure 27. Steps in developing an ERF project and generating carbon credits. (Source CER: http://www.cleanenergyregulator.gov.au/csf/Pages/How_it_works.html Accessed May 2020). .....73
Figure 28. Number and location of projects and ACCUs issued in Queensland, for the three major land sector method types relevant to livestock producers. Data for all savanna projects in northern Australia are also shown. Data as at 14 April 2020. (Source: CER www.cleanenergyregulator.gov.au/) .....75
Figure 29. Linkages between ISO 14067, the carbon footprint of a product (CFP), and related international standards for life cycle assessment (LCA) used to calculate environmental footprints, Product Category Rules (PCR) used to specifically define the environmental impacts of a specific product, and for communicating the footprint as a claim or label. (Adapted from ISO 2018https://www.iso.org/obp/ui/#iso:std:iso:14067:ed-1:v1:en) .....95
Figure 30. Beef production system and boundary as included in the EU red meat footprint category rules (FCR Red Meat) (UECBV 2019).....97
Figure 31. MLA's Roadmap to CN30 (https://www.mla.com.au/research-and-development/Environment-sustainability/carbon-neutral-2030-rd/cn30/).....101
Figure 32. Indicators of environmental stewardship in Australian Beef Sustainability Framework (ABSF 2019a).....102
Figure 33. Agricultural production zones in Australia (ABARES 2020). Approximately 355 million hectares lands, predominantly native grasslands and woodlands, are used for grazing to produce red meat. .....107

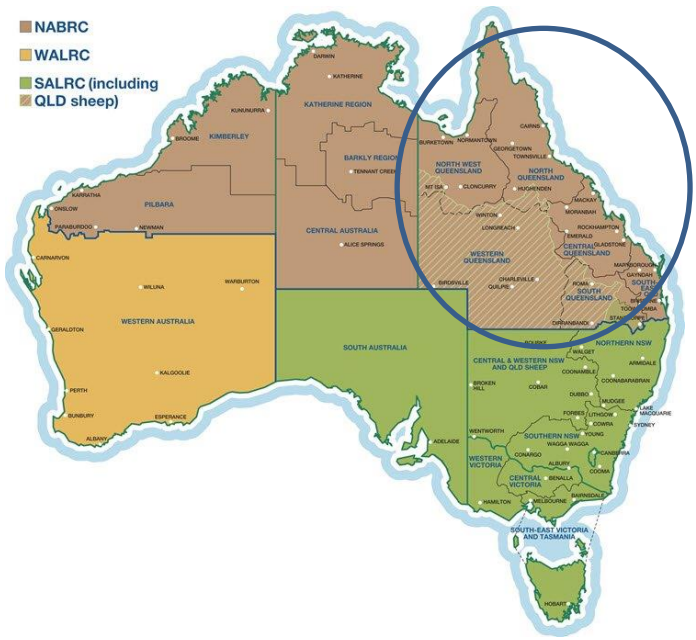
# Acronyms

| | |
|---|---|
| ABARES | Australian Bureau of Agricultural and Resource Economics and Sciences |
| ABS | Australian Bureau of Statistics |
| ABSF | Australian Beef Sustainability Framework |
| ACCU | Australian Carbon Credit Unit |
| AEEA | Australian Environmental-Economic Accounts |
| AFI | Australian Farm Institute |
| AfN | Accounting for Nature |
| CBD | Convention on Biological Diversity |
| AGEIS | Australian Greenhouse Emissions Information System |
| ALFA | Australian Lot Feeders Association |
| BEUC | Bureau Européen des Unions de Consommateurs, The European Consumer Organisation |
| CCB | Climate, Community and Biodiversity Standards |
| CDM | Clean Development Mechanism |
| CER | Clean Energy Regulator |
| $CH_4$ | Methane |
| CICES | Common International Classification of Ecosystem Services |
| CFI | Carbon Farming Initiative |
| CFP | Carbon Footprint of Products |
| CMI | Carbon Market Institute |
| CN30 | Carbon Neutral by 2030 |
| $CO_2$ | Carbon dioxide |
| $CO_2$-e | Carbon dioxide equivalents |
| CORSIA | Carbon Offsetting and Reduction Scheme for International Aviation |
| CSF | Climate Solutions Fund |
| DEE | Department of the Environment and Energy |
| DEFRA | Department for Environment, Food & Rural Affairs |
| DIN | Dissolved Inorganic Nitrogen |
| DISER | Department of Industry, Science, Energy and Resources |
| EPBC | Environmental Protection and Biodiversity Conservation [Act] |
| ERAC | Emissions Reduction Assurance Committee |
| ERF | Emissions Reduction Fund |
| ES | Ecosystem Services |
| ESM | Ecosystem Services Markets |
| ESMC | Ecosystems Services Market Consortium |
| ETS | Emissions Trading System |
| EU | European Union |
| FAO | Food and Agriculture Organization of the United Nations |
| FCR | Footprint Category Rules |
| FullCAM | Full Carbon Accounting Model |
| GHG | Greenhouse Gas |
| GRSB | Global Roundtable for Sustainable Beef |
| GS | Gold Standard |
| ICAO | International Civil Aviation Organization |

| | |
|---|---|
| IMF | International Monetary Fund |
| IPCC | Inter-governmental Panel on Climate Change |
| ISO | International Organization of Standardization |
| IUCN | International Union for the Conservation of Nature |
| LCA | Life Cycle Assessment |
| LRF | Land Restoration Fund |
| MBI | Market based Instruments |
| MLA | Meat & Livestock Australia |
| MNES | Matters of National Environmental Significance |
| NAPCO | North Australian Pastoral Company |
| NBS | Nature Based Solutions |
| NDC | Nationally Determined Contribution |
| NFF | National Farmers Federation |
| NGO | Non-Governmental Organisation |
| NIR | National Inventory Report |
| NPP | Net Primary Productivity |
| NRM | Natural Resource Management |
| OECD | Organisation for Economic Co-operation and Development |
| OIS | Offsets Integrity Standards |
| PCAS | Pasturefed Cattle Assurance System |
| PEF | Product Environmental Footprint |
| RE | Regional Ecosystem |
| REDD | Reducing Emissions form Deforestation and forest Degradation |
| RMAC | Red Meat Advisory Council |
| SDG | Sustainable Development Goal |
| SEEA | System of Environmental-Economic Accounts |
| SNA | System of National Accounts |
| TCFD | Taskforce on Climate-related Financial Disclosures |
| TRRP | Thiaki Rainforest Restoration Project |
| UECBV | European Livestock and Meat Trades Union |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VCS | Verified Carbon Standard |
| WTO | World Trade Organisation |

# Foreword

This review forms the first step in the project by Queensland Department of Agriculture and Fisheries for Meat and Livestock Australia entitled *From Method to Market – Unlocking Ecosystem Service Market Opportunities for Livestock Producers.* The project seeks to overcome technical and economic barriers to producer participation in ecosystem services markets whilst producing livestock. This review examines available literature and online material relating to existing methods that enable livestock producers to be remunerated for providing ecosystem services with public good value whilst maintaining or increasing livestock production. It develops preliminary recommendations on enhancements to existing methods that could improve producer adoption. It focusses on extensive beef producers in Queensland but with a view to noting the relevance of findings for sheep producers, feedlot production and for livestock in other regions of northern Australia. The review will inform further consideration of enhancement of existing methods and development of new methods for livestock producers to be remunerated for provided ecosystem services, including carbon credits, biodiversity credits and water quality credits, for community benefit whilst producing livestock.




Map showing the regions of MLA's consultation framework for red meat production in Australia with the area of focus circled (www.mla.com). Outputs for beef producers in Queensland also have relevance to beef production in the Northern Territory and Western Australia (shaded brown) and to sheep production in Queensland (green hatching). (NABRC – Northern Australia Beef Research Council; WALRC – Western Australia Livestock Research Council; SALRC – Southern Australia Livestock Research Council). National inventory data indicate that enteric methane emissions from the northern beef herd (area shaded brown) contribute approximately 4% of Australia's total emissions.

# Executive Summary

Livestock production is the major management activity on around 50% of Australia's land area. In Queensland, more than 80% of land is used primarily for grazing beef cattle or sheep, with livestock a major contribution to the economy and to the social structure and cultural identity of many regional communities. Livestock are also significant in interactions between people and the environment and affect resource condition and the sustainability of ecosystem services for current and future communities. Governments, industries and individual land holders are seeking to understand the positive and negative effects of land and vegetation management practices on landscape health and the services ecosystems provide, and to encourage practices that support productivity and profitability for both private and public good. Placing a monetary value on ecosystem services is seen as a key strategy in incentivising and rewarding actions that improve sustainability, with climate change mitigation, biodiversity and water quality recognised globally and in Australia as an urgent focus for agricultural lands. Socio-economic and cultural benefits of 'nature based solutions' to these major challenges are also recognised in global initiatives such as the climate change *Paris Agreement* and the United Nations *Sustainable Development Goals*. However, in practice, the complexity of effects of natural factors and management changes on ecosystem function in combination with the diversity of agricultural systems makes establishment of practical, credible and financially viable programs and markets difficult.

This review examines the current state of knowledge of issues related to markets in ecosystem service trades and pricing mechanisms, with an emphasis on existing and potential new or modified methods applicable to livestock activities contributing to carbon offsets, biodiversity credits, indigenous values and water quality ecosystem services in northern Australia. The review is a component of the Queensland Department of Agriculture and Fisheries project, *From Method To Market – Unlocking Ecosystem Service Opportunities For Livestock Producers* that seeks to overcome technical and economic barriers to producer participation in ecosystem services markets whilst producing livestock. By engaging with livestock producers and reviewing existing and developing scientific methods the project aims to support livestock producers to be remunerated for providing ecosystem services (generation of carbon credits, biodiversity credits, water quality credits) in viable red meat production systems. Specific project objectives are to:

1. review available literature on existing scientific methods for livestock producers to be remunerated for providing ecosystem services to the community whilst producing livestock;
2. consider enhancements to existing methods to improve producer adoption; and
3. develop new scientific methods for livestock producers to be remunerated for providing ecosystem services to the community whilst producing livestock.

This review contributes primarily to Objective 1, and it also provides a basis to address Objective 2 and Objective 3. It includes consideration of:

- Extensive beef relevant ecosystem markets and methods, highlighting key considerations, barriers to adoption, limitations and opportunities;

- Industry scale issues for social license affecting market access, reputation, image, 'right-to-farm'; and
- Recommendations on how to overcome barriers and enhance specific opportunities for northern Australian livestock producers in current and emerging industry and policy settings.

Understanding existing methods and opportunities for financial returns through market mechanisms can help to promote adoption by livestock producers of practices that contribute to community and global goals for climate change mitigation and environmental sustainability, with significant benefits from many activities for productivity and profitability and for the capacity of the red-meat industry and individual producers to demonstrate their stewardship of resources. The review also identifies potential opportunities through future development of new and more useable methods, discusses how practical and cost-effective it is for producers to obtain income from implementing methods for credits or from premium pricing for products with carbon and ecosystem services certifications. Specific methods have different data and baseline requirements, and the information in this report can also inform how the case studies within the project can incorporate consideration of data collection, sampling or measurement protocols and manage implementation costs associated with participating in market mechanisms for carbon or ecosystem services.

# Key findings

### *Overview of red meat production*

- Australia's cattle herd was 26.4 million head at June 2018 and the sheep flock was 70.6 million head, representing about 2% and 6% of global cattle and sheep numbers, respectively[1]. Ruminant livestock grazing on native or naturalised pasture, predominantly for red meat production, is important to the Australian economy, environment and socio-cultural identity.
- Grazing of cattle and sheep is the major land use on 355 million hectares, around 50% of Australia's land mass. Queensland accounted for 46% of the national beef herd in 2018, with grazing being the primary land use over more than 80% of the area and having approximately 50% of Australia's 400 accredited feedlots.

  [Note: The review focusses on northern beef production but many of the findings could be adapted to other states and other ruminant species.]
- Data show that beef cattle, sheep and goat enterprises are a significant contributor to Australia's greenhouse gas emissions and represent a major land and resource use over the continent.Australia's national greenhouse gas inventory reports that agriculture was responsible for 73 Mt $CO_2$-e, representing 13% of the total national greenhouse gas emissions (2017 data). According to the inventory, enteric methane from ruminant livestock accounted for 71% of agricultural emissions (about 50 Mt $CO_2$-e or 10% of the total for all sectors).
- Emissions from the red meat sector, taking into account production on-farm and in feedlots

[1] ABS (2019), OECD-FAO (2019).

and processing, were estimated to be 55.72 Mt $CO_2$-e for 2017[2], using data for animal numbers, feed intake, meat production and resource use. Accounting includes the major sources of emissions (animal enteric fermentation and manure; feed production; and fossil fuel use for farm, feedlot and processing activities) and the net change in carbon stored in vegetation and soils (i.e. the net of sequestration and loss) associated with land management for beef cattle, sheep and goats.

- The red meat sector recognises that responding to climate change and sustainability challenges, while representing a substantial challenge, is not only important to meet consumer and market expectations but represents a potential path to increased efficiency and resilience of production in the longer term. Participating in well-designed market and pricing schemes that credit carbon and other ecosystem services (ES) or that provide certification linked to price premiums and market access represents an opportunity and potential income incentive for individual producers and for the industry.

### *Introduction to valuing ecosystem services*

- Global agreements, notably the United Nations *Global Agenda for Sustainable Development* and the *Paris Agreement* on climate change, are setting long-term targets to address climate change and environmental outcomes whilst balancing food and nutrition security and social, economic and cultural goals. National governments are working on contributions to the global goals that also meet the interests of their own country and citizens.
    - Australia is a party to both the Sustainable Development Agenda and the Paris Agreement. Australia's climate change commitment is to reduce greenhouse gas emissions by 26-28% on 2005 levels by 2030. A primary policy framework to meeting this target is the Emissions Reduction Fund (ERF), which was set up in 2014 and extended from 2020 under the Climate Solutions Fund. It established a crediting and pricing market mechanism to encourage low-cost additional greenhouse gas abatement activities. Land sector projects in vegetation and agriculture have been the major contributors. All Australian state and territory governments have committed to net zero greenhouse gas emissions by 2050 (a Paris Agreement objective) and the red meat industry, through Meat and Livestock Australia, has an aspirational target to be carbon neutral by 2030[3].
    - Under the Paris Agreement, 196 countries have pledged to reduce greenhouse gas emissions as set out in Nationally Determined Contributions (NDCs). Of the 196 NDCs, 119 include targets for cutting emissions from agriculture, with 61 countries specifically mentioning goals for livestock emissions.
- Climate change ambitions at national, regional and organisational levels elevate the potential

[2] DEE (2019a), Mayberry (2020), MLA (2020), Commonwealth of Australia (2020a).

[3] https://www.fsb-tcfd.org/; https://www.qld.gov.au/environment/climate/climate-change/transition; https://www.mla.com.au/research-and-development/Environment-sustainability/carbon-neutral-2030-rd/cn30/

for markets as part of the suite of mechansims to achieve emissions reduction and to offset hard-to-reduce emissions. Export industries are exposed to the possibility of carbon border adjustments (taxes) such as that being discussed in Europe with the announcement in June 2020 of the European Green Deal[4]. The tax is likely to be proportional to the amount of carbon in the imports, and the relative difference in carbon price between Europe and the exporting country.

- Governments around the world are responding to a suite of consumer and community concerns on product sustainability. For example, the British government is considering an environment bill introducing legally binding targets on air quality, waste reduction, biodiversity and cleaner water, including addressing land management impacts on wildlife and agriculture effects on water quality[5]. Industries and businesses are also responding by incorporating sustainability targets within their core business strategies. The Australian red meat industry, through Meat and Livestock Australia, has an aspirational target to be carbon neutral by 2030 and also has strategies for sustainability[6].
- As a result of climate and sustainability concerns, goods certified as having carbon and other ecosystem services benefits have potential to attract premium prices. A 2018 Nielsen survey in the US showed that 90% of millennials (ages 21 – 34) and 61% of Baby Boomers (ages 50 – 64) surveyed said they were willing to pay more for products that are environmentally-friendly or sustainable. Red meat certified under labels such as organic, grass-fed or low carbon has seen some price advantage. However, analysts suggest that price premiums for sustainable products like low emissions beef will remain limited because, in reality, consumers are not necessarily prepared to pay more despite ranking it high as a concern.[7]
- While carbon accounting has become more well-established, quantifying other ecosystem services for credits or certification is challenging and approaches vary. Two broad approaches are the *Natural Capital Approach*, which considers nature as a set of assets that benefit people, and *Nature Based Solutions* accounting, which looks at the extent to which nature can provide solutions to overcome problems and support sustainable development. The Queensland Land Restoration Fund is seeking to value ecosystems service co-benefits of carbon projects under the ERF[8]. A framework developed in Australia, *Accounting for Nature*, which provides principles for standardising estimates of ecosystem service value will be initially used. Environmental credentials such as carbon abatement and biodiversity, may also be certified through private verified standards and schemes, e.g. Verra, some of which pay farmers for participating and reporting under their offset market scheme.

[4] https://www.bcg.com/en-au/publications/2020/how-an-eu-carbon-border-tax-could-jolt-world-trade
[5] https://www.endsreport.com/environment-bill
[6] https://www.fsb-tcfd.org/; https://www.qld.gov.au/environment/climate/climate-change/transition; https://www.mla.com.au/research-and-development/Environment-sustainability/carbon-neutral-2030-rd/cn30/
[7] (https://www.foodbusinessnews.net/articles/13133-sustainable-product-market-could-hit-150-billion-in-us-by-2021);
[8] https://www.qld.gov.au/environment/climate/climate-change/land-restoration-fund; https://verra.org/

### *Ecosystem services and carbon market mechanisms*

- Interest in supply of ecosystem services has grown since the concept gained prominence in the Millennium Ecosystem Assessment in 2005, particularly over the last five years, but trades have remained low with very limited increase in demand[9].
    - Globally, approaches to assessing the capacity of landscapes to provide services are inconsistent, being largely determined by levels of expertise, data quality and data availability, although the ecosystem services matrix approach[10] is the most commonly used. Assessment approaches will necessarily depend on user data access and skill level, but choosing and implementing a method appropriate for the goals of an ecosystem service assessment that is also able to provide results readily interpreted by stakeholders, policy-makers, decision-makers and land managers is, in reality, very difficult.
    - The ecosystem services receiving most financial support to date have been water quality, biodiversity, soil health and carbon. A study for Australia being undertaken by the ClimateWorks' Land Use Futures program[11] is expected to provide an analysis of the multiple dimensions of sustainability, including consideration of issues and goals for greenhouse gas emissions abatement, and for water, soil, biodiversity benefits and for socio-economic and cultural crediting.
- Growth in markets and methods for carbon has been stronger than for other ecosystem services. Carbon farming and sequestration in vegetation and soils are recognised by the UNFCCC as essential to efforts to stabilise the Earth's temperature and markets. A strong carbon price is seen as also helping with repairing degraded lands, improving farm productivity and supporting food security and resilience of regional communities.
    - The World Bank reported that in 2019, there were 61 carbon markets existing globally or scheduled for imminent implementation, raising US$45 billion. Globally, 42% of the total credits issued over the past five years have been for forestry activities, and the fastest rate of growth in traded volume across voluntary global carbon markets in recent years has been in land sector credits. These carbon credits have been preferred because they were seen to have additional environmental or social co-benefits. Looking forward, International Monetary Fund (IMF) data show continued growth in interest in sustainable investing creating demand and driving upward price movement in ecosystem services markets[12].
    - In Australia, the large areas managed for grazing are already enabling an alternative income stream for some red meat producers through ERF vegetation and agriculture methods and pricing mechanisms. In addition, voluntary carbon offset schemes offer

[9] Campagne et al. (2020)
[10] Burkhold et al. (2009)
[11] https://www.climateworksaustralia.org/our-work/land-use/
[12] World Bank Group (2020)

an alternative private market, with international schemes including the Gold Standard and Verra's VCS.25 provide well-respected private carbon crediting mechanisms[13].

- The price of Australian Carbon Credit Units (ACCUs) remains low relative to international trading systems such as the EU and New Zealand schemes, but analyses suggest the demand-supply balance could change driving higher prices. Contributing factors may include: (1) demand for offsets to meet public and private 2030 or 2050 net-zero emissions targets; (2) possible adjustments to the Safeguard Mechanism compliance market; (3) growth in certification schemes such as the Climate Active Carbon Neutral program; (4) initiatives for ecosystem services co-benefits, such as Queensland's Land Restoration Fund (LRF) and the national Agriculture Stewardship Program; and (5) increased uptake of high quality credits in the international voluntary markets[14]. Information on some of these factors is summarized below.

- Agricultural industries and individual farmers are committing to contribute to the global threat of climate change. In 2017, the Australian red meat industry, through MLA, announced the red meat industry CN30 initiative, with a target of net zero greenhouse gas emissions from Australia's red meat sector by 2030. In 2019, the National Farmers Federation (NFF) release of its 2030 Roadmap included an aim towards being carbon neutral by 2030 (NFF 2019). The commitment is significant in providing an agriculture-wide policy driver and supporting climate change advocacy, but the target will very likely require offsets.

- The Climate Active program, which certifies organisations, products and services as carbon neutral against the Climate Active Carbon Neutral Standard also provides a market for ACCUs where high-integrity credits are preferred. Certifications under this program have doubled since 2017 and are projected to grow further.

- Premium prices for products potentially provide an additional incentive for livestock producers to engage in carbon and ecosystem services markets. International markets have indicated a premium of 5-7% is typically sufficient to enable matching of conventional profits for branded products such as 'organic'. Similar premiums are being realised for some beef cattle certified as fully grass-fed under the PCAS system. Importantly, trust in product labelling is fundamental to customer willingness to pay in premium markets. In world markets, credibility for some labelled products has been questioned due to early carbon footprint claims being misleading and inaccurate 'green-washing' labels. More recently, rapid growth in type and number of claims e.g. biodiversity, welfare and health claims may lead to confusion and eroded confidence as credibility in benefits is diluted. Clear, accurate and meaningful labels and claims are critical to maintaining trust.

- Queensland's investment in the LRF aims to expand carbon farming in the state by supporting land-sector ERF projects in agriculture and forestry that also deliver environmental, social and

[13] www.goldstandard.org; https://verra.org/

[14] CER (2019); www.mla.com; NFF (2019); Commonwealth of Australia (2020b); Queensland Government (2020); https://www.agriculture.gov.au/ag-farm-food/natural-resources/landcare/sustaining-future-australian-farming

economic co-benefits to the carbon abatement activities. Priority areas for investment in land restoration for carbon offsets include improving the health of wetlands and coastal ecosystems and improving biodiversity. In a similar way, the national Farm Biodiversity Certification Scheme provides a link between enhanced biodiversity and increased carbon storage in vegetation and soils on agricultural land.

### *Markets and methods for credits or certification*

- There are a number of established or emerging markets for credits or certified products providing opportunities for livestock producers to realise recognition and potentially income for verifiable improvements in ecosystem services. While carbon markets have dominated to date, incentives for biodiversity, water quality and other ecosystem services are emerging to provide additional or alternative sources of income from selling credits or accessing consumer markets and premium pricing for industry or individual advantage. Once issued with carbon credits, livestock producers and other participants in crediting schemes have a number of choices on how to translate those credits into value, including: (1) selling in primary markets such as the government auction system for carbon credits (ACCUs); selling in secondary markets which may be public (e.g. the Queensland government LRF) or private (e.g. Verra); (2) using credits to offset emissions to achieve carbon neutral status e.g. for Climate Active certification; (3) retaining credits against possible market access adjustments; or (4) for product/enterprise claims for personal or public good, e.g. developing a 'sustainability story' for a branded product. A credit can be used only once, i.e. it cannot be sold in a government Clean Energy Regulator (CER) auction and also used to achieve carbon neutral status.
- Australia's ERF is a carbon crediting and pricing mechanism aimed at providing incentives for organisations and individuals to adopt new practices and technologies that reduce their emissions and/or increase sequestration. Participation is voluntary. To October 2020, the CER has held 11 auctions for the ERF, and has committed to purchase approximately 200 million tonnes of abatement through 463 contracts. The average price per tonne of abatement purchased at the latest auction was $15.74 and the CER estimates the total value of all contracts awarded has reached $2.4 billion. Vegetation activities have dominated in ERF contracts, but there are signs of increasing project diversity with registration of projects using methods other than vegetation rising to 45% in the first quarter of 2020 compared to 27% across all 2018 registrations. Vegetation methods have provided most projects and ACCU issuance in Queensland, with Human Induced Regeneration and Native Forest from Managed Regrowth projects in south-west Queensland dominating[15].
    - While the government auction scheme provides the primary market for ACCUs, voluntary demand is increasing with 206,000 ACCUs surrendered in Quarter 2 2020, up 85 per cent compared to Quarter 2 2019. Spot prices declined from $16.40 at the end of

[15] CER (2020c,d); Commonwealth of Australia 2020b,c,d)

Quarter 1 2020, to $15.85 at the end of Quarter 2 2020.

- Reports and policies released by the government provide recommendations and initiatives that are positive for continued incentives and income opportunities for land managers under the ERF. Recommendations in the King Review (released May 2020) include more efficient processes of method development, streamlining of administration procedures for projects and support for sampling costs for soil carbon which has been a barrier to uptake of sequestration projects in agriculture land. The *Technology Investment Roadmap Discussion Paper* (May 2020) listed support for enhancing soil carbon stocks and livestock productivity, along with deploying technologies to enhance fertilizer use, carbon storage in vegetation and improving fire management. It looks to pursue opportunities for promising technologies in the research and development phase include alternative feeds for northern pasture cattle (*Leucaena* and *Desmanthus*) and the use of supplements (*Asparagopsis* (red algae) and 3-NOP) in beef feedlot and dairy systems.
- Methods under the ERF define eligible emissions reduction activities and set the rules for implementation of a project and for estimating and reporting abatement or sequestration. Priorities for new methods are set by the Minister with advice from the responsible Department (DISER). In July 2020, responsibility for method development moved from DISER to the CER with an intent to accelerate development of new methods. The CER has a target of developing new methods within a 12 month timeframe, while maintaining the strong integrity of methods required under legislation by compliance with the set of six Offsets Integrity Standards. Integrity of ERF credits based on these standards gives a high degree of credibility to ACCUs and their value in government and private offset markets and ensures continuing strong international respect for the scheme.
- Method determinations currently available with most relevance to ruminant livestock systems in northern Australia are (1) enteric methane emissions abatement methods *(Beef herd management* and *Beef cattle nitrate supplement methods*); (2) vegetation methods that credit emissions avoidance or sequestration in biomass (*Avoided clearing of native regrowth, Human induced regeneration, Native forest from managed regrowth, New farm forestry plantations, Environmental plantings* and *Plantation forestry*); (3) soil carbon sequestration methods (*Measurement of soil carbon sequestration in agricultural systems, Estimating soil carbon in soil using default values)*; (4) savanna fire management methods *(Emissions avoidance, Sequestration and emissions avoidance*).

- The Queensland Government's Land Restoration Fund (LRF), announced in 2017, makes a $500 million commitment to build the state's carbon farming industry by expanding environmental markets and valuing natural capital and co-benefits[16].
    - The LRF elected to use the Accounting for Nature (AfN) Framework in its initial

[16] https://www.qld.gov.au/environment/climate/climate-change/land-restoration-fund

phase as a basis for the measuring, reporting, and third-party certification of environmental outcomes to verify environmental co-benefits under the LRF Co-benefits Standard. The AfN Framework was developed based on a model first proposed in 2008 by the Wentworth Group of Concerned Scientists for national environmental accounting[17]. It underpins development of a method to measure changes in the biophysical condition of environmental assets, using an *Econd*™ index, a value between 0 and 100, where 100 describes an environmental asset in an undegraded state.

    - In 2020 the Queensland Government released a *Land Restoration Fund Native Vegetation Monitoring Method* for measurement and reporting of improvement in condition of vegetation, soil and native fauna that can be third-party certified as evidence of environmental co-benefits under carbon farming projects in Queensland in the context of eligibility for crediting under the LRF.

- The Reef Credit Scheme is a market-based mechanism to incentivise water quality improvements across catchments of the Great Barrier Reef. The scheme enables landholders to undertake projects that improve water quality through changes in land management to generate a tradeable unit of pollutant reduction (a Reef Credit) that represents a quantifiable volume of nutrient, pesticide or sediment prevented from entering the Great Barrier Reef catchment[18]. It has the potential to be developed into a certified water quality co-benefits method under the LRF and to be linked to ERF projects.

- The Australian Government backed Climate Active Carbon Neutral is a certification program that aims to demonstrate in a credible and transparent way that carbon neutrality has been achieved. There are a broad range of possible applications of Climate Active certification, including products and services, organisations, events, buildings and precincts[19].

    - The credibility of Climate Active certification is supported by the Climate Active Carbon Neutral Standard (previously known as the National Carbon Offset Standard), providing confidence in claims of carbon neutrality for purposes such as reporting or marketing. Use of ACCUs generated in ERF projects as offsets towards Climate Active certification further strengthens the credibility of claims.

- The Australian Farm Biodiversity Scheme was announced in 2019 under a four-year, $34 million Agriculture Stewardship Package. It includes the Agriculture Biodiversity Stewardship Pilot Program with funding to incentivise on-farm adoption of good practice for biodiversity with an allocation to develop methodologies to support the pilot, and for monitoring and evaluation to quantify production and biodiversity benefits. The Package also funds a Farm Biodiversity Certification Scheme to provide a means for voluntary participants to demonstrate and to communicate best practice biodiversity management of

[17] www.accountingfornature.org
[18] https://www.reefcredit.org/
[19] https://www.industry.gov.au/sites/default/files/2020-07/climate-active-carbon-neutral-standard-organisations

natural resources[20]. If the development of a monitoring, reporting and measurement framework for the Farm Biodiversity Scheme were consistent with the LRF methods based on AfN, this would enhance opportunities for beef and sheep producers in northern Australia in carbon and ES markets.

- In summary, this review revealed a range of technical, practical and social factors that could be considered to enhance opportunities under operating and emerging schemes. Social aspects that, in some cases, receive less attention include consideration of diverse landholder goals and motivations, social and cultural risks of participation, and the benefits of knowledge exchange (as opposed to one-way knowledge transfer) in building trust and commitment amongst landholders, communities and industry. The same factors are also relevant to varying degrees in development of new or varied methods for enhanced acceptance and participation in ecosystem services and carbon markets. Maintaining collaboration and capacity in industry and natural resource management networks, and commitment to continuous improvement based on learning at farm and program levels also support participation in programs and markets.

### *Services and metrics for participants*

- Market and certification schemes specify methods or frameworks for monitoring, reporting and certifying/verifying outcomes for emissions abatement or environmental services. These metrics aim to provide credibility for environmental outcomes and confidence in units of value for trading credits in markets for income, for compliance or to certify claims for price premiums. Quantification and associated requirements in methods can be highly technical and administratively and legally complex, so that landholders interested in engaging in a project for carbon or ecosystem services benefits will generally need to engage specialist expertise. Services contracted often include providing specialist information on opportunities, associated cost and benefits and assessment of the risks and obligations of participating in markets as well as registration, contracts, reporting, auditing and other implementation procedures. They may also include aggregation arrangements. However, while providing valuable services, these specialist providers may struggle to gain a reasonable level of trust in agricultural communities, especially if they do not have practical on-ground and farm business background and if the charges for their services appear high.
    - The types of services being offered by a number of established carbon service providers (some also servicing other environmental crediting projects) and the areas of competency needed are discussed in this review.
    - Factors that may provide comfort to participants in carbon markets are that: (1) All carbon providers under the ERF must hold an Australian Financial Services License; and (2) Carbon service providers who are signatories to the Carbon Market Institute Australian Carbon Industry Code of Contact have made a commitment to a set of

[20] https://www.agriculture.gov.au/ag-farm-food/natural-resources/landcare/sustaining-future-australian-farming

principles established in 2018 and moving in 2020 to an operational stage[21].

- Where carbon project activities also generate co-benefits, additional expertise may need to be engaged to ensure the level of knowledge required for nature-based accounting and crediting for ecosystem services price mechanisms such as within the LRF scheme.
- Farm businesses also need to consider whether participation in aligned with the farm financial situation and producer's personal values, and with the social context in which the farmer operates. The level in confidence in genuine public and private production benefits able to be generated over time by adopting particular activities or practices should also be considered.

- Prospective participants may need to obtain independent advice from a person without a financial interest in the carbon or ecosystem services scheme(s) to fully explore whether engaging in these markets is aligned with the farmer's business model, financial situation and personal values. Impacts of participation may be short-term such as efficiency gains and private production benefits, but others may be longer term such as placing permanence obligations for 25 or 100 years for sequestration projects, potentially land value or affecting succession planning.
- Understanding widely accepted accounting systems and metrics in use for quantification and reporting in ecosystem services crediting schemes or certification standards relevant to livestock producers in northern Australia, is essential to informing requirements and limitations for creating eligible and verifiable credits. Seven accounting systems are reviewed. Each has value in particular applications but, in any particular system, the choice of method should be fit for purpose, i.e. applicable to the type, quality and resolution of data available and provide results able to be interpreted and verified to meet the objectives of the accounting.

### *Industry targets and incentives*

- Industries globally are recognising the real and present risks that climate change poses to business and financial markets, and making changes that smooth their individual transition to the low-carbon economy. Timely transitioning is seen as building stronger, more resilient and more sustainable national and global positions, supporting future economic development and human welfare[22]. Industries are also responding to consumer and community concerns that production of goods and services should be sustainable for the health of the planet and future generations.
- As demonstrated by Australia's National Farmers Federation, agricultural businesses perceive benefits in making climate change and sustainability commitments. For Australia's red meat industry these benefits have been articulated as[23]:

[21] http://www.cleanenergyregulator.gov.au/ERF; https://carbonmarketinstitute.org/

[22] TCFD (2017); https://www.cnbc.com/2020/07/14/joe-biden-unveils-green-jobs-and-infrastructure-plan-during-2020-election.html

[23] NFF (2019); RMAC (2020)

- Consumer and community support leading to red meat having increased demand and/or value;
- Market access, e.g. border adjustments under discussion in the EU (and also the US with change in Presidency);
- Access to funding or lower cost capital;
- Decreased risk of government regulatory burdens;
- Enhanced adaptive capacity and resilience of production systems to climate changes or extremes.

- The position of the Australian Red Meat Industry in response was an announcement in 2017, through MLA, of the Carbon Neutral by 2030 (CN30) initiative. This initiative established a target of net zero greenhouse gas emissions from Australia's red meat sector by 2030. The industry has also adopted an Australian Beef Sustainability Framework (ABSF) to report across four key sustainability themes – Animal welfare, Economic resilience, Environmental stewardship and People and community. These initiatives are complementary, and both are supported by red meat industry investment in actions, monitoring and market mechanism development to achieve objectives and targets. Companies now using the ABSF to support internal environmental sustainability commitments or business and shareholder reporting and communications include McDonalds Australia, Greenham, NAPCO, Teys Australia, RaboBank, Woolworths and OBE Organic.

- MLA supported development of the 2015 ERF method for Beef Cattle Herd Management that credits practices that result in reductions in the intensity of enteric emissions of beef production from grazing animals, i.e. result in lower emissions per kg of beef produced. MLA is now working with other research, industry and government stakeholders to develop new and improved methods to enable producers to earn carbon credits from additional proven practices and technologies, including improved feedbase and supplementation technologies. Lead candidates for grazing and feedlot cattle in northern Australia are including legumes (Leucaena and Desmanthus) in pastures and using supplements that reduce enteric methane and improve animal productivity (3-NOP and Asparagopsis). The CN30 program is undertaking research, accounting and adoption projects for carbon abatement and ecosystem services co-benefits for red meat production and processing.

- The red meat industry is also responding to supply chain and retail priorities to ensure consumer preferences are able to be met and to ensure the industry's social license can be maintained. Illustrating these pressures are initiatives by McDonald's across focus areas of farm management to reduce the carbon footprint, rebuilding soils and conserving forests and announcements by major supermarkets, including Woolworths, Coles, Aldi and IGA for animal welfare, carbon neutral and sustainable sourcing strategies and targets with potential to direct supply chain actions for the goods they offer consumers.

### *Opportunities for participation in carbon and ecosystem services markets*

- Based on this review, there are a number of current and emerging programs and market

mechanisms with potential to enable livestock producers in northern Australia to diversify their income through actions that mitigate greenhouse gas and/or enhance ecosystem services in the landscapes they manage. This potential is enhanced by growing global and national commitments to climate change and sustainability and acceptance that land sector offsets will be needed, at least in the short to medium-term. In Australia, recent changes to the governance structure of the ERF, including partnerships with private industry in co-design of new methods, streamlining method development and less restrictive administration and auditing requirements is intended to facilitate participation in the scheme. Opportunities are also supported by industry commitments. Investment in research, development and adoption in programs such as the red meat industry's CN30 target, provides specific support for beef, sheepmeat and goat meat producers to undertake activities that reduce the carbon intensity of products and contributes to method development for enhanced crediting of offsets with environmental and market pricing benefits. Factors providing incentives to participation include:

  - Many activities enabling participation by livestock producers in government and private ecosystem services credit schemes also provide pathways to improving the efficiency and profitability of livestock businesses. Methods for carbon with environmental co-benefits, e.g. developed by Verra and under development for the LRF, should align with sustainability goals such as maintaining or enhancing water quality and soil health that support long-term productivity.
  - Voluntary carbon offset markets, particularly for high quality credits with ecosystem services co-benefits, are offering higher returns, and if demand increases as projected, income for producers participating in these crediting schemes is expected to grow towards 2030 and mid-century target dates.
  - There are some indications of expanding opportunities to receive premium prices for food and fibre goods certified as having carbon and/or other ecosystem services benefits. These certified goods may also be better placed to maintain market access and avoid border taxes as countries or regions with climate change commitments discuss adjustments to protect their own products from being financially disadvantaged.
  - In Queensland the opportunities for producers are theoretically substantial with livestock producers managing more than 80% of the State's land area of 1,727,000 square kilometres, mostly for grazing on native pastures. Feedlots also offer potential access to strategies for supplementation and 'low methane' feed additives that reduce enteric methane.

- At this time, the proportion of livestock producers realising the potential value of offset and ecosystem service credit markets offered by current schemes is small[24]. Implementation of accounting, reporting, validation protocols and certification procedures by early movers

[24] CER (2020c)

have helped to improve methods and streamline administration so that experienced service providers are better able to support scheme entry. Overtime better understanding of the business proposition and benefits for efficiency, productivity and resilience to weather and climate events as well as diversified income may encourage further participation.

### *Barriers for participation in carbon and ecosystem services markets*

- There are a number of barriers to fully realising the opportunities outlined above, and these have contributed to the low participation of livestock producers to date.
    - Low ACCU price is a significant barrier, particularly for methods involving new activities with high implementation cost. The low price reflects limited demand and the requirement under legislation for the government to purchase lowest cost abatement. To date, the ACCU spot price has largely remain aligned to the CER average auction price[25].
    - The complex design of markets and administratively heavy reporting and auditing requirements have been designed to provide credible credits that represent genuine, additional abatement. However, the administrative burdens and costs can act as a disincentive to uptake particularly when there is uncertainty about future income from market mechanisms or possible trade-offs resulting from unclear policy directions at national or global scales. Overcoming this barrier needs to start with providing farmers with an understanding of 'what's in it for me?'. Information should be broader than simple cost-benefit ratio as surveys have indicated that adoption by farmers of new management practices is influenced by more factors than simply financial returns.
- The characteristics of available schemes and related policy can influence participation in carbon market mechanisms and environmental programs. Important factors include:
    - Ease of understanding the scheme which is affected by availability of information, scheme complexity, transaction costs, and degree of uncertainty in policy and prices.
    - Methods targeting new practices that are not compatible with farm management strategies or requiring skills for implementation that many farmers do not have and for which specific training is not readily or freely accessible[26].
- Surveys specifically looking at the ERF revealed that barriers to participation related to policy (particularly real or perceived uncertainty), high transaction costs, lack of information, an absence of applicable methods, and the duration of permanence periods. These barriers include scheme-wide issues and factors relevant to individual methods[27].
    - Price and policy uncertainty may be partially addressed where support is increased across different levels of government, as illustrated by the arrangement for combined ERF and LRF credit purchasing under the Queensland government. There is potential

[25] CER (2020d)
[26] Dumbrell et al. (2016)
[27] Macintosh et al. (2019)

for participation in the market to achieve greater economic and socio-cultural returns if collaborative arrangements across levels of government and with industry, research and community groups are prioritised to add efficiency and realise value in market mechanisms, and if the benefits of the arrangement are clearly communicated.

- The restriction within the ERF scheme of being able to register only one method on each project area is a barrier to achieving higher abatement. Being able to undertake multiple projects on agricultural land with combined monitoring, reporting and auditing would reduce costs and enabling greater levels of abatement and net income. To support what it commonly referred to as 'method stacking', changes to the ERF Rule would be needed to allow proponents of stacked projects to submit a single, aggregated offsets report with combined auditing. The King Review recommended that this be explored.[28]

### *Opportunities and barriers to uptake of specific methods*

- The credibility and scope for marketing or certification depends on the confidence in methods that generate units of carbon abatement or environmental assets (ecosystem services credits). Methods vary between schemes in their rigour and level of integrity. Some methods under respected voluntary market mechanisms and government backed schemes are reviewed but monitoring, reporting and verification tools and data to account for changes in ecosystem services with management practices is an evolving science and prospective participants should ensure up-to-date understanding or requirements of individual methods as well as scheme obligations.
- Method development and implementation for the Australian ERF scheme is globally respected as enabling carbon credits with high integrity. The decade of experience provides some insights to help understand some opportunities and barriers for land managers, including for specific methods suitable for uptake by livestock producers in northern Australia. Available data on the economics and practical usability of selected methods relevant to livestock producers is discussed in this review with three of those methods here providing illustrative examples of possible actions to realise value and increase uptake.
- *Vegetation Methods:* Current regeneration methods with projects in Queensland – Human Induced Regeneration (HIR), Native Forest from Managed Regrowth (NFMR) and Avoided Clearing – provide for issue of credits for assisted natural regeneration of forest but not for planting trees. This means the projects are less costly to implement and helps ensure regeneration is of local native species, but can result in slow increase in biomass carbon and, therefore, delays significant income returns and means projects are restricted to certain regions of native forest/woodland ecosystems. Some service providers have recommended the government explore the potential to develop a method with application in higher rainfall regions such as reef catchments for forest regeneration as permanent forest C sinks, including

[28] Commonwealth of Australia (2020b)

assisted by planting. They envisage that the method would allow more flexibility in eligible activities and simpler auditing of regeneration.

  - Depending on method details an enhanced regeneration method may also allow harvesting for wood products as an alternative to the farm forestry method, and provide funding support for planting of shade or shelter belt trees to enhance animal welfare and resilience of the enterprise.
  - Regenerating forest cover in more productive regions would be expected to provide greater ACCUs per hectare and potentially enhance eligibility to earn co-benefit ecosystem services credits (e.g. under the LRF)[29].

- *Beef cattle herd method:* The ERF beef cattle herd management method attributes reductions in greenhouse gas emissions to changes in herd structure and productivity. It theoretically provides for gains in profitability as well as income from carbon credits or premium pricing of 'low-carbon beef' but few projects have been registered. Reasons given for the low uptake include low ACCU prices, but also the complexity and limited functionality of the calculator that must be used to estimate emissions avoidance. Work has been initiated to explore how the existing beef herd method could be varied or a new method developed more financially viable for beef cattle producers.

  - Analysis showed that for cost-effectiveness the method was restricted to large herds (at least 50,000 head), excluding many producers unless a practical mechanism could be applied for aggregation of smaller herds to 'form' a financially viable herd. In 2019, an innovative project led by Paraway Pastoral Co, demonstrated an aggregation model that made the herd management method more accessible to smaller operators.
  - There is considerable industry interest in the development of ERF methods able to account for alternative feeds or supplements that reduce or inhibit methane production in the rumen during enteric fermentation. For pasture-fed cattle in northern Australia, research shows the most promising options for new/enhanced feeds that reduce methane while increasing productivity are the legumes, *Leucaena* and *Desmanthus. Leucaena* is already providing good results for live weight gain and resilience to climate variability in northern Australia, and studies are ongoing to demonstrate the abatement and develop dose-response relationships and other data needed for a legume feed method that can be audited.
  - Certain compounds have been shown to reduce enteric methane production *in vitro* and in animal trials. Prospects for substantially avoiding methane production appear strong using 3-NOP (available commercially in some countries as *Boveur*) and species of the red algae, Asparagopsis. Initial use would be in feedlots[30].

- *Soil carbon methods:* There has been substantial interest across farm to policy scales globally and in Australia in the prospects for soil carbon sequestration as a greenhouse gas abatement

[29] http://carbonmarketinstitute.org/; Evans et al. (2015); van Oosterzee et al. 2020

[30] MLA 2015; Mayberry et al. 2018; Harrison et al. (2016)

strategy. However, uptake of the two methods currently legislated for crediting soil carbon sequestration under the ERF has been limited. The model-based soil carbon method for grazing lands that estimates sequestration of carbon in soil has had no project registrations. This method estimates sequestration using default values that are very conservative reflecting high uncertainty in levels of storing carbon in different soils and climates and the prospects for retaining additional carbon stocks 'permanently' (i.e. for 25 or 100 years). The measurement method for soil carbon sequestration in agricultural systems has had around 60 projects registered by mid-2020, although only one, located in Victoria, has been issued credits. Options are being explored to help overcome the obvious major barrier to uptake, of high measurement costs. The CER announced (September 2020) that forward payments for ERF projects of $5,000 would be available to help proponents cover baseline sampling costs. In addition, development of a new method with reduced need for costly sampling rounds and higher reliance on a combination of on-ground sampling and modelling is also being explored[31]. These changes help overcome some financial barriers but a technical barrier remains as debate continues amongst researchers and other experts on the prospects for soil carbon sequestration over longer time periods and for permanence. This is particularly relevant to landscapes in northern Australia grazing regions that have a highly variable climate and are subject to extreme events such as extended drought. Although levels of soil carbon sequestration may be uncertain, there is more confidence that activities eligible in these methods provide co-benefits for soil health potentially eligible under Queensland's LRF.

## Recommendations

- **Recommendation 1:** Identify gaps relevant to northern livestock producers and invest in research for new and improved methods for carbon and ecosystem services co-benefits.

*Investment in research to fill gaps in data and calculations of emissions abatement, certification information or quantifying co-benefits will improve usability and accuracy of methods. More accurate, less conservative crediting ensures greater confidence in the method and encourages adoption. Collaborative arrangements across government, research and industry interest groups should be facilitated to reduce duplication and accelerate progress in method development for carbon crediting schemes such as the Emissions Reduction Fund (ERF) and voluntary trading such as the Verra framework. Similarly, collaboration should be sought in the less mature area of method development for ecosystem services, including for the Queensland Land Restoration Fund (LRF) and the Australian Farm Biodiversity Scheme. Consistency in the metrics used between schemes and markets, where appropriate to the objectives and priorities, will help to optimise returns on investment and minimise costs and duplication in monitoring.*

- **Recommendation 2:** Engage with certification and standard bodies and with scheme

[31] Commonwealth of Australia 2020b); http://www.cleanenergyregulator.gov.au/About/Pages/News%20and%20updates/NewsItem.aspx?ListId=19b4efbb-6f5d-4637-94c4-121c1f96fcfe&ItemId=812

managers including Commonwealth and state governments to propose and explore development of new or varied crediting methods and certification protocols appropriate to northern beef enterprises.

*There is a clear recognition that land sector carbon offsets and agricultural emissions reduction will be needed, at least in the short to medium term, to meet global and Australian climate change goals and to address environmental sustainability challenges such as soil degradation and biodiversity loss. However, methods and certification schemes often have accounting, reporting, verification and auditing requirements that are costly and time-consuming. This along with the lack of methods to enable crediting of certain beneficial activities or a lack of flexibility to enable application to individual farm management or business circumstances are substantial barriers to adoption by livestock producers. The Climate Active program has undergone revision and there is recognition in recent reviews and analyses of the ERF of the need for more practical methods covering more land sector activities. Early industry input to development of methods for the LRF and Farm Biodiversity Scheme may avoid the need for similar future revisions. As the largest contributor to agricultural emissions, the ruminant livestock subsector has potential to significantly contribute experience and expertise, and collaboration should be encouraged at industry and individual level. Participating in co-design of new ERF methods with the CER or review of methods drafted by Verra and Gold Standard could help to optimise credits generated for government and private markets and encourage development of methods that are practical and cost-effective for livestock production systems in northern Australia.*

- **Recommendation 3:** The importance of communication and maintaining collaboration and capacity in industry and natural resource management networks should not be overlooked as a way to encourage and support producers to participate in ecosystem services markets.

*Review of methods and their uptake indicated the significance of factors such as diverse landholder goals and motivations, social and cultural risks of participation, and the benefits of knowledge exchange over knowledge transfer in building trust and commitment amongst landholders when developing methods. Considering these factors at the method development stage can enhance participation in ecosystem services markets. Good communication and of maintaining collaboration and capacity in industry and natural resource management networks is fundamental for uptake. The review also pointed to the need for continuous improvement through commitment to active experimentation and learning from experience at farm and program levels during implementation.*

- **Recommendation 4:** Ensure trainers/advisers are able to support market participation by northern livestock producers by supporting access to up-to-date understanding and skills to assist needed to take advantage of carbon and ecosystem services market opportunities. Training of advisers in methods for crediting agricultural or vegetation projects and certification protocols for products as well as market and pricing mechanisms is an ongoing requirement to ensure producers have access to accurate information.

*Choosing and implementing a carbon or ecosystem services crediting method is complex and requires expertise across a range of disciplines, including business management, contracting, data collection and storage, monitoring, reporting and auditing. Service providers with appropriate skills can support registering and implementing projects but trusted farm advisers trained in market mechanisms may be better able to advise*

*producers on the financial and legal aspects of what to do with credits once issued e.g. whether to sell in government or commercial markets or whether to use as offsets for carbon neutral certification.*

- **Recommendation 5:** Communicating the 'sustainability story' and maintaining confidence in verified carbon and co-benefit credits and certified labels.

*Land sector offsets that come with environmental, social and/or cultural co-benefits are generally favoured in international carbon markets. This value is yet to be sufficiently realized in domestic market mechanisms, but there are indications of growing interest based on company board and government commitments. Sustainability claims based on the ERF crediting and integrity standards and on the LRF AfN Standard provide strong credibility for the 'sustainability story' of the offsets generated. If communicated well and more consumers are willing to pay for high quality carbon and ecosystem services offsets verified based on credible standards, income and premium pricing is more likely.*

- **Recommendation 6:** As stewards of large areas of grazing land, the red meat industry and northern Australian producers should seek to fully understand methods and opportunities for vegetation projects that align with farm business goals. Experience has shown that relatively low input cost projects that regenerate native forests or farm forestry plantations on part of extensive grazing properties have the potential to generate income in ecosystem services markets, e.g. for carbon offsets, biodiversity credits and reef credits, while providing multiple benefits on-farm, including climate resilience.

*Beef cattle and sheep producers in Queensland manage large areas of land with potential for strategic forest activities under ERF regeneration, environmental planting or farm forestry vegetation methods able to generate carbon credits with biodiversity or other co-benefits, while supporting livestock production. Analysis using the state's remote sensing capability could identify the most suitable areas to ensure positive impacts on productivity and to provide an indication of the potential volume of credits to inform decisions.*

- **Recommendation 7:** Develop educational and training materials and ensure service providers and farm advisers are equipped to understand red meat industry and producer priorities and regional community and indigenous interests. Most producers will need to engage specialist services in methods and market mechanisms for ecosystem services crediting and pricing and for understanding certification schemes for premium pricing of products. Engaging with these providers will help to ensure producers receive practical, relevant advice.

*Industry and peer leadership is well-positioned to train and support trusted advisers to link carbon and ecosystem services methods and market understanding to livestock production systems. Case study demonstrations with cost-benefit or NPV analysis based on available markets and methods would provide a powerful tool. For example, an ERF regeneration method such as a HIR earning ACCUs and co-benefits estimated with the pilot LRF AfN vegetation method for biodiversity credits integrated into a northern beef production property could demonstrate realistic and independent assessments of obligations, costs and risks before project registration or contracting entering into contracts.*

# 1. Introduction

Agricultural systems are a critical component of interactions between people and the environment. The effects of animal agriculture, in particular, on the world's natural resources and the ecosystem services they provide are increasingly a focus of strategies and policies directed at more responsibly meeting the current and future needs for the health of people and the planet.. Growing awareness of the global challenges of climate change and environmental, social and economic sustainable development has led to a degree of concern amongst consumers and communities. Agricultural industries, farmers and other landholders are responding to this concern and also to their own observations of the impacts of climate and management on the productivity and profitability of the resources they manage. Good stewardship of the land and resources is already integral to many agricultural systems but expanding and enhancing good practice by farmers and livestock producers can contribute further to solutions for todays global challenges. Well-constructed and implemented market mechanisms are recognised as a tool to facilitate investment in with benefits for climate change mitigation and resilience and for improving or maintaining ecosystem services while supporting food and fibre production.

Over recent decades there has been a rise in market and pricing initiatives to incentivise actions that maintain or restore ecosystem services (e.g. World Bank Group 2019). Ecosystem services such as biological diversity, soil health, water quality and carbon storage in biomass and soils are widely understood to provide benefits for climate, productivity, nutrition, and aesthetics. However, putting a monetary value on natural assets or quantifying benefits as a tradeable unit are more complex. Without standardised metrics and crediting methods to monetise an ecosystem service confidence in a trading or other market mechanism is likely to be limited, and demand for ecosystem service credits has remained low over several decades. As a result, expansion of incentive schemes has been constrained. However, more recently there has been some evidence of significant attitudinal change driven largely by widespread concerns about the scale of climate change, biodiversity loss, food security and water quality threats. Governments, organisations and communities are turning to 'nature based solutions' for a substantial contribution to efforts to address these global challenges.

Ruminant livestock production, the major land use on 26 percent of the world's ice-free land surface (FAO 2012), has the potential to be a significant part of nature based solutions and, notwithstanding well-documented examples of past resource degradation, recognition of this potential is growing. In Australia, grazing of cattle, sheep and goats on native grasses and on improved pasture or crop residues, predominantly for red meat production, is very important to the economy, environment and to socio-cultural identity. Grazing of cattle and sheep is the major land use on 355 million hectares (around 50% of Australia's land mass). In 2018 there were approximately 26 million head of beef cattle and 66 million sheep in Australia (ABS 2019). Australian beef production is anticipated to increase by 16 per cent by 2030 as the global demand for livestock products increases in line with a growing global population and increasing affluence (OECD-FAO, 2020). The Australian red meat industry recognises its important role in stewardship of large areas of land and of Australia's ecosystem services as well as socio-economic environment (RMAC 2020). The industry acknowledges

a potential for both positive and negative impacts on ecosystem services, including climate change, and has adopted an aspirational goal of net zero greenhouse gas emissions from red meat production by 2030 (Carbon Neutral by 2030, CN30) and partnership in an Australian Beef Sustainability Framework (ABSF 2019a). CN30 is a strategy that has implications for greenhouse gas mitigation with co-benefits for resilience to climate variability and change and ecosystem services such as biodiversity and water management.

For individual livestock producers and animal agriculture industries, the level of investment in development of verifiable methods to assess environmental impacts in a way that can support programs to link management to environmental outcomes in market mechanisms will be a major determinant of the opportunities accessible. Market mechanisms depend on having methods that reward and financially incentivise the actions most likely to provide private and public good and to discourage practices that negatively affect long-term productivity and condition of ecosystem services. Methods set out the rules and obligations for participation in a market based scheme as well as the technical details for measurement reporting and verification of credits. In agriculture and land management sectors, the diversity and complexity of landscapes, climate, ecosystems and livestock management practices add complexity to method development and to the establishment of practical, credible and financially viable programs. However, research and development starting around three decades ago is guiding efforts to overcome barriers to valuing ecosystems services.

This review examines how livestock producers in northern Australia providing ecosystem services can realise value in existing and emerging markets. Market opportunities include payments for credits and premium prices in consumer markets for environmentally friendly products. It examines the current state of domestic and international ecosystem service markets and method development to measure and verify carbon and other ecosystem service credits, e.g. biodiversity and water quality. It also looks at experience in accessing maintaining or accessing new markets or premium prices for red meat products certified or branded as providing ecosystem services, e.g. 'carbon neutral'.

The report is structured to firstly provide an overview of Australia's ruminant livestock industries with a focus on northern Australian red meat production, drawing on experience and opportunities in Queensland. This overview provides the setting for considering environmental and industry implications of current policies and programs for carbon and ecosystem services markets and credit and certification methods, stepping through: (i) the development of ecosystem service markets and nature based solutions in relation to environmental management goals; (ii) existing and emerging frameworks with potential to enable red meat producers to realise value from carbon and other ecosystem services while maintaining productivity and profitability; and (iii) detailed analysis of the technical and practical methods and issues in markets for ecosystem service (including carbon) credits and red meat market access and premiums. The review also looks at policy, industry and support services potentially available to livestock producers and prospective opportunities, barriers and knowledge gaps affecting participation in markets, and concludes with some considerations that could be developed by the industry in making recommendations to overcome barriers to realising expanded opportunities for northern red meat producers in ecosystem services markets.

# 2. Overview of red meat production

## 2.1 Australia's red meat sector

Australia's cattle herd was 26.4 million head at June 2018 and the sheep flock was 70.6 million head (ABS 2019), representing about 2% and 6% of global cattle and sheep numbers, respectively (ABS 2019, OECD-FAO 2019). Although a small proportion of the global cattle herd and sheep flock, Australia is the largest red meat exporter by value, exporting 65% of beef, 73% of sheepmeat and 90% of goatmeat production with a total value of $13.5 billion in 2018. Australia's live export of 1.1 million cattle and 1.2 million sheep was worth an additional $1.5 billion in 2018.

Driven by poor seasonal conditions (BOM 2019), particularly in eastern States, the national herd was forecast to have declined to 24.8 million head by the end of June 2020, but then to start re-building over two to three years (MLA 2020) (Figure 1). Dry conditions also drove a record number of cattle to be on feed in Australia in 2018 with a quarterly average for the year of 1.1 million head (See below for an overview of the feedlot sector).

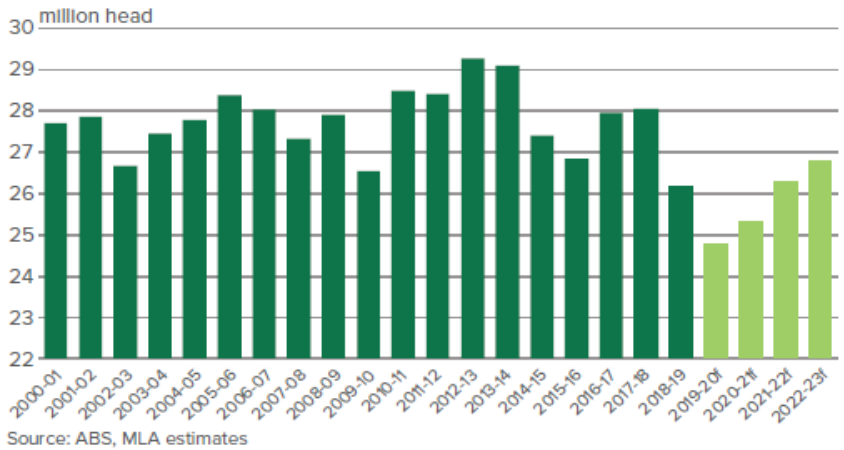



*Figure 1. National beef cattle herd with projections by MLA to financial year 2022-23 (MLA, April 2020).*

At 30 June 2018, the Australian sheep flock was 70.6 million head (ABS 2019), with most located in NSW (36%), Victoria (21%) and WA (20%) (Figure 2A). Total sheepmeat production (lamb and mutton) was 736,557 tonnes cwt in 2018. The number of goats processed in 2018 totaled 1.65 million head, with the majority of slaughter in Victoria (54%) and Queensland (26%) (Figure 2B).

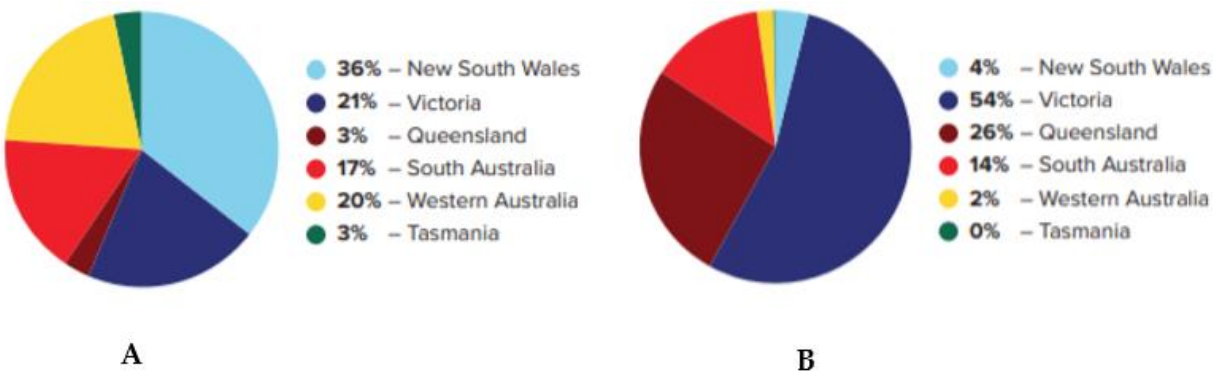



*Figure 2. (A) Australian sheep flock by state (2018); (B) Australian goat slaughter by state (2018) (Source: ABS 2019).*

## 2.2 Red meat production in Queensland

Queensland accounted for 21% of industry economic turnover for red meat and livestock (Figure 3) and 48% of total beef produced nationally in 2018 (MLA 2019). Economic turnover, defined as income generated by businesses within the industry from the sales of goods and services, for red meat and livestock was $65.7 billion in 2017-18 which makes the industry equivalent to around 2% of national total key industry turnover (MLA 2019).

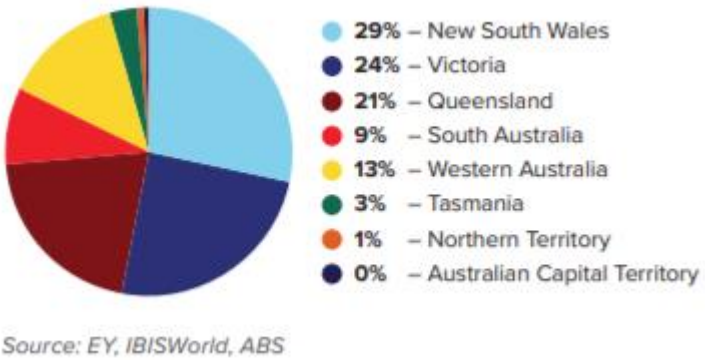



*Figure 3. Red meat and livestock industry turnover by state in 2017-18 (Source: MLA 2019).*

Industry data show that, of the total red meat and livestock businesses in Australia in 2017-18, 17,721 (22%) were in Queensland, second only to New South Wales with 21,422 (26.7%) (MLA 2019). In 2017-18, the Australian red meat and livestock industry directly employed slightly over 172,400 people across almost 80,300 individual businesses. Around 90% of employees lived in rural and regional areas. Of the total export value of $15 billion in 2017-18, 85% of volume came from the three eastern states led by Queensland with 39% (Figure 4).

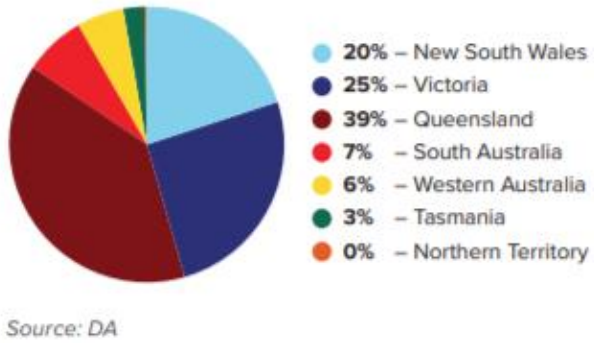



*Figure 4. Red meat export volume by state of production (2017-18) (Source: MLA 2019).*

Queensland cattle have generally accounted for around half of the national herd over the last three decades (ABS 2019), being 46% of the total in 2018 (Figure 5). However, from year to year, herd numbers, structure and productive efficiency depend strongly on seasonal conditions, particularly rainfall. Understanding the strong influence that climatic conditions can have on animal numbers, their distribution across the State and in feedlots, and the quantity and quality of pasture for grazing animals is critical to assessing what actions will be practical and economically feasible in a method to

credit ecosystem services and provide income from market mechanisms. Climate and weather events affect options for manipulating enteric methane emissions, for practical and effective strategies for to increase carbon stocks and sequestration rates in vegetation and soils, and for influencing ecosystem services such as biodiversity and water quality benefits.

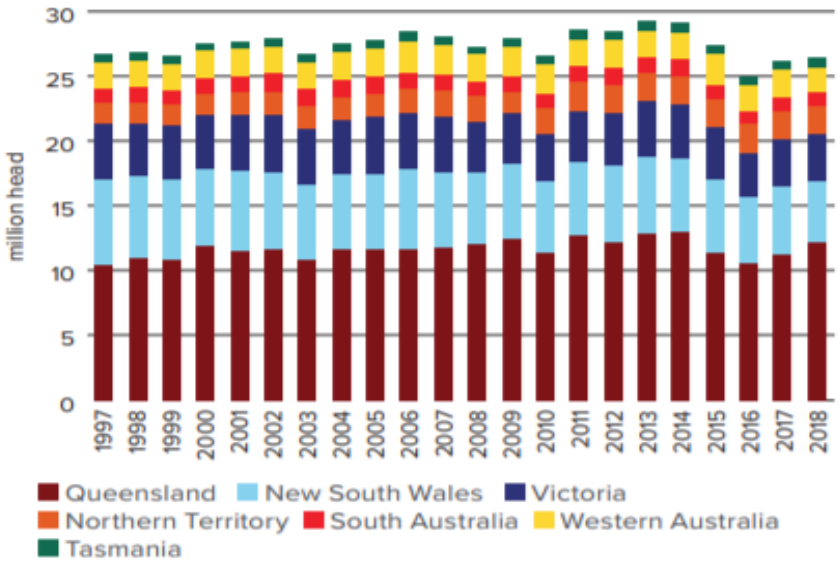



*Figure 5. Australian cattle herd by state (Source: ABS 2019).*

Beef cattle production is the major red meat subsector in northern Australia, with sheep and goat meat playing a smaller though regionally important role. Queensland accounted for 3% of the national sheep flock which, at 30 June 2018, was 70.6 million head (ABS 2019) (Figure 6A). Of the 1.65 million goats processed in Australia in 2018 Queensland accounted for 26% (Figure 6B).


**A** **B**

*Figure 6. (A) Australian sheep flock by state (2018); (B) Australian goat slaughter by state (2018) (Source: ABS 2019).*

## 2.3 The Feedlot sector

Approximately 50% of Australia's 400 accredited feedlots are located in Queensland (Figure 7). While dominated by large corporate facilities with a capacity up to 60,000 head, sizes across the

country range down to small 50 head family feedlot operations.

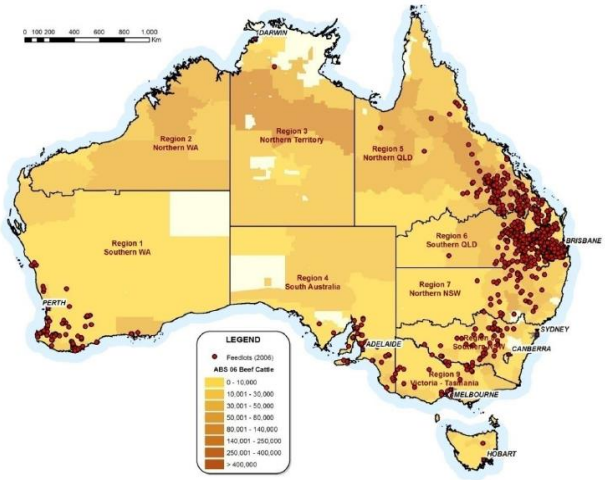



*Figure 7. Location of feedlots in Australia.*

Over the past 50 years, this industry segment has grown markedly, albeit from a very low beginning (https://www.feedlots.com.au/). Total feedlot capacity across the sector was 1.4 million head in 2019, with 1.2 million on feed and total slaughter of 8 million head. Although numbers on feed fell in all States following improved rainfall in early 2020, the decline was not uniform and June numbers indicated that approximately 60% of cattle on feed were in Queensland (Figure 8).

There are also an increasing number of lambs finished in commercial feedlots (MLA 2020), with further expansion planned. A new 20,000-head capacity sheep feedlot will be built in Queensland at Allora near Toowoomba with the help of a $250,000 State Government grant announced in May 2020 (Sheep Central, 22 May 2020).

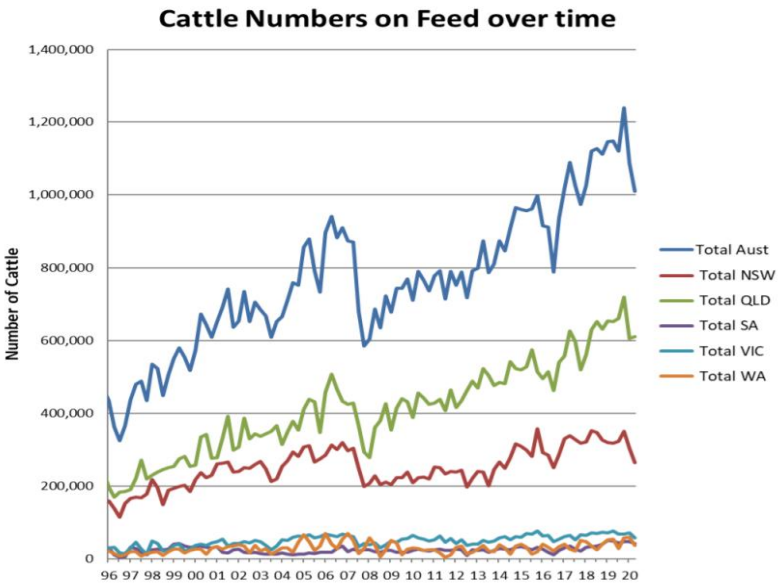



*Figure 8. Number of cattle on feed by state, 1996 to 2020. (Source: ALFA/MLA 2020).*

Feedlots are an important tool for managing climate variability and under drought conditions, as in 2019, processors use feedlots as a base for daily kill, helping them to meet demand. Lot feeding enables good liveweight gain on high quality feed, commonly 75 – 85% cereal grains, in intensive feeding systems. Lot feeding has also been estimated to assist in managing the climate change impact of the red meat industry by decreasing the greenhouse gas intensity of meat production. The high growth rates of animals on feed means animals come to slaughter weight at a younger age and/or are heavier and life cycle accounting shows the outcome is less enteric methane emissions per kg of live weight or per kg of beef produced compared to animals on poorer quality grass forage where, particularly during drought periods, stock take longer to reach sale weight. Intensive management also offers an opportunity for using feed additives or supplements that can enhance live weight gain and, in some cases, inhibit methane formation in the rumen further reducing enteric methane emissions. Research has demonstrated the inhibition of methanogenesis by certain compounds or feed supplements during enteric fermentation (MLA 2015, Mayberry et al. 2018, 2019). Feeding feed additives or supplements is now being explored as a potential method eligible under Australia's ERF (https://www.industry.gov.au/regulations-and-standards/methods-for-the-emissions-reduction-fund) (See Section 8). Future development of commercial feed additive products with robust dose-response relationships, may open opportunities for producers to earn carbon credits for emissions reduction in intensive management. Development of delivery mechanisms for pasture based production could then open up opportunities for extensive beef cattle and sheep production.

## 2.4 Greenhouse gas emissions

In 2017, Australian agriculture was reported in the national greenhouse gas inventory as responsible for 73 Mt $CO_2$-e national greenhouse gas emissions or 13% of total emissions. Enteric methane from ruminant livestock accounted for 71% of agricultural emissions (about 50 Mt $CO_2$-e or 10% of the total for all sectors) (DEE 2019a, Figure 9). Agriculture emissions declined by 9% from 1990 to 2017, with reduction in enteric methane providing the largest decrease in emissions, 20% (Table 1).

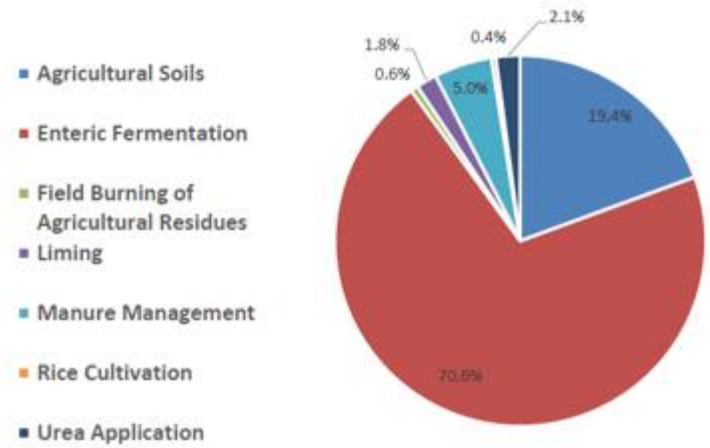



*Figure 9. Australia's agricultural emissions in 2017 (Data source: DEE 2019a).*

*Table 1 Greenhouse gas emissions (Mt CO2-e) from agriculture by sub-sector in 1990 and 2017 (Data source: DEE 2019a).*

| Category | 1990 | 2017 | % Contribution to National | % Change since 1990 |
|---|---|---|---|---|
| **3. Agriculture** | **80.25** | **73.00** | **13.7** | **-9** |
| 3.A Enteric Fermentation | 64.63 | 51.54 | 70.6 | -20.2 |
| 3.B Manure management | 2.49 | 3.68 | 5.0 | 47.6 |
| 3.C Rice Cultivation | 0.40 | 0.29 | 0.4 | -28.2 |
| 3.D Agricultural Soils | 11.72 | 14.17 | 19.4 | 20.9 |
| 3.F. Ag residue burning | 0.43 | 0.47 | 0.6 | 8.6 |
| 3.G. Liming | 0.22 | 1.32 | 1.8 | 512.2 |
| 3.H Urea Application | 0.37 | 1.54 | 2.1 | 320.9 |
| | | | | |

The National Inventory Report to the UNFCCC for 2017 showed that approximately 63% of enteric methane emissions (51.5 Mt $CO_2$-e) were from beef cattle, with around 60% of that from cattle on pasture. Of emissions from manure management which make up a further 3% of agricultural-related emissions (3.7 Mt $CO_2$-e), most (about 75%) comes from intensive livestock systems where $CH_4$ is formed from waste under moist anaerobic conditions. Under extensive pasture grazing $CH_4$ emissions from livestock manure are negligible because anaerobic decomposition rarely occurs. Improved efficiency of beef cattle production systems between 1990 and 2017 has resulted in a lower emissions intensity. Conversely, manure management emissions rose by about 45% due predominantly to cattle in feedlots increasing from approximately 330,000 to 940,000 head (DEE 2019a,b). The decline in enteric methane intensity as a consequence of more beef cattle on grain feed (Wiedemann et al. 2015a) has been offset in absolute terms by a trend of increasing production. The overall decline in enteric methane emissions for Australia is largely a reflection of the fall in sheep numbers since 1990 (Figure 10).

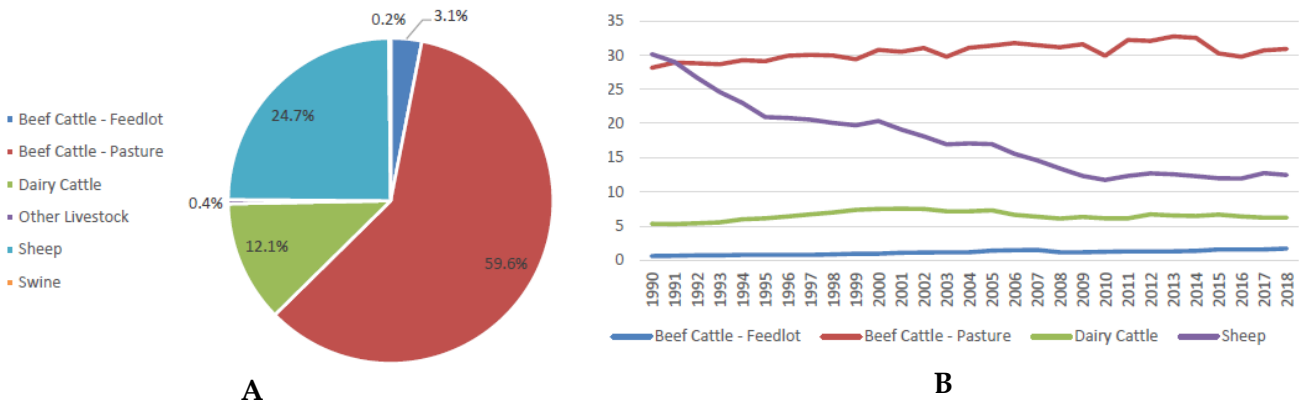



*Figure 10. Enteric emissions (A) by livestock type in 2017 and (B) by year from 1990 to 2017 (Data source: DEE 2019a).*

Mayberry (2020) used data from the 2017 National Inventory report (Commonwealth of Australia 2020a) and livestock statistics to allocate greenhouse gas emissions from cattle, sheep and goat production (farm and feedlot) and processing to the Australian red meat sector. This enabled an

estimation of the red meat carbon footprint for selected years – 2005, 2015, 2016, 2017 (Table 2). Allocation of emissions to the red meat sector was based on animal numbers, feed intake, meat production and resource use (Mayberry et al. 2019), presented for major sources: animal emissions from enteric fermentation and manure; emissions from feed production (pasture and crop); carbon sequestration and loss associated with land management including changes in forest cover; and emissions from fossil fuel use for farm, feedlot and processing activities. A major influence of allocation is the sharing of enteric methane emissions from sheep between meat and wool. Mayberry (2019 used a protein mass allocation approach after Wiedemann et al. (2015b) for all sheep sources of greenhouse gas. This estimation method for sectoral emissions and annual data on production then allow the red meat industry to track the carbon footprint (net greenhouse gas emissions per unit of production) over time relative to the nominated baseline year of 2005 (Mayberry et al. 2019).

*Table 2. Greenhouse gas emissions (Mt $CO_2$-e) from the red meat sector (beef cattle, sheep meat and goats) (Mayberry et al. 2020).*

| | *2005* | *2015* | *2016* | *2017* |
|---|---|---|---|---|
| *Cattle* | 105.55 | 55.14 | 50.55 | 45.71 |
| *Sheep* | 25.12 | 10.70 | 9.15 | 9.94 |
| *Goats* | 0.07 | 0.07 | 0.07 | 0.07 |

In summary, data for the red meat sector show that beef cattle, sheep and goat enterprises are a significant contributor to Australia's greenhouse gas emissions and represent a major land and resource use over the continent. The red meat sector recognises that responding to climate change and sustainability challenges, while representing a substantial challenge, is not only important to meet consumer and market expectations but represents a potential path to increased efficiency and resilience of production in the longer term (MLA 2020b). The following sections explore how participating in well-designed methods and schemes that credit carbon and other ecosystem services or provide certification linked to price premiums and market access can represent an opportunity to incentivise actions by individual producers and the industry.

# 3 Introduction to valuing ecosystem services

Interest in valuing environmental good has been increasing over three decades with a more rapid expansion over the past five years. The United Nations brokered agreements setting 2030 goals for climate change mitigation (the 2015 UNFCCC Paris Agreement, (https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement) and sustainable development (the 2015 UNEP Global Agenda for Sustainable Development (https://unstats.un.org/sdgs/report/2018/overview/) have provided for more coordinated global action and potential demand for compliance and voluntary credits and offsets.

Terms used in the literature discussing markets for environmental good, including *Ecosystem Services*, *Natural Capital Approach* and *Nature Based Solutions*, have evolved over time and inconsistency in use and interpretation of various approaches and units can be confusing. Box 1 sets out more commonly used terms and definitions to clarify how they are applied in this report. This understanding of terms and approaches, although somewhat academic, is necessary to underpin discussion of activities that

could be valued and monetised for providing ecosystem services (ES) and the data and method needs for ES credits.

**Box 1: Understanding terms related to 'Ecosystem Services'**

Terms used in relation to the benefits provided by the environment have evolved over the past few decades and there is now a degree of confusion and lack of clarity about intended meaning in policy, media and even in technical documents. The intention of the definitions and discussion in this box is to assist readers of this review rather than to provide a comprehensive explanation of the evolution of terms or academic precision in meanings. It should be noted that, while services indirectly supporting agroecosystem resources such as productivity, water and soil are critical to farm resources, lack of clarity in definitions relating to services valued in market based instruments can be a direct monetary risk, and should be addressed at the outset of any program.

***Ecosystem services*** are the benefits people obtain from ecosystems. The Australian Department of Agriculture website definition is "the benefits to humans from nature or, direct and indirect contributions of ecosystems to human wellbeing" (https://www.agriculture.gov.au/ag-farm-food/natural-resources/ecosystem-services).

***Environmental services*** are defined in various ways and identified as either ecosystem services or ecological services with some authors accepting that the three terms imply the same processes while others identify differences and argue for a more rigorous ecological definition (Gomes et al. 2019), such as "ecosystem services are a function of complex interactions between species and their abiotic environment, use and usage of complex patterns and different perceptions by the beneficiaries" (Rodrigues et al. 2012). In this review the term Ecosystem Services is used when referring to a recognised or potential market credit.

***Ecosystem services approach*** considers the full range of benefits and costs (both monetary and non-monetary) associated with decisions that affect, or are affected by, ecosystems, including agricultural ecosystems that in Australia make up over 60% of land managed by farmers. (https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/natural-resources/ecosystem-services/ecosystem-final-full.pdf).

**Note:** While the ecosystem services approach to natural resources management was being used by governments in the United Kingdom, the United States, Canada and New Zealand at the start of this century, but has more recently been replaced by the concept of a "Natural Capital Approach".

***Natural Capital Approach*** considers nature as an asset, or set of assets, that benefit people. The ability of natural capital assets to provide goods and services is determined by their quality, quantity and location (DEFRA 2020 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/869801/natural-capital-enca-guidance_2_March.pdf).

***Nature Based Solutions*** refers to actions to protect, sustainably manage, use and restore natural and modified ecosystems for tackling socio-environmental challenges, including climate change, water security and quality, food security, and human health and well-being. (Adapted from IUCN and EU definitions www.iucn.org, https://ec.europa.eu/ )

## 3.1 Valuing ecosystem services

Incentives for positive environmental actions have been introduced in a number of countries over several decades but were formalised by adoption of the United Nations Sustainable Development Goals (SDGs) in 2015 (Box 2). Countries are now increasingly reporting directly against SDGs, with these benchmarks also providing tools for Australian industries to demonstrate responsiveness to changing consumer expectations and maintain or increase market access (AgriFutures Australia 2020). Reporting by Woolmark (Sustainable Material Guide https://www.woolmark.com/) includes SDGs for climate action, responsible consumption, industry innovation, sustainable communities clean water and gender equality. Livestock production is viewed as an important part of achieving many SDG goals but particularly, 1 No Poverty, 2 Zero Hunger, 3 Good health and well-being, 13 Climate Action, 15 Life on land (Smith 2017).

**Box 2. The UN Sustainable Development Goals and livestock production**

In 2015, the United Nations adopted a resolution to transform the world by 2030 by achieving 17 ambitious Sustainable Development Goals (SDGs) that seek to address economic, social and environmental global challenges. The Agenda and 17 SDGs are significantly influencing how governments, organisations and industries, including livestock industries think about their impact on the environment (e.g. FAO 2018).

Contribution to the SDGs has increasingly become part of sustainability reporting and social license, including for agricultural products. In August 2020, a letter to Australia's Prime Minister from a group of the country's businesses, universities and civil society organisations called for the Australian government to align future policy frameworks (including for post-Covide-19 recovery) with the SDGs to realise the benefits of policies that encourage a sustainable future.


*The 17 Sustainable Development Goals adopted by the United Nations in 2015.*

Pricing of ES arose out of the development of economic theory to include the concept of externalities, and a 'tax' on pollution was proposed as long ago as the 1920s. In the period from the 1970s to 1990s, pollutant emissions trading was introduced with the well-documented success of the acid rain cap-and-trade program. This success led to pricing of 'carbon' being included in the 1997 Kyoto Protocol through allowing offsets as one of the 'flexibility mechanisms' able to be used by developed countries to meet their greenhouse gas emissions reduction targets. Carbon in this context is the commonly

used short term for greenhouse gas emissions to, or removals from, the atmosphere in units of carbon dioxide-equivalents ($CO_2$-e) contributing to anthropogenic climate change. The European Union Emissions Trading System (ETS) was the first major greenhouse gas pricing scheme but other financial arrangements have included subsidies, stewardship payments and a range of market-based instruments (MBIs). These can be grouped broadly as Ecosystem Services Markets.

The United Nations Framework Convention on Climate Change (UNFCCC), through the Intergovernmental Panel on Climate Change (IPCC), led development of rules and protocols for parties to report on greenhouse gas emissions, known as IPCC Guidelines for National Greenhouse Gas Inventories. This national scale inventory reporting facilitated the development of regional and project scale accounting frameworks that had a degree of consistency, and the Kyoto Protocol flexibility mechanisms added development of consistent guidance for accounting for Clean Development Mechanism (CDM) projects, including for forestry projects. In turn this formed the basis for projects and carbon credits that could be priced in national and regional emissions trading schemes and other financial arrangements.

In contrast to the situation with carbon credits, there is currently no globally-accepted standardised system for assessing and valuing other ES. Most approaches are consistent with the Common International Classification of Ecosystem Services (CICES) framework for identifying the contributions ecosystems make to human well-being. The CICES, which builds on the pioneering work of the 2005 Millennium Ecosystem Assessment, consists of categories of ES, contributing directly or indirectly to human well-being (Figure 11):

> ***Provisioning Services*** comprise the products we obtain from ecosystems, including food, freshwater, fuel (e.g. dung, wood), fibre (timber, cotton, wool, silk), biochemical and pharmaceuticals, and ornamental resources (e.g. flowers).
>
> ***Regulating Services*** regulate and maintain ecosystem processes, including maintaining the composition of the atmosphere, regulating climate, controlling erosion, regulating water quality and water flow (e.g. runoff, aquifer recharge), decomposing waste, regulating diseases, controlling crop/livestock pests and diseases, pollinating plants, and storm protection (e.g. coastal mangroves and reefs), recycling nutrients.
>
> ***Cultural Services*** comprise non-material benefits obtained through recreation, tourism, intellectual development, spiritual enrichment, reflection, creative and aesthetic experiences. Local ecosystems offer people a sense of place, cultural landscape, and spiritual attachment.
>
> ***Supporting services*** are the ecosystem services necessary to produce all other ecosystem services. Examples include biomass production, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

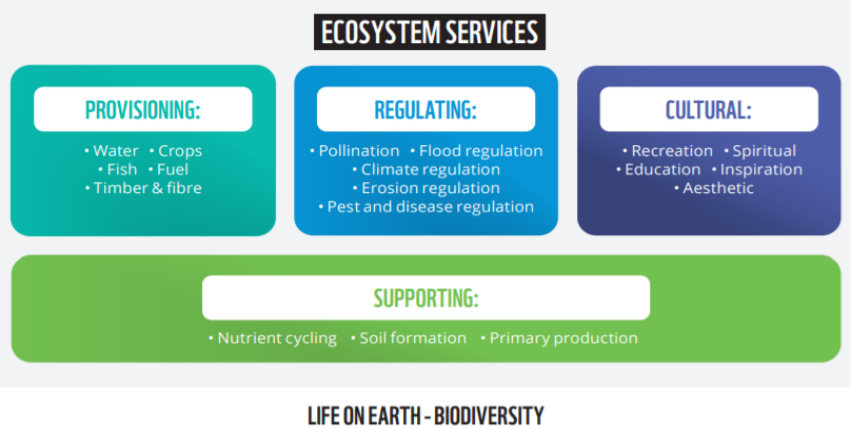



*Figure 11. Summary of types of ecosystems services (Roxburgh et al. 2020).*

Examples of concepts often referred to in connection with ES that are broadly consistent with the CICES framework are the Natural Capital Approach and Nature Based Solutions. In a *Natural Capital Approach*, nature is considered as an asset or a set of assets that benefit people (DEFRA 2020). The extent to which natural capital assets are able to provide ES is determined by their quality, quantity and location (Figure 12), and these aspects are affected by factors such as baseline conditions, type of management practice and drivers of demand. Some services require additional inputs in order for desired benefits to be realised while in other cases the benefit arises directly from the service without the need for further capital or human inputs. It follows that the extent to which nature can provide solutions to overcome problems (*Nature Based Solutions*) and support sustainable development is a function of: (1) the quality and diversity of ecosystems restored and protected (including grasslands and woodlands); and (2) the well-being of those who depend upon them (including indigenous peoples, graziers and other land managers) (Lechner et al. 2020).

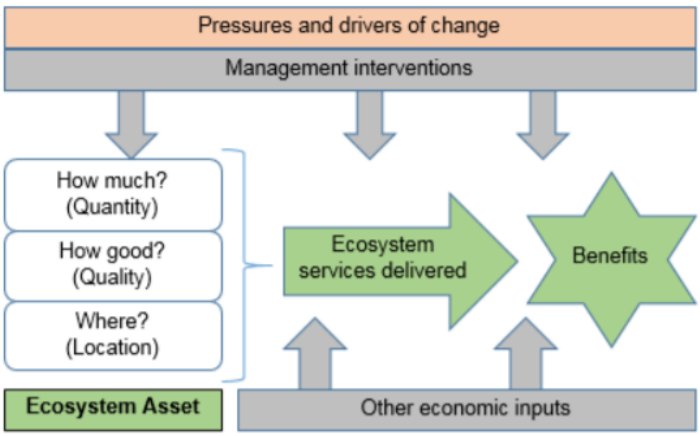



*Figure 12. Framework for the Natural Capital Approach illustrating how the quality, quantity and location of natural capital assets influence delivery of ES and benefits for society. (Source: DEFRA (2020) based on Natural England https://www.gov.uk/government/organisations/natural-england).*

To be meaningful in addressing societal challenges, the concept of *Nature Based Solutions* needs to be supported by sound scientific information covering a range of natural processes and species. The value of forest restoration and expansion illustrates this complexity. Programs such as the One Trillion Trees Initiative, a replanting campaign launched at the Davos World Economic Forum in

January 2020, are undoubtedly *part* of the solution to environmental degradation and climate change, but they need to be informed by sound science to ensure tree plantings are conducted in the right place and at the right time. Use of approaches leveraging forestry and land-based activities, such as wetlands restoration for carbon storage, more clearly assist in mitigating climate change plus provide ES co-benefits. In regions where small-holder farmers and local communities rely on access to land for crops and pastoralism, planting trees on arable land or fencing off access to grasslands can negatively impact food security and exacerbate poverty. Thus, despite the documented benefits, particular activities such as tree-planting should not be seen as a 'silver bullet' for climate change or for environmental sustainability or restoration.

### *3.1.1 Development of markets for carbon credits*

Climate change is now the most well-developed and most visible of the ES with credits traded in market mechanisms. Carbon credits represent a reduction in greenhouse gas emissions or an increase in carbon sequestration which can be measured or modelled using tools and relationships based on scientific evidence. The 1997 Kyoto Protocol flexibility mechanisms provided a foundation for markets in carbon credits, but the volume of trades has remained relatively small. This is due, in large part, to limited demand and resultant low prices (Newell et al. 2013). Modelling by the IPCC (2019) has shown that for nations to achieve emissions reduction in line with keeping global warming to no more than 2$^{o}$C above pre-industrial temperatures, action is required in all sectors, including the land sector. This temperature goal was operationalised through signing of the Paris Agreement in 2015 by 196 countries with emissions reduction commitments specified in a Nationally Determined Contributions (NDCs). As more countries adopt increasingly ambitious climate change targets growth in interest in carbon offsets also increases and has led to establishment of more well-structured and organized carbon markets. The World Bank estimates that in 2020 more than a fifth of global emissions are covered by 46 national and 32 regional systems carbon-pricing schemes operating today or in the planning stage (https://econews.com.au/65893/carbon-pricing-rises-as-worlds-weapon-of-choice-in-climate-fight/). Multinational and domestic businesses specializing in support carbon services, including financial analysis, technical feasibility, agricultural, accounting and auditing, are now operating in many jurisdictions. In Australia, the Carbon Market Institute (CMI) (https://carbonmarketinstitute.org/) which acts as an independent peak body representing all aspects of business interests in carbon trading, has led the development of a Carbon Industry Code of Conduct to provide guidance for bodies wishing to undertake carbon projects - project developers, agents, aggregators and advisers.

Through Article 6 of the Paris Agreement, the framework and institutional structures to enable flexibility and market mechanisms for countries to use or buy carbon offsets to achieve the net greenhouse gas emission targets in their NDCs will be available. However, details of international trading rules under the Paris Agreement have yet to be finalized, slowing market development, until at least the next Conference of Parties, (COP 26) which has been delayed a year due to the Covid-19 pandemic until November 2021. The strength of the market will continue to be dependent on demand and supply factors. There are currently constraints on both but supply generally outstrips demand,

although demand is predicted to grow over the coming decade as a result of parties to the Paris Agreement raising their commitments to emissions reduction. Agricultural producers will be affected since, of the 196 countries that pledged to reduce their emissions under the Paris Agreement, 119 of the NDC commitments include cutting emissions from agriculture. Of these countries, 61 specifically mention livestock emissions. Prices in voluntary markets will also be affected by demand from companies and facilities adopting action on climate change as part of business risk management (e.g. https://www.fsb-tcfd.org/).

In addition to opportunities for Australian agriculture as stronger targets in NDCs and net-zero goals by both governments and other organisations drive growth in carbon offset markets, export industries should consider their exposure to the risk of carbon border adjustments. Such taxes are being discussed in Europe to support the European Green Deal announced in June 2020 (https://www.bcg.com/en-au/publications/2020/how-an-eu-carbon-border-tax-could-jolt-world-trade). The tax would most likely reflect the amount of carbon emissions attributed to goods imported into the 27-nation region, with exemption applied to producers in countries with carbon-pricing mechanisms 'equivalent' to that in the EU. A significant number of economists around the world are voicing support for a carbon tax adjustment mechanism (https://clcouncil.org/economists-statement/).

At the same time as government and community awareness of the threats posed by global warming and extreme weather events increasingly places pressure on all sectors to reduce greenhouse gas emissions, there is clear evidence that the agriculture sector is very exposed to the impacts of climate change. Extreme events are becoming more severe under global warming (IPCC 2019; BOM 2020). Through their management of large areas of land and natural resources, farmers are in a position to contribute to nature based solutions to global warming (Murray 2020), but are also directly affected by loss of ecosystem services. Farmers and other land managers are undertaking actions to protect and restore ES to maintain productivity and to demonstrate good stewardship of nature to maintain their social license, and because they know from lived experience that it is the right thing to do for future generations. Livestock producers have arguably received most attention from environmentally conscious consumers but unfortunately the concerns raised have often been mis-informed or based on incomplete understanding of the scientific evidence for both greenhouse gas emissions and natural resource degradation.

Like other human activities, livestock production contributes to climate change and resource use (e.g. Wiedemann et al. 2015a), but simplistic responses to environmental concerns such as eliminating meat from human diets are not supported by scientific analysis of social, economic and nutrition implications. Globally, around a billion people depend partially or entirely on livestock for their livelihoods (Herrero et al. 2009, GAIN 2020). According to the FAO (2018), most societies, including in industrialised countries, remain critically reliant on animals for food and nutrition security. Ruminant agriculture produces food on 57% of the earth's land that cannot be used for crop production. In 2016, livestock supplied 25% of protein and 18% of calories consumed globally, noting that both are required for nutritional security (Mottet et al., 2017). Competition between humans and

livestock for feed vs food and land occupation occurs in some regions but is often overstated. FAO data indicate that only about 14% of the feed dry matter ingested by livestock is edible to humans (Mottet et al. 2017), and lower still for grassland ruminant systems.

Methods and metrics are needed to document, promote and financially reward contributions by livestock producers to nature based solutions through carbon and ecosystem service crediting or product certification. Nature based solutions must be founded on rigorous science and ecological principles that align with objectives for carbon, biodiversity and other ecosystem services, and to be effective, methods should ideally quantify and financially support multiple environmental, social and economic benefits. There are challenges to developing metrics that can support a balance between co-benefits and trade-offs in natural and agricultural systems. Intact soils, forests, grasslands, shrublands, wetlands and aquatic ecosystems are undeniably substantial repositories of carbon and biodiversity, that provide a host of ES for humanity and therefore represent priority regions. However, it is critical that management strategies ensure local communities, including agricultural producers and indigenous peoples, are able to benefit from the social, economic and ecological services that ecosystems provide.

### *3.1.2 Ecosystem services markets in Australia*

Australia is a party to the 2030 Agenda for Sustainable Development which encourages action to improve the way the environment is managed and put a value on ES in the framework of broader economic, social and cultural well-being and sustainable development. Amongst parties to the Agenda, community-led demands are supporting stronger policy action to protect natural capital. The British government, for example, is considering an environment bill introducing legally binding targets on air quality, waste reduction, biodiversity and cleaner water, including addressing land management impacts on wildlife and effects of agriculture on water quality (https://www.endsreport.com/environment-bill). An increasing number of companies are also responding to shareholder and consumer pressure to take greater responsibility for environmental and climate action, with BHP, Telstra and AGL amongst others making announcements in August 2020.

Despite strong interest and some investment, linking changes in ES to land management actions is multi-faceted and attribution of improvements in ES to human activities rather than natural factors, let alone a specific practice change, is neither linear nor straightforward. In Australia the complexity of attribution is exacerbated by high natural climate variability and more recent trends in climate averages and in extreme events due to anthropogenic climate change. Impacts of extreme weather events on land condition, wildlife and agricultural systems have long been observed in Australia, but management has no doubt exacerbated the severity of some events (McKeon et al. 2004) and experience and research are providing insights into more sustainable management practices in northern Australian conditions (e.g. O'Reagain et al. 2018). In recent years environmental effects have become more visible with dramatic reports and articles in global and Australian media (BOM 2019). The world was shocked by images and statistics of effects on livestock, agricultural land and regional communities and by reports of biodiversity loss over the course of Australia's 'Black Summer' of

2019-20 (BOM 2020). These types of events have a strong influence on community sentiment, raising awareness of climate change risks to the natural environment as well as communities. Adding to other pressures, Covid-19 with associated lockdowns and restrictions has emerged as another influence on the natural world and the ES it provides. Some analysts suggest that the economic downturn in 2020 as a result of the global pandemic could accelerate growth in markets in carbon and ES if government investment stimulus packages are linked to the 'green' re-building (UNGC 2020). There is also evidence that the pandemic has increased the value people are placing on a healthy environment following times of lockdown. This, in turn, can translate to lobbying of governments to strengthen policies to protect nature's assets (Diffenbaugh et al. 2020).

While various schemes and programs have been initiated by governments and other organisations to encourage positive agri-environmental management through financial support or payments for ecosystem services, until very recently, success in Australia has mostly been limited to small scale activities and constrained by short investment cycles (Page & Bellotti 2015). Nevertheless, agriculture is the major land use by area in Australia, with the country's farmers and livestock producers responsible for managing 58% of land, and for maintaining and managing the ES it provides (Jackson et al. 2020), and agricultural industries and individuals are interested in contributing to 'nature based solutions' (NFF 2019, RMAC 2020).

Schemes supporting carbon credit pricing have been more successful than those rewarding other ES to date, and in some cases are being used as a foundation for incentivising activities that provide co-benefits such as biodiversity and water quality (https://www.qld.gov.au/environment/climate/climate-change/land-restoration-fund). Hence, it is useful to examine the data and metrics used for carbon accounting and how it links to monitoring other ES in Australia's approximately 769 million hectares of managed land. Nationally, land use related greenhouse gas emissions and removals are monitored using the FullCAM model. This modelling framework estimates biogenic carbon stock change in the major pools relevant to land use and land use change - above and belowground biomass, debris (standing and on-ground) and soil organic carbon. Emissions from agriculture are estimated based on farm and livestock statistics and information on management practices that determine the emissions associated with production systems as collected by the Australian Bureau of Statistics and agricultural industry reporting (ABS 2019, Commonwealth of Australia 2020a).

'Carbon farming' and the ERF (Carbon Solutions Fund from 2020) are key components of Australia's climate change response (*Carbon Credits (Carbon Farming Initiative) Act 2011* https://www.legislation.gov.au/Details/C2020C00281). The financial incentives through pricing carbon aim to help meet Australia's emissions reduction target through avoiding emissions and increasing sequestration in biomass and soils. The ERF can provide income for voluntary participants through carbon credit markets or supporting low/zero carbon product certification through offsets. The activities incentivized by the ERF can also support regional communities to repair degraded landscapes and landscape productivity. As a party to the Paris Agreement, Australia has submitted an NDC, with a commitment to reduce greenhouse gas emissions to 26-28% below 2005 levels by 2030

(DISER www.industry.gov.au). Separate to the national target, but aligned with Paris Agreement ambition, each Australian state and territory has independently committed to achieving net zero emissions by 2050, expressed either as a target or an aspirational goal. Speaking at the Stimulus Summit[32] (6 May 2020), respected economist, Professor Ross Garnaut AC, proposed that taking action to reduce emissions and investing in less carbon intensive technologies and practices, including for land sector offsets, would generate positive outcomes for the Australian economy in the long-term.

Similarly, the costs and effectiveness of nominated contributions to global UN Sustainable Development will depend on having suitable systems and policies in place to promote actions, and these systems may in part initially extend from carbon markets. Markets in ES including carbon provide opportunities for flexibility and least-cost participation by individuals, industry and government. Understanding developments in pricing ES inform consideration of the market opportunities for ruminant livestock producers in northern Australia.

## 3.2 Premium pricing for goods with ecosystem services

Farmers issued with credits for ES can diversify their income by selling them in trading markets to government or to industries or individuals seeking offsets for compliance or certification purposes. Alternatively they can seek to realise value by attracting a price premium in markets for their products labelled as 'environmentally friendly'. This option depends on meeting requirements under a credible certification standard and on ethical consumers being willing to pay a higher price. Translating interest in environmental good, to financial returns for labelled products over the longer term will depend on confidence that the methods for footprint calculations and/or certification of brand or label claims for environmental 'value' of food and fibre products are credible and have integrity. Environmental credentials may be established through government backed programs such as the ERF and Climate Active that have regulated standards or through private verified standards and schemes, e.g. Verra (https://verra.org/), some of which pay farmers for participating and reporting.

According to analysis by agribusiness specialist Rabobank, market-based approaches rather than regulations are likely to drive red meat industries towards greenhouse gas mitigation (Gidley-Baird 2020). However, while Gidley-Baird (2020) argues that incentives such as price premiums will be needed to stimulate change, he believes that because consumers are not necessarily prepared to pay more for sustainable products (despite ranking it highly as a concern) premiums for low emissions beef will remain limited for some time. The traditional drivers for protein choice such as freshness, value, healthiness and ease of preparation are likely to remain dominant.

Consumer willingness to pay is complex. A Nielsen survey of US shoppers in 2018, reported by Food Business News, showed that 90% of millennials, ages 21 to 34, and 61% of Baby Boomers (ages 50 – 64) surveyed said they were willing to pay more for products that contain environmentally friendly or sustainable ingredients. Overall only 22% of purchases carried a 'sustainable' claim

[32] https://www.smartenergy.org.au/events/stimulus-summit-renewablesled-economic-recovery

(https://www.foodbusinessnews.net/articles/13133-sustainable-product-market-could-hit-150-billion-in-us-by-2021). Brands and labels such as 'carbon neutral', 'low carbon', 'organic', 'regenerative' 'green' and 'grass-fed' are attracting small premiums for red meat producers, but mainly at the upper end of retail and food service sector (e.g. carbon neutral Five Founders beef, https://www.beefcentral.com/trade/165287/). Moreover, there is a risk of 'diluting' the value of sustainability claims due to this growing number of claims or labels that tend to make it difficult to distinguish or prioritise sustainability issues. Importantly, however, even in the absence of significant price premiums, producers may realise value from activities that reduce emissions through productivity gains, consumer trust, social acceptance and access to markets or capital e.g. bank loans.

Despite products with ecosystem service benefits being a niche market to date, 'ethical' consumers and company shareholders are starting to drive a transformation towards change (https://www.beefcentral.com/trade/165287/), and businesses and governments are developing policies that have the potential to further affect market share for these products, including agricultural goods. For example, influenced by data showing that food production is responsible for approximately 11.3% of European Union (EU) greenhouse gas emissions and claims that food systems are driving environmental degradation and biodiversity loss, the European Commission engaged the EU Consumer Organisation (BEUC) to undertake a survey of consumer attitudes to food sustainability in late 2019. This survey reported in June 2020 that almost half (47%) of European consumers say they pay some attention or a lot of attention (17.3%) to the environmental impact of their food choices (BEUC 2020). The EU is currently developing a number of frameworks to identify and preference sustainable production. This 'green taxonomy' is intended to define what is aligned to green investment and low carbon objectives with enable criteria for both emissions abatement and climate adaptation to be defined (European Commission 2019a). There have been suggestions that products would need to meet these criteria to be considered 'green' enough to be allowed into markets. There are limited cases where environmental standards are mandatory currently, e.g. Australian canola exported to the EU biofuel market (Eady 2017). Other country examples include China's development of green finance guidance, a framework development for sustainable goods by Canada and Japan, and New Zealand's progress of a green finance agenda. The pace of these and related developments may potentially affect Australian agricultural exports in the near to medium term, and the CSIRO has reflected on the importance 'for Australia to continue to promote its clean, green, safe meat credentials on the global protein market' to maintain market share (Mayberry et al. 2018).

# 4 Market mechanisms

## 4.1 Ecosystem services markets

Since the concept of ES gained prominence through the Millennium Ecosystem Assessment in 2005, interest has grown but only slowly, particularly on the demand side. A literature search (Campagne

et al. 2020) reported that the number of published studies assessing ES has increased progressively especially during the last five years (Figure 13). Interest has been mainly in assessing and mapping ES supply (including capacity and potential), with demand being markedly lower. Over the period from 2008 to 2019, growth in market activity has been low.

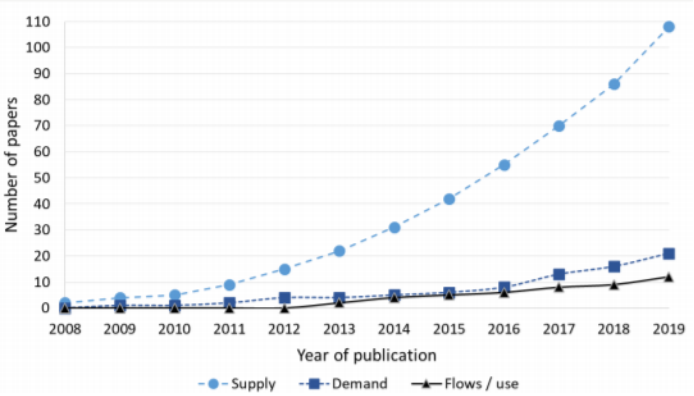



*Figure 13. Growth in the number of published studies up to the end of 2019 analysed for the use of an ES matrix approach to assess ES (Source: Campagne et al. 2020). ('Supply' includes assessment of capacity, potential or supply; 'Flow/use' is an assessment of flow of ES from nature to society; 'Demand' is society demand).*

The approach most commonly used to assess the capacity of landscapes to provide services is an ES matrix. This approach is based on a conceptual framework developed by Burkhard et al. (2009) to use available information, including expert knowledge, to understand land use and land cover impacts (Jacobs et al. 2015, Figure 14). Campagne et al. (2020) note that, while it provides a quick analysis, its application often suffers from poor data quality and lack of rigour. Harrison et al. (2017) preferred a decision tree approach and suggested that reported method choices for assessing and mapping ES were indicative of different levels of expertise, data quality and data availability. It is appropriate that an approach will be matched to user data access and skill level but choosing and implementing a method that is appropriate for the goals of a particular ES assessment and that is able to provide results interpretable by stakeholders, policy-makers, decision-makers and land managers is, in reality, very difficult.

Until standards for ES accounting are available for a range of user skills and budgets, diverse assessment options can assist with initial understanding and development of market opportunities to support land managers in various crop and livestock production systems to adopt practices that increase or maintain ES. In turn, this will contribute to raising their capacity to verify ES outcomes as credits. Remuneration may be linked to units of soil emissions abatement, carbon sequestration, water quality improvement, cultural value or biodiversity protection/enhancement. The Ecosystems Services Market Consortium (ESMC), established in the US in 2019, is leading in developing a verification and certification program to quantify and monetise changes in ES so that farmers can receive payment for ES credits (https://ecosystemservicesmarket.org/). An aim of this program is to align crediting with, and further influence, consumer trends and industry attitudes.

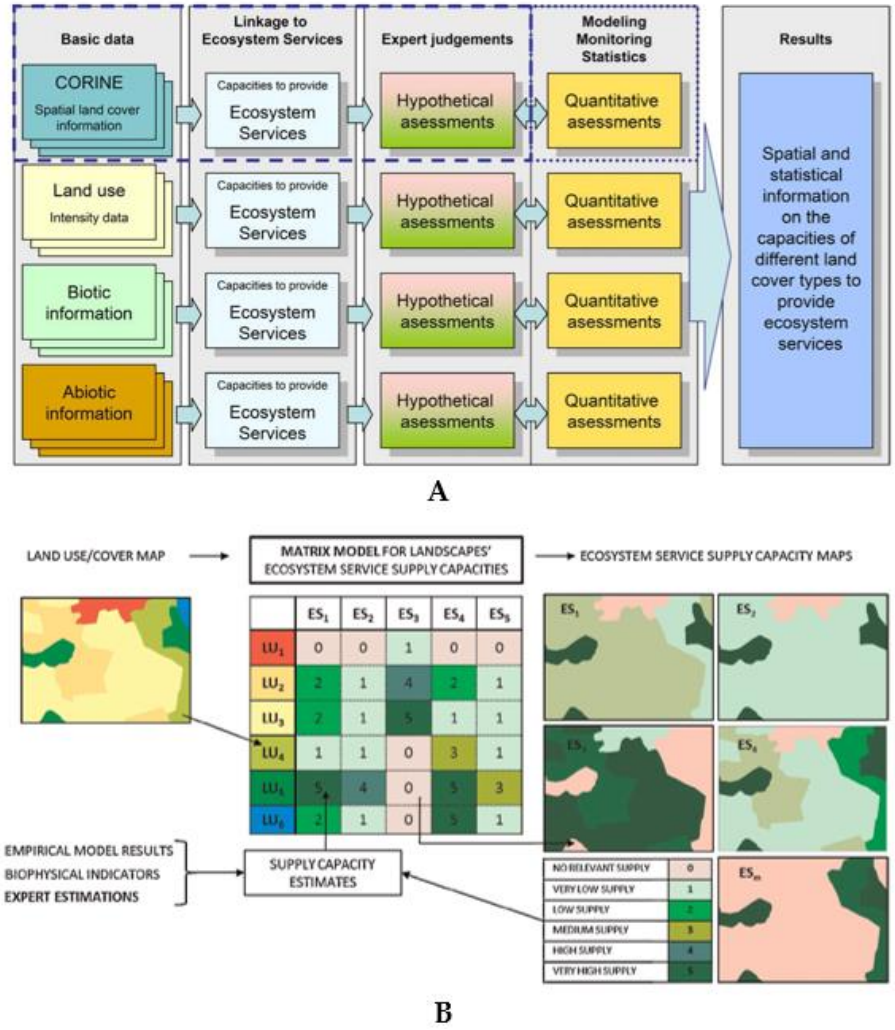



*Figure 14. Conceptual framework to assess and quantify landscapes' capacities to provide ecosystem services (A) and its adaptation to an ES matrix model illustrating the use of expert based estimations, physical quantifications or empirical model results to attribute the capacity to supply ES to land use/land cover (B). (A – Reproduced from Burkhold et al. 2009; with dashed and dotted lines indicating the components presented in their paper; B – Reproduced from Jacobs et al. 2015).*

Participation in ES markets can be voluntary or for compliance obligations. Voluntary participation may be to demonstrate personal or corporate values, and may lead into sustainability reporting or product labelling and price advantage. Compliance relates to regulatory schemes that place restrictions on emissions. Compliance obligations may be subject to rigorously defined methods that quantify permits to emit and eligibility of offsets and likely require third-party verification, especially in the case of climate change markets. To date most ES benefits are more difficult to quantify than carbon credits, but standards such as developed within the Australian Accounting for Nature framework are being applied to ES (Queensland Government 2020).

Within ES markets and in actions based on the concept of Nature Based Solutions tree planting has received considerable attention. General media coverage, the visibility of new forests, and the perception of multiple benefits has driven wide interest, along with the relatively low-cost implementation of reforestation and afforestation. The forestry sector accounted for 42 percent of the global trade in carbon credits over the five years from 2015 – 2019 (Figure 15), mainly for private

investment interests. Regional buyers such as the California Compliance Offset Program have also shown strong uptake (World Bank Group 2020). Demand for forestry credits in the voluntary carbon markets has increased leading to interest in ways to identify and better value the benefits of tree planting or regeneration for ES such as biodiversity.

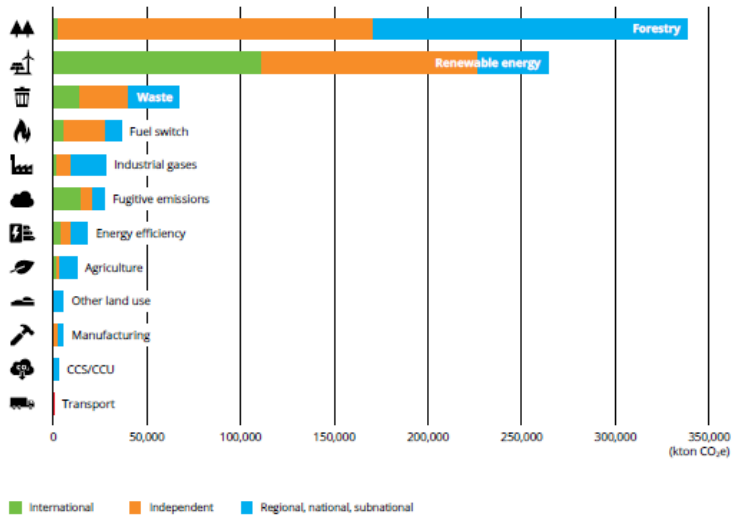



*Figure 15. Issuance volumes of credits in the voluntary carbon markets (kt CO2-e) by sector and type of market mechanism for 2015 – 2019. (Source: World Bank Group 2020).*

Ecosystem services such as biodiversity benefits more commonly use proxy indicators for quantifying credits rather than direct measures. These indicators can have significant uncertainty affecting market prices and interest. Uncertainty can be due to a range of factors, commonly including the absence of a linked positive management action, spatial and/or temporal separation of action and ES outcome, and difficulty in attribution of ES change to an activity due to multiple influences. For example, reducing livestock grazing pressure can lead to an increase in indicators of biodiversity such as groundcover, species diversity and insect pollinator populations in native pastures but the changes in each or some may not be able to be detected for several seasons i.e. they are temporally separated from the practice change.

The ES receiving most interest for financial support have been water quality, biodiversity, soil health and carbon (climate change mitigation). Practices to preserve and grow these ecosystem services are often consistent with goals for productivity and profitability in farm enterprises. However, trade-offs between ES and business goals are possible and should be identified in programs for ES credits. For example, reforestation of grasslands for biodiversity benefits and carbon sequestration can lock up productive agricultural land (e.g. Henry et al. 2018). A study in Australia being undertaken by the ClimateWorks' Land Use Futures program (ClimateWorks 2020b) is expected to provide an analysis of the multiple dimensions of sustainability including consideration of issues and goals for GHG emissions and for water, soil, biodiversity and also socio-economic benefits. The study is expected to examine land sector trade-offs and synergies between different social, economic and environmental objectives, including analysis of trade-offs associated with carbon forestry. It will explore farm diversification (e.g., the mix of livestock, crops, strategic carbon and environmental plantings) and

options for other nature based solutions such as soil carbon and regenerative agriculture, and includes northern Australia and semi-arid areas livestock production regions as a focus.

Research and development work is expected to progress towards accepted standards and methods for quantifying and valuing ES credits for market mechanisms or certification in the near future. In addition to the Climate Works study in Australia (ClimateWorks 2020b), other countries are also investing in this complex area. As an example, the UK government commissioned a report on the challenge of putting a monetary value on environmental goods in developing markets for ES (Dasgupta 2020). The interim report released for consultation in May 2020 discussed the economics of biodiversity. It argued that if ecosystems are viewed as assets, i.e. as durable objects that provide valuable goods and services over their lifetime, then increase in average global income and life expectancy and the decrease in the percentage of the world's population living in absolute poverty over the past 50 years, have depended on these assets. Moreover, the assets represented by ecosystem services are infinite if (and only if) the ecosystems are able to regenerate. It follows that the value of natural capital can depreciate over time if not managed sustainably. This approach proposed by (Dasgupta 2020) that frames natural capital as an asset is interesting but highlights difficulties in consistent quantification of ES. The approach would class biodiversity as a quality or feature of ecosystems rather than an asset in its own right which appears at odds with the high value generally placed on biodiversity (e.g. under the LRF approach, Queensland Government (2020)). Differing priorities mean that such difficulties in consistent crediting of ES for remuneration will not be resolved easily. Interim approaches will likely be needed before consistent standardized global payments and trading are possible as discussed in Section 6.2.

## 4.2 Carbon markets – an overview

A carbon market refers to a defined framework for exchange of carbon units, representing greenhouse gas (GHG) emissions reductions or removals. Government-created carbon markets may be regulatory (compliance markets) or for voluntary emissions abatement actions and reporting. Voluntary markets may be jointly developed with business.

A compliance carbon market commonly allows emissions of GHG only when the facility or emitter holds an allowance or permit. This puts an obligation on industry to reduce emissions in line with the permits held. The compliance framework commonly allows the obligations to be met by the industry directly through implementing an activity or practice to reduce emissions, or indirectly by purchasing units of carbon emissions in the form of carbon credits to offset emissions. Offsets are important for hard-to-abate emissions. A unit is most commonly equal to one tonne of carbon dioxide equivalents (t $CO_2$-e). The success of this type of market in driving down emissions depends on the demand and supply ratio. The required reduction in emissions and cost of technologies or practices to directly reduce a business's emissions determine the demand side. This demand is generally managed by emissions reduction targets, and target reductions along with supply volume drive the price of carbon credits.

Sellers of carbon credits may be organisations or industry bodies in a position to be able to run projects or implement new management and technologies that reduce GHG emissions. Net emissions may also be reduced by increasing stored carbon (e.g. in trees or soil) to keep it out of the atmosphere. In addition, the demand-supply balance can be managed through intervention by a government or regulatory entity purchasing carbon credits either for selling to an emitting industry or being retired. Carbon markets operate domestically or internationally or both.

Voluntary carbon offset schemes operating nationally and internationally offer an alternative market mechanism to government compliance schemes. The Australian ERF is a government crediting and pricing scheme with voluntary participation, but independent schemes also exist. Internationally, crediting under the Gold Standard (www.goldstandard.org) and Verra's VCS.25 (https://verra.org/) provide well-respected private carbon market mechanisms. Crediting methods that underpin these voluntary markets are described in Section 4.2.

Following this overview this section of the review describes selected carbon markets which are currently operating globally and within Australia. Features analysed include demand and supply elements and, where relevant, the potential for participation using Australian carbon credit units (ACCUs).

### *4.2.1 Global carbon markets*

In 2019, there were 61 carbon markets existing globally or scheduled for imminent implementation, raising US$45 billion (World Bank Group 2020)[33] (Figure 16). Data for 2018 (World Bank Group 2019) showed that the price of a carbon credit in operating markets varied from US$1 to 127 per t $CO_2$-e, with around half of all units valued at less than $10 per t $CO_2$-e. Global carbon markets currently have more than 14,500 registered crediting projects that have to date cumulatively generated almost 4 billion t $CO_2$-e carbon credits. While more than half of credits issued have been by the CDM (the Clean Development Mechanism under the Kyoto Protocol), the share by independent crediting mechanisms increased over recent years and represented two thirds of credits issued in 2019.

Globally, 42% of the total credits issued over the past five years have been for forestry sector activities, more than from any other sector. Also of interest to agricultural producers, is that the fastest rate of growth in traded volume across voluntary global markets over recent years has been in land sector credits (Table 3). These units also attracted a high price relative to those from other sectors, second only to those grouped as 'household devices' (Donofrio et al. 2019).

[33] *The following discussion draws on data originally published by The World Bank in 2019 and 2020. Responsibility for the views and opinions expressed in the adaptation rests solely with the author of the adaptation and are not endorsed by The World Bank.*

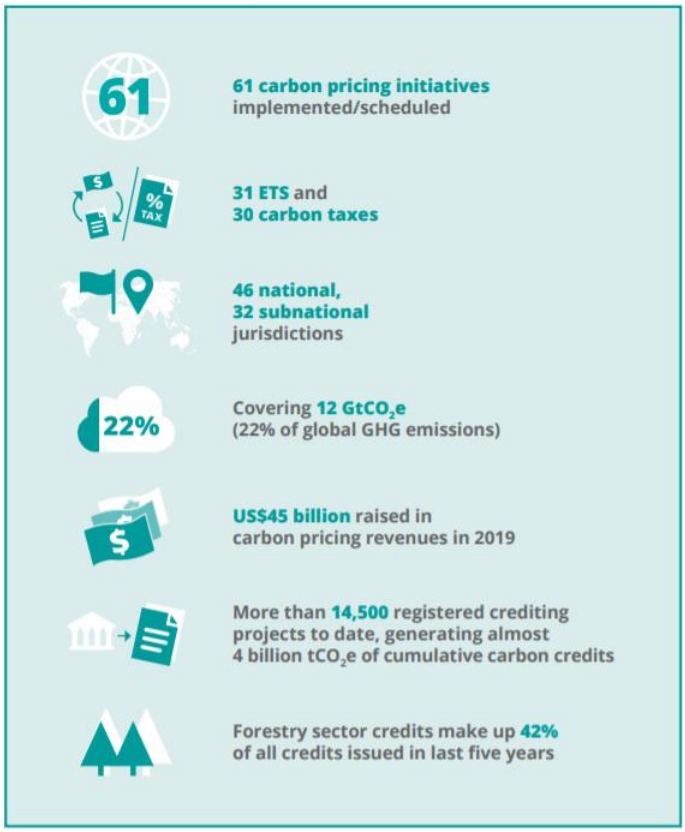



*Figure 16. Summary of global carbon pricing systems in 2019 (World Bank Group 2020).*

Analysis by the World Bank (World Bank Group 2019) indicated that land sector credits were preferred because they were seen to have additional environmental or social co-benefits. The largest increase in price was for credits that achieved not only GHG certification under Verra's VCS, but also accreditation under the Climate, Community & Biodiversity (CCB) Standard that certifies projects that simultaneously address climate change, support local communities and smallholders, and conserve biodiversity (https://verra.org/).

*Table 3. Change in the volume and price of emissions abatement traded in 2017 and 2018 in global markets. (Source: Donofrio et al. 2019, State of the Voluntary Carbon Markets 2019).*

| | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|
| | Volume (Mt $CO_2$-e) | Average price (US$) | Value (M US$) | Volume (Mt $CO_2$-e) | Average price (US$) | Value (M US$) |
| *Forestry and Land use* | 16.6 | 3.4 | 63.4 | 50.7 | 3.2 | 171.9 |
| *Renewable energy* | 16.8 | 1.9 | 31.5 | 23.8 | 1.7 | 40.9 |
| *Waste disposal* | 3.7 | 2.0 | 7.4 | 4.5 | 2.2 | 10.0 |
| *Household devices* | 2.3 | 5.0 | 11.8 | 6.1 | 4.8 | 29.5 |
| *Chemical processes/ Industrial manufacturing* | 2.6 | 1.9 | 4.9 | 2.5 | 3.1 | 7.9 |
| *Energy efficiency/ Fuel switching* | 1.1 | 2.1 | 3.3 | 2.8 | 2.8 | 7.8 |
| *Transportation* | 0.1 | 2.9 | 0.2 | 1.7 | 1.7 | 0.5 |

Data reported by the International Monetary Fund (IMF) also show continued growth in interest in sustainable investing (https://blogs.imf.org/2019/10/10/connecting-the-dots-between-sustainable-finance-and-financial-stability/), creating further pressure on companies to demonstrate a commitment to sustainability either through internal change or offsetting (Figure 17).

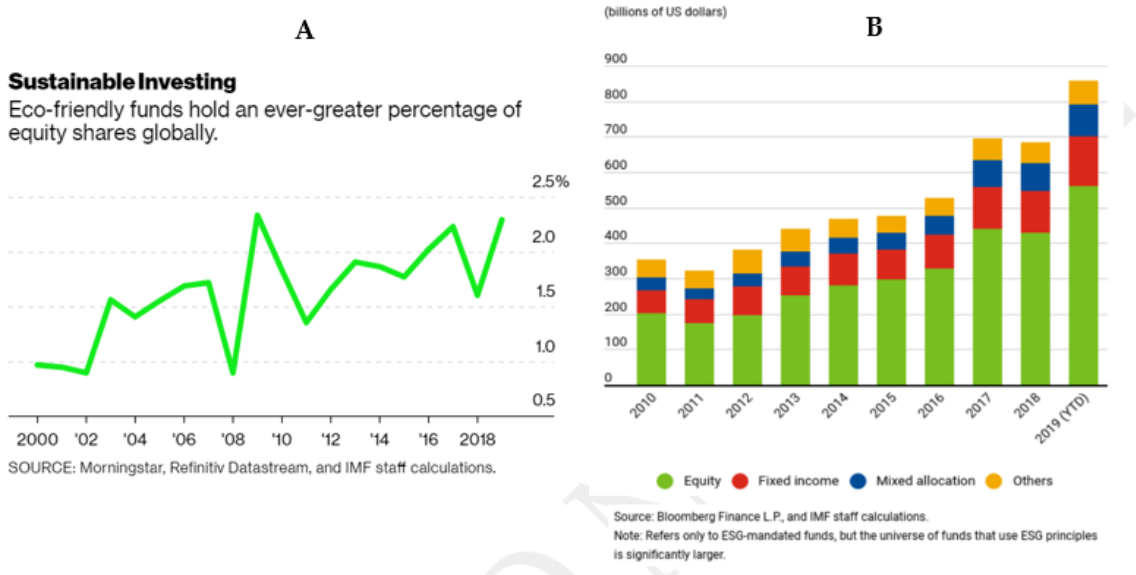



*Figure 17. Growth in the percentage of global equity shares held by 'Eco-friendly' funds from 2000 to 2019 (A) and sustainable investment(B).*

Most analyses in the first half of 2020 indicated that, despite difficult economic times due to the Covid pandemic, the growth in demand for carbon offsets and for ecosystem service credits will continue (e.g., CMI Webinar 14 August 2020). Major investors such as BlackRock have announced that they are initiating actions that will also potentially increase demand for carbon and ES credits (https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter):

> *to place sustainability at the center of our investment approach, including: making sustainability integral to portfolio construction and risk management; exiting investments that present a high sustainability-related risk, such as thermal coal producers; launching new investment products that screen fossil fuels; and strengthening our commitment to sustainability and transparency in our investment stewardship activities.*

Another projected source of demand side pressure for carbon credits is the airline industry, although the severe downturn in travel in 2020 due to the coronavirus will likely affect how actions progress. In 2016, the International Civil Aviation Organization (ICAO) reached agreement on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), with the objective of addressing emissions from international air travel. CORSIA obliges airlines to monitor and report their emissions from 2019 and to purchase emission reduction units generated by projects in other sectors to cover any growth in emissions above 2020 levels starting from 2021. For economic reasons airlines operate as efficiently as possible, but until long distance electric or other non-fossil fueled planes are operational, carbon credits will be a major compliance tool for airlines. Most major airlines have already implemented offsetting programs including through voluntary contributions from passengers (Aster 2020). For example, Easyjet communicated (May 2020) that in spite of the impacts of the coronavirus:

> *We recognise that we have a responsibility to minimise the impact of our flights and are focused on operating efficiently now, and on the development of electric aircraft in the future. In the interim, we*

*continue to offset the carbon emissions from the fuel used for all of our flights on behalf of our customers, and we're proud to be the first major airline in the world to do so.*

The most recent global analysis (World Bank Group 2020) shows that credits issued through a range of crediting mechanisms are primarily being used to offset part of their emissions for fulfilling compliance obligations or for meeting voluntary targets and this is likely to continue to be the largest use of carbon credits in the near future. At mid-2020, the price of carbon credits remains low and the opportunities for Australian carbon offsets seem set to be limited in the immediate term. Nevertheless, projections by a range of market analysts are that the price could be greater than US$100/t $CO_2$-e by 2050 as countries with 2050 zero net emissions targets increase demand. The price of high integrity ACCUs under the Australian Government legislated auction mechanism is low relative to pricing in most international emissions trading schemes (Figure 18). The spot price has tended to closely follow the ERF price. In the next section carbon markets in Australia are discussed in more detail, with reference to factors that could influence future ACCU price in secondary markets.

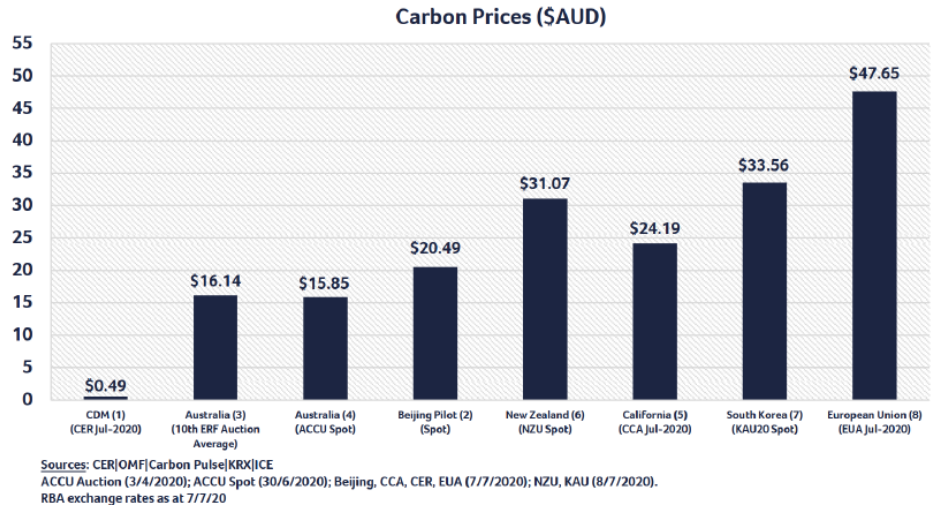



*Figure 18. ACCU price at around $16 remains well below that of the carbon credit price in most countries, with the EUA remaining firm, equivalent to over AUD $47 per tonne in the first quarter of 2020, despite the impacts of COVID-19 (CMI Media Release 15 July 2020).*

### 4.2.2 Carbon markets in Australia

The primary carbon market in Australia is provided through the *Carbon Credits (Carbon Farming Initiative) Act 2011* (the CFI Act) (https://www.legislation.gov.au/Details/C2017C00076) and the 2014 ERF legislation that established a framework for carbon crediting, pricing and government purchasing. Secondary markets also create opportunities for voluntary participation using the ERF crediting mechanism or private sector methods, including those discussed below developed by Gold Standard (GS) and Verra (Voluntary Carbon Standard, VCS), which offer certification of carbon credits eligible for trading in private commercial markets.

#### Government primary market

The ERF legislation covers roles in crediting, purchasing and compliance and is backed by government funding. Over the period 2014 to 2019, the ERF budget was $2.5 billion and this was extended with a further $2 billion dollars through the Carbon Solutions Fund (CSF) from 2020. Participation in the ERF is voluntary.

The crediting role establishes methods and oversight for carbon credits that are eligible to be used towards meeting Australia's 2030 Paris Agreement emissions reduction target. Under legislation, ERF methods must meet a set of Offsets Integrity Standards (OIS) which help to ensure that the ACCUs (Australian Carbon Credit Units) issued under the ERF represent a genuine additional reduction in emission or increase in removals relative to a baseline situation of what would have occurred under business-as-usual. ACCUs are eligible carbon offsets that are widely recognised as having high integrity. Income may be earned through sale of ACCUs into the Government's reverse auction system under contracts administered by the Clean Energy Regulator (CER), the statutory body responsible for administration of the ERF scheme. ACCUs may also be sold to meet compliance in the Safeguard Mechanism, which seeks to limit GHG emissions from large entities or into private secondary markets.

To date, the main purchaser of ACCUs has been the Government, and this is expected to continue to be a major purchaser of domestic carbon credits. However, private markets are expected to become more prominent in demand side growth of the market (CMI 2018). The CER has conducted eleven auctions since 2015, with the eleventh, held in September 2020, showing an increase in interest above the previous few auctions. This is due in part to innovations introduced by the CER, including optional purchase contracts whereby project owners have the flexibility to elect to sell into the secondary market rather than being tied to the fixed price contracted to government.

### Secondary markets for ACCUs

Private carbon markets operating in Australia can trade in ACCUs certified through the government legislated ERF scheme and in credits certified under private schemes. For ACCUs in the secondary market, the Safeguard Mechanism has potential to be a compliance driver by requiring large emitters to purchase offsets when they exceed their emissions baseline, effectively capping their emissions over time. Generous treatment of baselines under the ERF has meant that demand for carbon offsets by the majority of covered entities has been low, but prices for ACCUs in the secondary markets have shown a degree of volatility. This has been driven primarily by changes in demand with policy adjustments. Short-term price dynamics relate more to buying from corporates looking for cheap credits and speculators, and activity for Safeguard Mechanism compliance has been minor (Reputex Energy 2020) (Figure 19).


*Figure 19. Daily ACCU spot price from Sep 2018 to Feb 2020, showing responsiveness to supply and demand related to Safeguard Mechanism management (Source of Figure: Reputex Energy 2020).*

The relationship between the ACCU spot price and CER auction price, can influence demand due to the ability to fulfill government contract delivery through the secondary market. This may constrain the secondary market price to below fixed contract prices (Figure 20). At the time of the 10th ERF auction in March 2020 ACCUs were trading at $0.42 below the average volume-weighted price of $16.32 for fixed contracts at auction (CER 2020a), and since then spot prices in Australia appeared to be steady with three publicly reported trades at prices of $16.50, $15.95 and $15.90 (http://econews.com.au/64433/australias-carbon-market-holding-up-despite-coronavirus/).

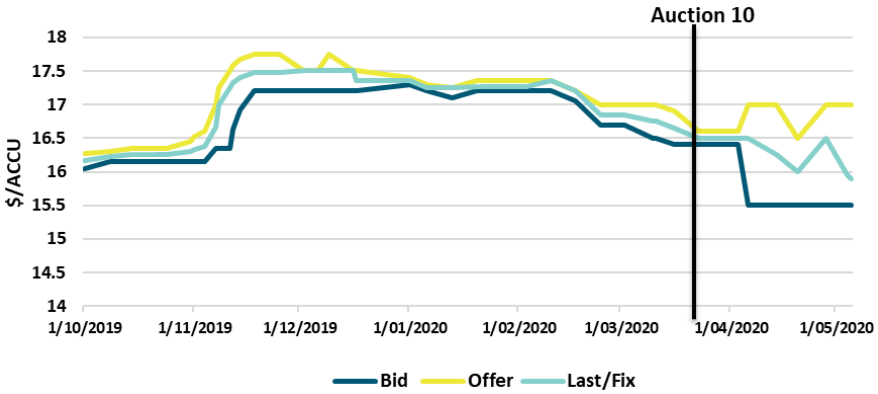



*Figure 20. ACCU spot price over period from 1 October 2019 to May 2020. (http://econews.com.au/) (Accessed 15 May 2020).*

## Carbon offset private certification schemes

Internationally operating voluntary carbon offset certification schemes can offer a broader and administratively simpler option for Australian projects than the ERF. Gold Standard (GS) and Verra's Verified Carbon Units (VCUs) are examples of fully accredited and traded carbon credits sourced

from projects worldwide, with many in developing countries providing social, economic and other environmental co-benefits. Carbon credits accredited by Gold Standard and Verra are globally recognised, and are an eligible offset under the Australian Government-backed Climate Active Carbon Neutral Standard (https://www.climateactive.org.au/), which was formerly the National Carbon Offset Standard. They are among the most widely used quality assurance systems for accounting for emissions reductions in the voluntary carbon market and as outlined below.

The ***Gold Standard*** (www.goldstandard.org) is a global voluntary carbon offset certification scheme that covers energy, land use, forests, agriculture, and waste and water projects. While targeting greenhouse emissions reduction, the Gold Standard requires projects to make a positive contribution to the economic, environmental and social well-being of local communities (Gold Standard, 2017). This requirement is assessed through demonstrated contributions to the Sustainable Development Goals (SDGs) (Box 1) and projects need to contribute to Goal 13 Climate Action and at least two other SDGs.

The Gold Standard develops methods but also recognises methods from other schemes, including the Kyoto Protocol's Clean Development Mechanism (CDM). Opportunities for livestock producers under the Gold Standard include afforestation/reforestation, manure management, livestock management, and fertiliser management. To prevent double counting, credits issued under other schemes must be relinquished before a project can receive Gold Standard credits. Projects must be certified as employing a best practice model of implementation, must transparently meet prescribed key principles and be independently audited. The Gold Standard framework may be used to certify credits used in international markets or other regulated markets. Gol Standard credits are also being used to achieve carbon neutrality under the Climate Active Carbon Neutral program.

The ***Verified Carbon Standard*** (VCS) is a private voluntary carbon offset certification scheme developed by Verra (https://verra.org/), under which certified projects receive a Verified Carbon Unit (VCU) for each metric tonne of CO2-e emissions avoided or sequestered. The VCS sets out rules and requirements for the certification of projects and estimating abatement in most sectors, including energy, industrial and AFOLU (Agriculture, Forest and Other Land Use). Like the Gold Standard, the VCS develops methods, and also accepts methods from other approved greenhouse gas programs such as the CDM, with CDM projects automatically eligible under the VCS. VCS rules provide mechanisms to manage non-additionality, measurement, leakage and non-permanence risks. These mechanism is not greatly dissimilar to how the ERF addresses the Offsets Integrity Standards, although VCS methods are generally less prescriptive regarding implementation than the ERF. For example, methods prescribe tests and baseline setting procedures to manages additionality risks and protocols and discounting to manage measurement uncertainty. The VCS considers both local and international leakage with risk of potential leakage required to be mitigated. For sequestration projects, the risk to permanency (over 20 or 100 years) is managed through requirement for long term management plans and maintaining a 'buffer account' of credits, similar to the 'risk of reversal' buffer in the ERF.

## Outlook for carbon markets in Australia

From 2020, the Climate Solutions Fund (CSF) will continue the crediting and purchasing of abatement set up through the ERF, with the aim of increasing supply of ACCUs to expand the offsets market in Australia. Proponents, including livestock producers, will continue to be able to earn carbon credits and sell them in the primary government market administered by the CER or in secondary markets to businesses, state government and other private entities. In responding to changes recommended by the King Review (Commonwealth of Australia 2020b) and the Technology Investment Statement (Commonwealth of Australia 2020d), the CER is seeking to increase participation. This will be facilitated through development of new and more useable methods, promoting visibility of co-benefits from carbon abatement projects and attracting new sources of finance for CSF projects (http://www.cleanenergyregulator.gov.au/csf/Pages/at-a-glance.aspx). In the near-term these changes are expected to increase supply and prepare for greater demand in both primary and secondary markets for ACCUs.

There are a number of factors that could influence the price for ACCUs and private carbon offsets in the secondary market in the medium term. As an indication of accelerating focus on climate change mitigation, in early November 2020 one of the leading Australian superannuation funds settled a court case with a 25-year-old member who argued that, by not properly considering the risks the climate crisis poses to investments, it failed to act in his best interests (The Guardian 2 Nov 2020). The response from the Fund was indicative of drivers for carbon offsets:

> *"Climate change is a material, direct and current financial risk to the superannuation fund across many risk categories, including investment, market, reputational, strategic, governance and third-party risks."*

Analysis by the CER (2019) showed that, in addition to potential increase in compliance demand under the Safeguard Mechanism, there was growing demand from private and state and territory jurisdictions for ACCUs including those governments, state-owned corporations and voluntary corporate participants making carbon neutral commitments (Figure 21).

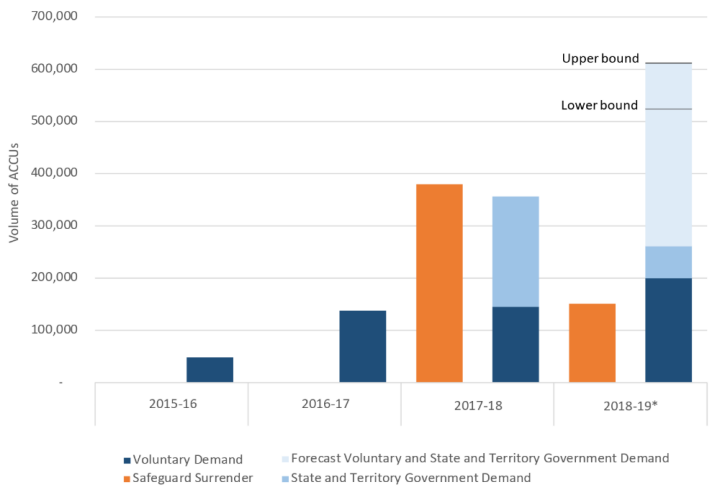



*Figure 21. Emergence of demand for ACCUs from 2015 to 2019 by source of interest (Source: CER 2019).*

The Climate Active program (https://www.climateactive.org.au/), which certifies organisations,

products and services as carbon neutral against the Climate Active Carbon Neutral Standard requires organisations to report their measurement of emissions, their reductions where this is possible and to offset remaining emissions to achieve carbon neutrality. While the majority of offsets used to date have been cheaper international units, primarily from Kyoto Protocol CDM projects accredited under the VCU or Gold Standard schemes, there are signs of increasing use of ACCUs over the past three years (Figure 22).

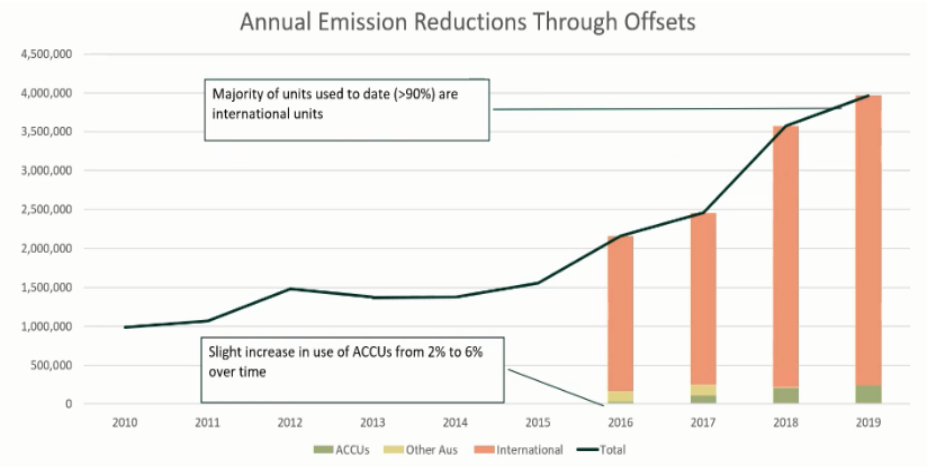



*Figure 22. Breakdown in offsets used for annual emissions reductions under the Climate Active Program (Source: Climate Active presentation to the CMI 14 August 2020).*

The extent and timing of possible adjustments to demand for ACCUs in Australia from 2020 with policy adjustments and implementation of changes to the ERF/CSF recommended by the King Review expert panel (Commonwealth of Australia 2020b) and recommended procedural adjustments and method prioritisation process identified in the First Low Emissions Technology Statement and the Technology Roadmap (Commonwealth of Australia 2020c, d) are not yet clear. If Safeguard Mechanism baselines were strengthened, a corresponding increase in compliance demand for offsets would be expected. Without changes supply of ACCUs issued under the ERF is likely to at least match demand in the short- to medium-term and modelling by Reputex Energy forecasts that by 2030 the price could fall as low as $7.50 (Reputex Energy 2020). Conversely an increase in demand arising from State and Territory commitments to net zero targets and corporate climate change ambitions may drive spot prices higher.

As discussed in the global context in the previous section, there is a possibility that demand for Australian carbon credits in the voluntary markets will increase due to demand for offsets to meet government and industry emissions reduction commitments. All Australian state and territory governments have committed to achieving net zero carbon emissions by 2050, and voluntary climate change targets have been adopted by a range of private organisations and industries, including in the agriculture sector (see examples below). Meeting these targets will likely require offsets. Taking the example of growth in applications for certifications through the government-backed Climate Active Carbon Neutral program, demand for offsets has increased over the past decade(Figure 23), doubling since 2017. Approximately half of the certifications are for small entities with an annual emissions profile of less than 2,000 t $CO_2$-e, indicative of growth in voluntary commitments.

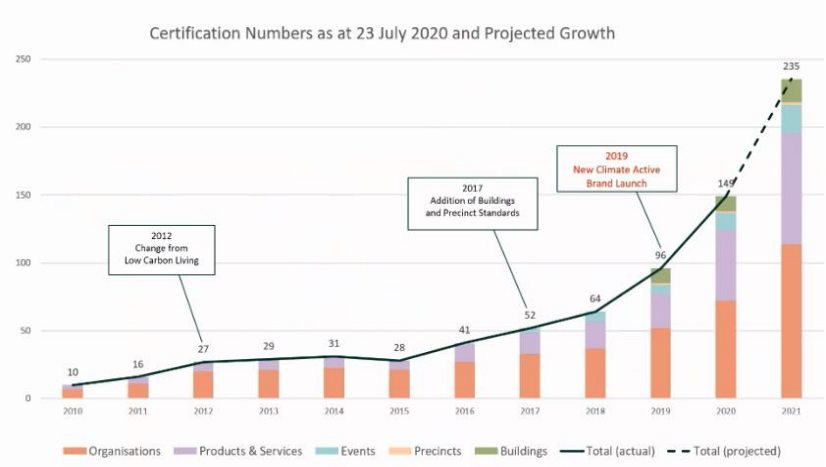



*Figure 23. Number of certifications for achievement of carbon neutrality under the government backed Climate Active program (Source: Climate Active presentation to the CMI 14 August 2020).*

Land sector carbon credits that have certified environmental, social and/or cultural co-benefits are generally favoured, mainly where there is not a significant price differential, because they can be used to support a 'sustainability story' for stakeholders and shareholders in a business (See also Section 5). Co-benefits can include enhanced biodiversity from the protection and regeneration of native vegetation and socio-cultural value in the use of traditional fire management practices for savannah burning where recognition and new income streams are provided to indigenous communities. An example of how these carbon offsets with co-benefits can be used to promote a company's sustainability story is the recent investment by Cooper Energy, an oil and gas company operating offshore gas wells for Victoria, in offsets from Biodiverse Carbon Conservation (https://www.afr.com/policy/energy-and-climate/cooper-energy-goes-carbon-neutral-via-offsets-20201012-p5648e). Cooper Energy will offset the emissions from its production processes to achieve its voluntary net zero emissions goal and chose to purchase carbon offsets generated in the Coorong project provided by Biodiverse Carbon, Greening Australia's carbon trading arm, from its Coorong project. The biodiverse native planting project in the Coorong, south-east of Adelaide at the mouth of the Murray River, is restoring native vegetation and increasing the habitat of the threatened Malleefowl and migratory shorebirds (Cooper Energy 2020).

The Clean Energy Regulator (CER) has initiated identification of carbon credits that also claim to provide co-benefits within the Australian National Registry of Emissions Units (ANREU) ANREU, the secure electronic system that tracks the location and ownership of carbon credits (ACCUs) under the ERF and CSF. Agriculture and vegetation management activities supported by ERF methods enable agricultural producers to not only generate carbon credits for reductions in farm emissions (such as enteric methane from cattle and sheep) and for increases in storage of carbon on agricultural land through new vegetation and soil management practices, but potentially to also receive payment for enhanced ecosystem services such as biodiversity, soil health or water quality credits.

Three climate change commitments are of particular relevance to Queensland livestock producers interested in participating in carbon markets. They are introduced here and will be expanded in later sections.

- *The Queensland Government commitment to be carbon neutral by 2050*: Certain ERF activities in Queensland grazing lands will have the potential to attract higher prices for ACCUs, if they can demonstrate eligible co-benefits. In 2019, the state government invested $500 million to establish a Land Restoration Fund (LRF) (https://www.qld.gov.au/environment/climate/climate-change/land-restoration-fund) that values the co-benefits of carbon farming projects registered under the ERF. Beef cattle and sheep producers managing large areas of land in the state may find practice change more financially attractive under the higher price for projects eligible under the LRF.
- *Australian red meat industry target for Carbon Neutral by 2030 (CN30):* In 2017, the Australian red meat industry, through MLA, announced the red meat industry CN30 initiative, with a target of net zero greenhouse gas emissions from Australia's red meat sector by 2030 (www.mla.com). Activities will be undertaken to reduce emissions as far as practical while maintaining or increasing productivity, with remaining emissions to be offset to achieve a carbon neutral position.
- *National Farmers' Federation (NFF) carbon neutral by 2030 goal*: In 2019, the NFF released its 2030 Roadmap which made a commitment to aim towards being carbon neutral by 2030 (NFF 2019). While this commitment is not specifically targeting red meat producers, livestock are responsible for a large part of agricultural emissions in Australia, and the goal is significant in providing an agriculture-wide policy driver and supporting climate change advocacy.

CSIRO has forecast that, by 2050, the carbon market could provide income of $40 billion to the land sector (Mayberry et al. 2018). This identifies a significant potential opportunity for agricultural producers. Achieving this projected land sector income through creating carbon credits will require accelerated rates of adoption of change, while increasing private sector drivers and ongoing research and government support for market development is needed to create demand and increased prices for carbon credits, in turn stimulating supply. Stimulation of both supply and demand drivers offers the best opportunity for market growth.

## 4.3 Price premiums as a market mechanism

The availability of 'green' or 'climate friendly' commodities is becoming more widespread in response to real or perceived consumer interest. Currently, premium priced food products claiming superior environmental, social or animal welfare benefits represent a small but growing retail segment, mostly at the high-value end of markets. In this review the focus is on the prospects for premium prices for red meat with certified carbon or ES credits but it should be noted that much of the evidence is anecdotal or derived from short-term or regional/local trends. In general, there is a need for more research and better adoption of existing knowledge and data on pricing mechanisms to support a transition towards broad acceptance of "sustainable" certified products in traditional markets.

### *4.3.1 Consumer perspectives*

In general, Australian agricultural products are rated highly in national and global markets for their quality and safety. The reputation of Australian red meat is underpinned by high standards for animal health and welfare, and for being produced in a clean, natural environment. National red meat integrity systems that provide industry-wide traceability and monitoring (https://www.integritysystems.com.au/) help to ensure these standards are maintained and that perceptions of Australian products are positive in domestic and international markets. In 2020, the annual consumer sentiment survey conducted on behalf of MLA by strategic consultancy firm Pollinate reported that 67% of consumers feel 'good' or 'very good' about the Australian beef industry, and 62% feel 'good' or 'very good' about the Australian sheep industry (https://www.mla.com.au/news-and-events/industry-news/ 15 Oct 2020).

Management decisions must always look to productivity and efficiency in profitable enterprises, and consumers will always value price and quality. Within the red meat sector, product differentiation through labels such as organic, grass-fed, or grain-fed beef provide choice for consumers and the potential for price differentiation. Producers may seek opportunities to market products that align with personal values and consumer and industry concerns for health, animal welfare and environmental value. Climate change and environmental sustainability as measured by ecosystem services methods are two of the concerns raised most often but confidence in the label integrity or conversely fear of 'green-washing'. These perceptions are important considerations for the prospect of attracting a price premium. International analysis of markets for organic products have indicated an organic premium of only 5-7% is typically sufficient for profit in organic production to match conventional profits (Crowder and Reganold (2015). Canadian beef producers participating in a pilot program were able to earn premiums for 'sustainable beef' although the value was variable (https://www.albertafarmexpress.ca/news/sustainable-beef-pilot-continues-to-expand-2/). Examples in Box 3 indicate that premiums exceeding 5-7% are now a reality for selected brands. Other examples include domestic supermarkets in Australia, having identified a willingness by customers to pay a premium for grass-fed beef, source a proportion of product from cattle certified as fully grass fed under the Pasturefed Cattle Assurance System (PCAS) (http://www.pcaspasturefed.com.au/). Australian beef producers are also demonstrating that there is an opportunity for price premiums for certified carbon neutral products (https://www.mla.com.au/news-and-events/industry-news/taking-the-carbon-neutral-leap/).

Trust in claims is critical in consumer willingness to pay a premium, but, in reality, consumer perceptions and willingness to pay may be based on information from a wide range of sources (see, for example, https://www.hellonaturalliving.com/ethical-beef-grain-fed-grass-fed-and-organic/). As benchmarks such as 'carbon neutral' become more common in world markets, Australia's agriculture industry will need to be able to demonstrate that it meets market requirements through standards and certification.

**Box 3: Example of Market Premiums for Beef**

In the first quarter of 2020, the COVID-19 pandemic contributed to growth in market premiums for meat products seen as certified for health and sustainability criteria (i.e. being more 'natural' or 'green'), providing some insights into future prospects.

Teys Australia Queensland plants offered in April 2020 a premium of 70c and 100c, respectively, on Grasslands Certified Grassfed (MSA, no HGP) product compared to HGP-free 100-day grainfed and generic four-tooth grassfed HGP-free ox.

NH Food's internally audited farm assurance scheme, Natrue's Fresh Certified Grassfed program attracted 90c/kg premium at Oakey and Mackay compared with equivalent four tooth Jap ox in the last week of April.

(Source: Beef Central, 30 April 2020).

### *4.3.2 Footprints and labels*

In order to maintain access to export markets, Australian agricultural industries are increasingly aware that they should seek to ensure that Australian production systems and products are not disadvantaged as metrics are developed for environmental labelling. The EU is leading the way as it progressively rolls out product environmental footprint (PEF) category rules for a growing range of products. An environmental footprint value attached to a product seeks to influence consumer decisions through information on the environmental sustainability. Footprint labels can be used to compare or rank similar products, but while scientifically-sound metrics are critical, so too is the use and interpretation of footprint labels. Experience has shown there is a risk of misinterpretation by consumers and by policy makers even when reliable information is provided on a labels or a footprint metric. As a result, there is no guarantee that the outcome of investment in a footprint on products will be beneficial for consumers, industry or the environment (See also Section 6.2.7).

Consumers often state in response to surveys that they have a preference for 'ethical' food products, but data show that it is generally more often price, quality and health considerations that drive the actual purchase. In this context, observations by Kieran Smith, Beef Extension Officer, following travel to the US with the Australian Intercollegiate Meat Judging team (Beef Central March 2020) provide some interesting perspectives on markets for Australian beef (largely for burgers) in the US. He noted growing consumer trends towards healthier products, an increasing awareness of the environmental impacts of food, a demand for fresh products, and a growing amount of labelling and branding of products. These trends tend to favour Australian lean meat, but shifts in marketing towards fresh products and increase in availability of alternative protein burgers (e.g. the plant-based Impossible Burger) have the potential to affect the demand. It is possible that willingness to pay a premium for Australian grass-fed beef, viewed by consumers to be healthier and more natural, may follow with appropriate marketing strategies. In 2019, approximately 73% of the 252,000 tonnes of beef exported from Australia to the USA was frozen grass-fed products, so in spite of not being 'fresh', developing trusted metrics and labelling for beef demonstrating ecosystem services and animal

welfare attributes of Australian beef can respond to consumer preferences.

A reliance on a single ecosystem service or environmental impact in product labels or market claims does not provide consumers or policy developers with sufficient information for decisions or strategies directed towards sustainability. The most common single score of environmental benefit presented on labels has become the 'carbon footprint'. This metric assigns a score using a life cycle assessment approach, frequently without considering the full 'cradle to grave' impacts of a product or potential for trade-offs with other ecosystems services such as biodiversity or water use and quality. The carbon footprint of meat, milk and fibre products from ruminant livestock is estimated to be high reflecting enteric methane emissions but does not consider beneficial impacts such as enhanced soil carbon or tree retention on farm (storing carbon, supporting biodiversity) compared to other production systems. Raising awareness of the need for balance and risk of perverse environmental outcomes can be difficult amongst the 'noise' of opinions and communications.

In January 2019, the UK Lancet Commission (Willett et al. 2019) published *Food in the Anthropocene: the EAT–Lancet Commission Report* which aimed to report on 'healthy diets from sustainable food systems'. The report proposed potential solutions to reduce the environmental impact of food production and consumption and endorsed a substantial reduction in global meat consumption. The authors acknowledged that, in some regions, animal production can be essential for quality of livelihoods, poverty alleviation and for ecosystem services from grasslands. Moreover, responses from a number of experts highlighted that sustainable nutrition has to be flexible and tailored to different cultures and food availability. The importance of sustainable livestock systems for socio-economic benefits, nutrition security, and in maintaining natural grassland biodiversity and land condition was noted, but most attention and publicity surrounding the publication centered on the recommendation to reduce meat consumption.

This is one of the more recent publications to highlight the importance of meat producers being able to demonstrate the positive aspects of sustainable livestock production if they are to maintain access to markets and, ideally, price premiums for certified ecosystem service benefits. Overall there are some examples of high end markets (e.g. Box 3) but little clarity about the potential scale of the market for products with carbon or other ecosystem service credentials. It seems likely that this segment will remain a niche market for some time.

# 5. Methods for markets in credits or certified products

There are a number of established or emerging markets for credits or certified products that can provide opportunities for livestock producers to realise recognition and potentially income for verifiable improvements in ecosystem services. The ecosystem services may be for public good or for both private and public benefits. The most important market mechanisms of relevance to red meat producers in northern Australia are described in this section, with a focus on those having high integrity and providing potential to earn credits and realise value for carbon and ecosystem service and/or market meat products at premium prices. This section also provides a critical review of

available information on metrics and accounting systems for credits and the most recognised tools and standards to enable a credible and verifiable label or claim to be made for the environmental qualities of a product.

## 5.1 Emissions Reduction Fund

### *5.1.1 Structure and Governance*

The ERF was enacted in Australia in 2015 through amendment of the Carbon Credits (Carbon Farming Initiative) Act 2011 (the CFI Act), the Carbon Credits (Carbon Farming Initiative) Regulations 2011 and the Carbon Credits (Carbon Farming Initiative) Rule 2015. The CFI Act, originally designed for agriculture, forestry, and landfill offsets only, was extended to cover all sectors of the economy – energy, industry, waste and transport. The overall goal of the legislation with a budget of AUD $2.55 billion for 2015 – 2019, was to support Australia's international obligations to reduce greenhouse gas emissions.

The ERF is a carbon crediting and pricing mechanism aimed at providing incentives for organisations and individuals to adopt new practices and technologies that reduce their emissions and/or increase sequestration. Participation is voluntary. ERF methods (or older CFI methodologies), set out the rules to enable projects to register under the scheme and to be issued with ACCUs. Eligible ACCUs can be sold either through Government reverse auctions or in private secondary markets for use as carbon offsets. The framework and rules for crediting and purchasing seek to ensure that abatement is genuine and additional. The eligible activities can also provide environmental, economic and social benefits for public good as well as private good through productivity and income benefits for farmers, landholders and indigenous communities. In addition to crediting and purchasing of ACCUs, the ERF has a compliance tole, known as the Safeguard Mechanism which aims to constrain growth in emissions from large entities (See Box 4).

Governance responsibilities related to the ERF scheme are shared by the Minister, responsible government department (DISER), Clean Energy Regulator (CER) and Emissions Reduction Assurance Committee (ERAC). The Minister is responsible for making new methods, varying and revoking existing methods and determining method development priorities. Up until September 2020, the Department was responsible for proposing new methods and method variations and assisting in the development of method priorities, but responsibilities for method development and reviews transitioned from the Department of Industry, Science, Energy and Resources (DISER) to the CER which retains previous roles in administering the scheme, including registering and crediting of projects, conducting auctions and managing the Safeguard Mechanism. The ERAC is a statutory committee which operates as an independent technical body to ensure the integrity of ERF credits by advising on new methods and variations, and proposals to revoke methods, and by undertaking periodic method reviews and crediting period extension reviews.

The integrity and auditing requirements aim to ensure the ERF incentivises additional and genuine abatement that can contribute to meeting Australia's international emissions reduction target. The governance structure also seeks to ensure practical arrangements that encourage participation and

provide projects the opportunity to earn income from credits with high credibility in primary and secondary market mechanisms.

**Box 4. Summary: Emissions Reduction Fund (ERF) policy context**

- The Carbon Farming Initiative (CFI) Act 2011 was established to supply offsets to Australia's Carbon Pricing Mechanism – a national ETS.
- In 2014, this mechanism was repealed, the CFI transitioned to the ERF.
- There are three components of the ERF:
  - A *crediting scheme* to generate certified offset credits as 'Australian Carbon Credit Units' (ACCUs) in offset projects, with one ACCU earned for each tonne of carbon dioxide equivalent (tCO2-e) sequestered or avoided being emitted by a project.
  - A *purchasing scheme* to enable the Australian Government to purchase ACCUs from owners of eligible offset projects who have voluntarily entered into a carbon abatement contract with the government and participated in the auction scheme; credits may alternatively be sold into the secondary market.
  - A *safeguard mechanism* that places legal emission obligations on major emitters (facilities emitting >100,000 t $CO_2$-e per year), which can be met through relinquishment of ACCUs (potentially supporting a market for compliance obligations).
- ACCUs issued by the ERF can be used for compliance under the ERF Safeguard Mechanism or sold under the Government auction system or secondary markets.
- Developers of projects can enter into contracts with the Australian government to deliver future ACCUs, and contracts are won through a reverse auction held by the Clean Energy Regulatory (CER) on the price of ACCUs to be delivered.
- As of April 2020, ten auctions had taken place with 475 projects contracted this way to deliver over 193 million ACCUs, with about two-thirds coming from forestry and land use activities.
- The government is seeking to introduce more flexibility to the ERF:
  - In January 2020, the government proposed amendments to allow projects and their credits under the ERF to be transferred to new project proponents;
  - In February 2020 the government included "option" contracts which provide successful project proponents with the flexibility to choose whether to deliver abatement at the contracted price to the government or to sell the credits elsewhere.

### *5.1.2 ERF results and status of projects*

Participants who have registered an ERF project with the Regulator, can elect to enter the reverse auction system and, if successful, have a contract for the purchase of ACCUs by the Australian Government. Participants submit a bid to the Regulator that includes the price and volume of ACCUs and the timeframes for delivery, with the success of a bid dependent on its contribution to lowest cost abatement. Successful bidders receive the price they specify in their bid. To date (October 2020), the Regulator has held 11 auctions for the ERF, and has committed to purchase approximately 200 million tonnes of abatement through 463 contracts (CER 2020d; Figure 24).

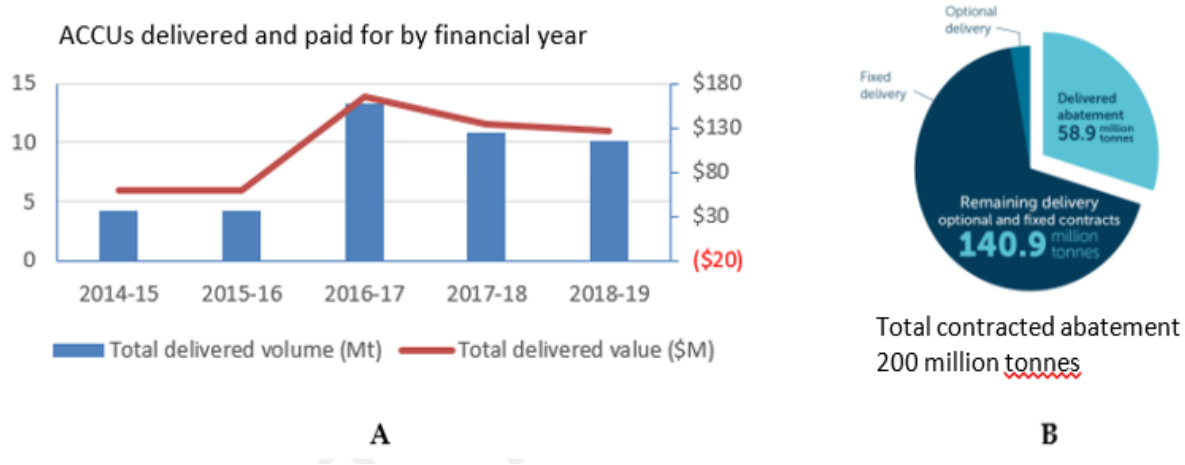



*Figure 24. Total ACCUs transferred to the Commonwealth each financial year under contracts with the CER (A) and total number delivered under contracts (B). (Source: CER http://www.cleanenergyregulator.gov.au/. Note the CER shows combined data for 2014-15 and 2015-16 and this has been arbitrarily split equally across the two years) (A), and proportion of contracted abatement delivered up to March 2020).*

The Regulator now has two options for contracting with successful auction bidders – fixed delivery and optional delivery. Fixed delivery contracts have been used for all 11 auctions, while auction 10 in March 2020 was the first to pilot an optional delivery contract. Following evaluation, this contract type was retained and will be offered at future auctions. At auction 11 in September 2020, optional were favoured over fixed contracts. The CER (2020c) estimates the total value of all contracts awarded has reached $2.4 billion. There are a number of factors that could be influencing participation in 2020, including uncertainty regarding outcomes of method reviews underway by ERAC and of the update of FullCAM, and effects on travel to project sites of COVID-19 restrictions.

**Box 5. Status of Emissions Reduction Fund after June quarter 2020 (CER 2020d)**

- Supply of Australian Carbon Credit Units (ACCUs) was 4.8 million in Quarter 2 2020 and on track for 16 million ACCUs in 2020.
- ACCU holdings grew to 7.5 million.
- Voluntary demand surged with 206,000 ACCUs surrendered in Quarter 2 2020, up 85 per cent compared to Quarter 2 2019.
- Project registrations surpassed 2019 with 43 projects registered in the first half of 2020, compared to 39 projects in all of 2019.
  - 23 new projects were registered in Quarter 2 2020, representing an estimated 3.5 million tonnes of potential abatement out to 2045.
  - At 31 July 2020, 91 project registration applications were on-hand, under assessment.
- Advance payments of up to $5,000 to assist with upfront costs of soil sampling will be offered to eligible proponents.
- Spot prices declined from $16.40 at the end of Quarter 1 2020, to $15.85 at the end of Quarter 2 2020. It has since rebounded reaching $16.05 in July, before falling again to $15.90 at the end of August.

The current status of the ACCU issuance under the ERF as provided in the Clean Energy Regulator Quarterly Carbon Market Report – June Quarter 2020 (CER 2020d) is summarised in Box 5, and data

in Figure 25 illustrates the continuing of dominance of vegetation activities in ERF projects. There are signs of increasing project diversity with registrations for projects using methods other than vegetation rising to 45% in first quarter of 2020 compared to 27 % of all 2018 registrations (CER 2020a).

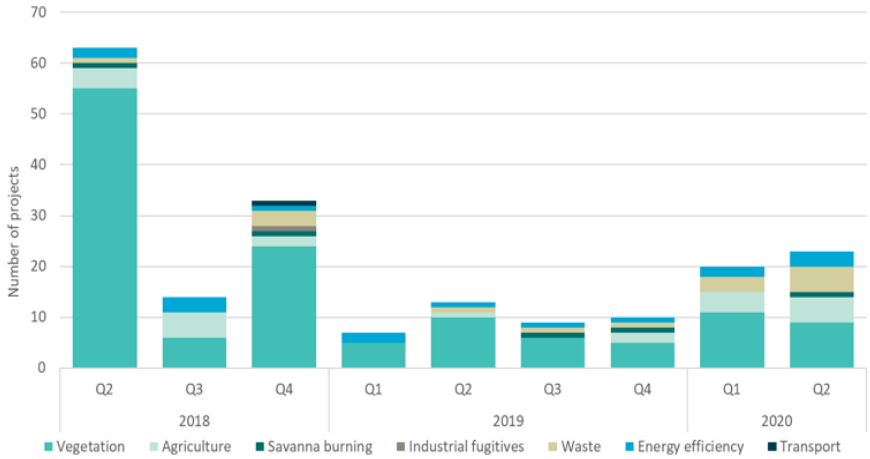



*Figure 25. Number of new project registrations by method type for each quarter from Q2 2018 to Q2 2020, showing that vegetation methods have a continued, but possibly declining, dominance. (Source: CER 2020d).*

Vegetation methods are the main activity type in projects in Queensland and New South Wales, the states which have been credited with most ACCUs (Figure 26). South-west Queensland has most activity in Human Induced Regeneration and Native Forest from Managed Regrowth projects, while savanna burning and waste (primarily landfill gas) project registrations are strong in the north and east, respectively, of the State (CER 2020d). Queensland dominated project registrations in the June Quarter 2020 with over a third of new projects and this potentially reflected the incentive of the Land Restoration Fund.

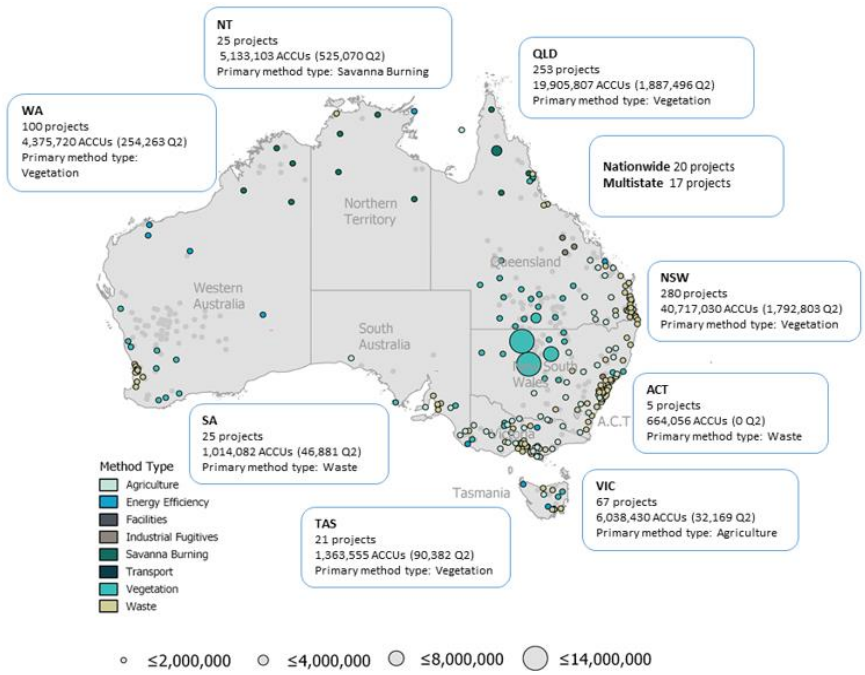



*Figure 26. Total number of ACCUs issued per method type by location, Q2 2020 and scheme to-date (Source: CER 2020d).*

### 5.1.3 ERF and CSF going forward

Under the ERF, more than 82 million ACCUs have been issued to projects, including a record 15 million in 2019-20, with 58.9 million ACCUs delivered under contract to the Government (CER 2020d). The eleventh auction held in September 2020 was the largest by volume since 2017 (CER 2020c), with the CER awarding contracts for 7 million tonnes of abatement on behalf of the Commonwealth. In total, 35 contracts were awarded for 33 projects with two projects securing both an optional and fixed delivery contract. The average price per tonne of abatement purchased at the auction was $15.74, an average price of $15.77 and $15.53 for optional delivery and fixed deliver contracts, respectively. The value of all contracts awarded at the eleventh auction was $110.3 million (2020c).

There are a number of developments and policy changes that may impact demand and supply going forward.

- State and territory government programs:
  - Increases in demand from state and territory governments aiming to meet net-zero targets could result in more project registrations.
  - Recent publication by the Western Australia EPA of its Environmental Factor Guideline identifies how greenhouse gas emissions are considered in the state's environmental impact assessment process and provides a framework for managing emissions. Under the framework, the WA EPA recognises surrender of ACCUs as an accountable and enforceable method for mitigating excess emissions.
  - Potential increase in interest in ERF projects may accelerate with implementation of the Queensland Land Restoration Fund (LRF) with the first call proceeding in 2020 (see Section 5.2).
- The federal government has recently invested in understanding how the ERF can be managed to provide additional emissions reduction and carbon sequestration towards meeting Australia's international targets by improve carbon abatement opportunities across sectors and increasing participation.
  - An expert panel examined additional sources of low-cost chaired by Mr Grant King (the "King Review') with the review report (Australian Government 2020a) providing 26 recommendations targeted at supporting an emerging trend of voluntary emissions reductions and maximising co-investment from the private sector and other levels of government alongside the $2 billion Climate Solutions Fund. These recommendations included changes that would help facilitate uptake by agricultural producers and other land managers, e.g. through more efficient processes for method development.
  - In May 2020, the government released a *Technology Investment Roadmap Discussion* Paper to provide a framework for future investments in low emissions technologies. The paper considers technologies across all sectors with a focus on fossil fuel sectors (energy,

transport, electricity generation) that currently have few ERF projects, but includes options for investment in technologies to accelerate abatement from agriculture and land management. Enhancing soil carbon stocks and livestock productivity, along with deploying technologies to enhance fertilizer use, carbon storage in vegetation and improving fire management are specifically listed. The report states (page 68):

> *In livestock, increasing soil carbon has the potential to reduce emissions and increase productivity. Reducing the cost of measuring the impact of management activities on soil carbon sequestration is critical to realising this potential. Other promising technologies in the research and development phase include alternative feeds for northern pasture cattle (Leucaena and Desmanthus) and the use of supplements (Asparagopsis (red algae) and 3-NOP) in beef feedlot and dairy systems.*
>
> *The Government will continue to pursue opportunities to increase productivity and reduce emissions in agriculture through a range of mechanisms, including the Climate Solutions Fund.*

The roadmap was followed by release on 22 September 2020 of the *First Low Emissions Technology Statement 2020*. The Low Emissions Technology Statement identifies five priority low emissions technologies:

1. clean hydrogen;
2. energy storage;
3. low carbon materials (steel and aluminium);
4. carbon capture and storage (**CCS**); and
5. soil carbon.

New ERF method development is planned to enable projects to earn credits for technologies such as CCS, the inclusion of soil carbon in the top five priorities suggests that carbon farming, and specifically soil carbon sequestration, is expected to have increased importance as part of Australia's future planning to reduce carbon emissions.

While Government response and changes arising from reviews and recommendations published in 2020 by the Expert Panel chaired by Grant King, the Technology Statement and the Climate Change Authority 2020 review of the ERF are still evolving, all indicate a continuing role for land sector abatement in meeting Australia's international commitments. There is a clear recognition that carbon offsets and agricultural emissions reduction will be needed as well as lowering emissions from fossil fuel sources for Australia to meet its 2030 Paris Agreement target. As the largest contributor to agricultural emissions, the ruminant livestock subsector has the potential to significantly contribute to Australia's 2030 target. Agricultural industries need to engage with the Commonwealth government in developing new or improved methods and in research to fill data gaps to realise opportunities to the greatest extent. Engagement with state and local governments and private organisations will also facilitate project implementation and access to carbon offset markets.

### *5.1.4 ERF Methods*

Methods under the ERF define eligible emissions reduction activities and set the rules for implementation of an ERF project and for estimating and reporting abatement or sequestration. Only projects complying with requirements of a method determination are eligible to be registered under the ERF and to earn ACCUs. In 2020, responsibility for ERF method development moved from the Department (DISER) which was previously responsible, to the CER and this transition is still in process at October 2020. Priorities for new methods are determined by the Minister and informed by the Department with consideration given to questions set out in the ERF White Paper. In developing methods, the department sought scientific advice and consulted with technical experts, industry, and potential end users of each method. Details of the process to be undertaken by the CER is still evolving but aims at a more streamlined process with a KPI of finalising each new method within a 12 month period. This section discusses some issues concerning method prioritization and development, and outlines methods that are applicable to northern beef producers. It should be noted that some aspects may change following a suite of announcements by Minister Taylor in connection with release of the *First Low Emissions Technology Statement* announcements (Commonwealth of Australia 2020d).

Before making a method, the Minister must be advised by the ERAC on whether a draft method meets the offset integrity standards (OIS) which are set out in the CFI Act, and cannot make a method if advised that these standards are not met. The OIS are critical to overall scheme integrity as well as the integrity of each method. They are intended to ensure carbon credits issued under ERF methods represent genuine abatement that can be counted towards meeting Australia's international emissions reduction obligations. The ERAC must be confident that the abatement would not have occurred without the incentive provided by the scheme. These standards and their interpretation are important in the context of discussing possible new methods or variations of existing determinations.

In summary, the six offset integrity standards legislated in the CFI Act are:

**1. Additionality:** A method should result in carbon abatement that is unlikely to occur in the ordinary course of events (disregarding the effect of the Act).
**2. Measurable and verifiable:** A method involving the removal, reduction or emissions of greenhouse gases should be measurable and capable of being verified.
**3. Eligible carbon abatement:** A method should provide abatement that is able to be used to meet Australia's international mitigation obligations.
**4. Evidence-based:** A method should be supported by clear and convincing evidence.
**5. Project emissions:** Material greenhouse gas emissions emitted as a direct result of the project should be deducted.
**6. Conservative:** Where a method involves an estimate, projection or assumption, it should be conservative.

Methods and method variations must satisfy all the integrity standards. Appendix 3 provides more detail on how the ERAC interprets the standards in seeking to achieve the objects of the Act:

- to remove greenhouse gases from the atmosphere, and avoid emissions of greenhouse gases, in order to meet Australia's international mitigation obligations;
- to create incentives for people to undertake offsets projects;

- to increase carbon abatement in a manner that is consistent with the protection of Australia's natural environment and improves resilience to the effects of climate change; and
- to authorise the purchase by the Commonwealth of units that represent carbon abatement.

The method assessment process aims to ensure that, to the extent practicable, credits are only issued in relation to genuine abatement, while also being mindful of the importance that methods still create incentives for people to undertake offsets projects in the course of running a viable and profitable business. Only with uptake and achieving new and genuine abatement will the ERF help Australia meet its mitigation targets and there must be realistic balance between requirements that provide strictly accurate emissions and sequestration accounts, enabling practical, cost-effective project activities and ensuring that the integrity of credits is maintained for market confidence. The interrelatedness of the OIS is also considered. For example, in assessing whether a method satisfies the measurable and verifiable standard, the Committee must be satisfied the mechanisms contained in the method are supported by clear and convincing evidence.

As of mid-2020, there are 34 methods under which projects can apply for registration with the CER – 12 relevant to industry and transport, 4 for waste and wastewater management and 18 for activities in the land sector. Agricultural producers and other land managers can generate carbon credits from eligible activities that reduce emissions from agricultural production or increase removals through vegetation and soils on agricultural land (Table 4).

*Table 4. ERF methods of most relevance to livestock producers in Queensland.*

| **Method** (Short common-use name)[1] | **DESCRIPTION**[2] |
|---|---|
| ***Methods to avoid enteric methane emissions*** | |
| Beef cattle herd management | Improvements in grazing beef cattle herd management to reduce methane emissions (e.g. establishing higher quality pasture, feeding supplement, improving weaning percentage, installing fences or expanding watering points) |
| Beef cattle nitrate supplement method | Reducing methane emissions in pasture-fed beef cattle by replacing urea lick blocks with nitrate lick blocks |
| Feeding dietary additives to dairy cows | Providing dietary additives (e.g. canola meal, cotton seed) to milking cows to reduce methane |
| ***Vegetation management*** | |
| Avoided deforestation | Preserving forests on land where land managers have a clearing permit that permits deforestation (according to eligibility requirements) |
| Avoided clearing of native regrowth | Avoiding clearing of native regrowth to increase sequestration in continued growth |
| Human induced regeneration | Changes in management to promote natural regeneration of a permanent even-aged native forest |
| Native forest from managed regrowth | Changes in management to promote natural regeneration where there would otherwise be a cycle of re-clearing |
| New farm forestry plantations | Establishing small-scale forests for harvest on cleared agricultural land with measurement based sequestration |
| Environmental or Mallee plantings | Establishing a forest through direct seeding or planting with FullCAM based sequestration |
| Plantation forestry | Establishing forests for harvest on cleared land, or changing from short to long rotation plantation management |

| | |
|---|---|
| ***Soil carbon sequestration*** | |
| Soil carbon sequestration in agricultural land | Increasing soil carbon stocks in agricultural land using eligible new practices, with sample-based measurements[3] |
| Soil carbon sequestration using default values | Increasing soil carbon in grazing lands using eligible activities, with change estimated using modelled default values |
| ***Savanna fire management*** | |
| Savanna burning – emissions avoidance | Using early dry season burning to reduce emissions from late dry season fires in savannas |
| Savanna burning – emissions avoidance and sequestration | Using early dry season burning to reduce emissions from late dry season fires and to increase carbon stored in savanna landscapes |

[1]For full name of the Method Determination see https://www.industry.gov.au/regulations-and-standards/methods-for-the-emissions-reduction-fund

[2]These methods are those most relevant to extensive cattle and sheep lands in Queensland. For additional material including factsheets and explanatory material see www.cleanenergyregulator.gov.au .

[3]The 2014 *Soil carbon in grazing lands by measurement* method (revoked in 2019) also has several registered projects.

### 5.1.5 Participating in the ERF

There are four main steps that must be followed to participate in the ERF: (1) Applying to register a project; (2) Establishing a contract; (3) Reporting and auditing: and (4) Delivery and payment. The process is shown in Figure 27 and explained briefly below, with further detail available from the Department of Industry, Science, Energy and Resources and the Clean Energy Regulator websites.

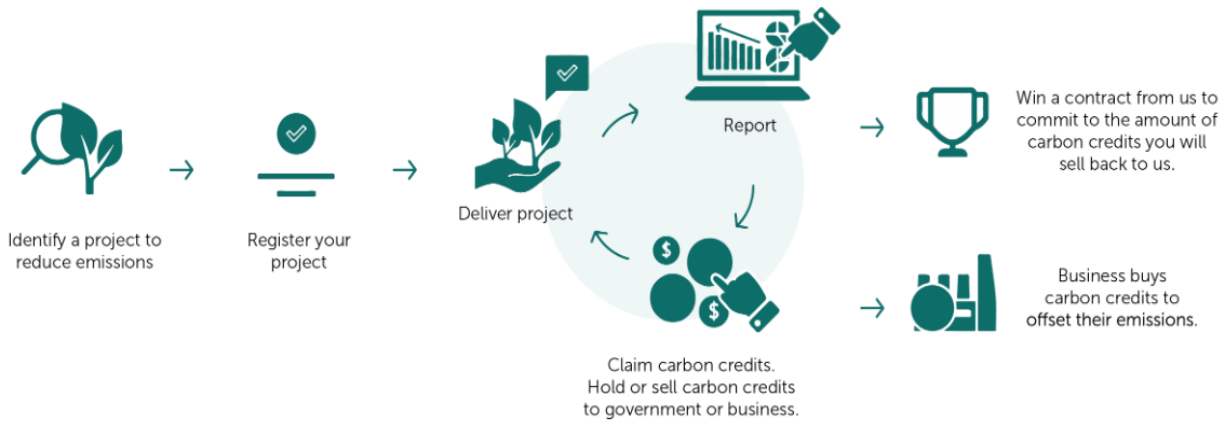



*Figure 27. Steps in developing an ERF project and generating carbon credits. (Source CER: http://www.cleanenergyregulator.gov.au/csf/Pages/How_it_works.html Accessed May 2020).*

Participation in the ERF is voluntary. Organisations or individuals can diversify their income through earning ACCUs, but participation can be daunting as legislation, process and the rules set out in methods are not simple. Many new participants choose to engage a service provider specialising in carbon projects to manage the details of the steps shown in Figure 27. Section 6.1 of this report summarises the services provided by service providers who represent land managers, farmers or others wishing to participate in ERF projects.

As with all business interests, it is important that due diligence is done before entering into an

agreement with a service provider or a contract with the Government. A proponent, whether an individual or organization, should ensure they understand well the full implications for their business and any land rights or covenants, the legal and time commitments involved, and any risks arising from the arrangements. While project methods and supporting material provide details on how to run a method, measure and calculate abatement and reporting obligations, impacts on time of technical requirements and analysis costs may require more investigation. It is generally recommended that a prospective proponent should seek specific expert advice on eligibility, risk, and impacts on their land or business, and should undertake an individual risk analysis based on that advice. Examples of information that should be obtained to support decisions include:

- Determining if a project can meet the eligibility requirements.
- Selecting the appropriate legislated project method noting that to participate in the ERF.
- Understanding the reporting and auditing requirements and the costs of these obligations under the selected method.
- Ensuring the project is well-planned and considers personal and business impacts including:
    - Undertaking a cost-benefit analysis
    - Ensuring access to the capability and skills needed (either existing or through engaging a service-provider).
    - Establishing the project structure (whether as an individual or aggregated project).
    - Setting up monitoring and record-keeping systems.

After a project is registered, the project owner may bid at any time to sell credits in the Government reverse auction process. If a bid is successful, the project owner enters into a carbon abatement contract administered by the CER to deliver abatement of at least 2,000 t $CO_2$-e per year for the duration of the contract. The standard contract period for emissions reduction projects is 7 years, but for projects with a crediting period of 10 or more years, it is up to 10 years. Short-term contracts of less than 7 years or a one-off immediate delivery are also possible. Sequestration projects are subject to a 'permanence period' – the period over which the carbon stocks built through the project activity must be retained and steps taken to prevent loss of the stored carbon. This period is nominally 100 years, but proponents can opt for a shorter 25 year permanence period at a discounted credit issue. Contracted ACCUs must be transferred from the Australian National Registry of Emissions Units (ANREU). However, the required volume of ACCUs can be met through any project or purchased from another source to meet the contract conditions and, if anticipating a shortfall in delivery, a contract owner can normally negotiate a revised schedule, although this may be restricted to 20% under-delivery. Requirements for registering a project, entering an online bid and delivery on contracted ACCUs are set out on the CER website (http://www.cleanenergyregulator.gov.au).

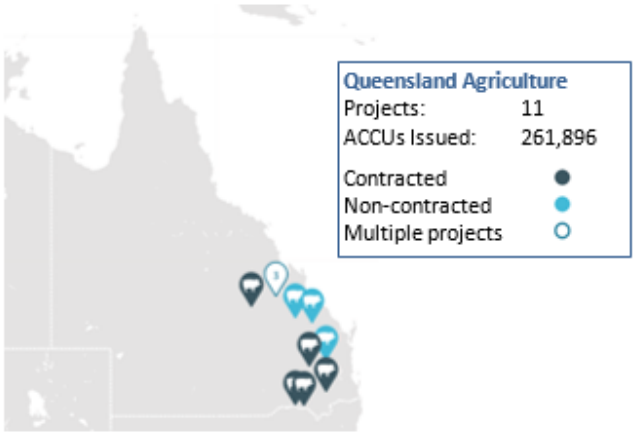
### *5.1.6 Status of ERF projects*

At 14th April 2020, there was a total of 822 projects registered, and 78,106,315 ACCUs had been issued nationally. Grazing lands dominate the projects by location and number of ACCUs contracted (Figure 26). In this discussion of status, the focus will be on projects in Queensland to illustrate the status of

ERF uptake in this important northern red meat production region. Figure 28 gives data from the Australian National Registry of Emissions Units (ANREU) (http://www.cleanenergyregulator.gov.au) on the number and location of registered ERF projects in Queensland relevant to livestock production.

1. Vegetation methods


2. Agriculture methods




3. Savanna burning methods

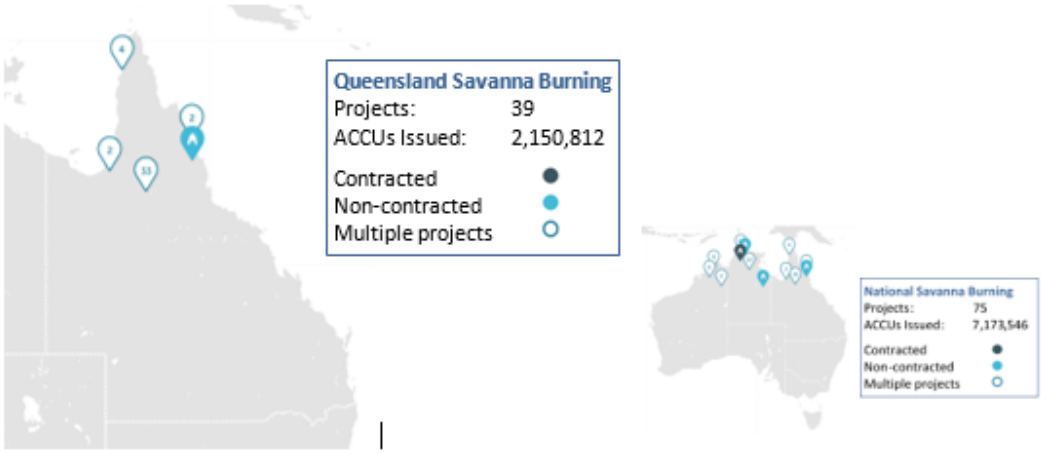



*Figure 28. Number and location of projects and ACCUs issued in Queensland, for the three major land sector method types relevant to livestock producers. Data for all savanna projects in northern Australia are also shown. Data as at 14 April 2020. (Source: CER www.cleanenergyregulator.gov.au/)*

Fifteen projects registered under Agriculture methods were located wholly or partly in Queensland, i.e. in Qld; Qld + NSW; Qld + NT + WA, but, of these, four have been revoked. Most projects (eight) are under the 2014 grazing land soil carbon sequestration measurement method which is now revoked (all with a 25 year permanency period; all yet to start reporting). Only three projects use the beef herd management method, with 176,716 ACCUs delivered in total for two of these.

In Queensland there have been 47 savanna burning projects registered, with eight subsequently revoked, and across the northern Australia beef region there are 75 registered projects issued with over 7 million ACCUs. Many of these projects are managed by indigenous proponents using traditional burning approaches. Nine projects have registered under the now revoked 2013 method, 37 under the 2015 (revoked) emissions avoidance savanna burning method. There are four projects using the 2018 method for emissions avoidance and one using the 2018 method for emissions avoidance plus sequestration. In total, to May 2020, 2,215,968 ACCUs have been issued under these projects.

By far, most interest has been in forest projects, with 167 projects having been registered under vegetation methods of which 17 have been revoked. The majority, 118, were registered under the 2013 Human Induced Regeneration method. There are 33 Native Forest from Managed Regrowth projects, eight Environmental Plantings projects, three Avoided Clearing projects, four Reforestation method projects and one Plantation Forestry project. The nominated permanence period is 100 years for 62 registered projects, with the remainder being 25 year projects. In total 10,897,186 ACCUs have been issued for vegetation projects located in Queensland, including 83,357 Non-Kyoto ACCUs.

### *5.1.7 Future method development*

Several announcements from Government during 2020 will affect the timing and scope of opportunities for livestock producers in Australia's carbon credit market initiatives. While the process of how delivery of the new process and priorities is yet to be fully revealed, planning during the second half of the year gives positive indications for engagement with industry in development of new methods. Section 8.3 discusses some specific opportunities for the livestock sector arising from recommendations from the King Review (Commonwealth of Australia 2020b), directed at expanding abatement from the ERF. Other announcements and initial reactions include:

- The ERF method development function transitioned from the DISER to the CER in October 2020. The CER has a goal to streamline method development with a goal to develop new methods within a 12 month period, and to increase consultation and input of industry, potential end-users and experts in co-design. The CER also continues to administer the scheme (https://www.minister.industry.gov.au/ministers/taylor/media-releases/cutting-red-tape-support-emissions-reduction).
- In the 2020-21 budget the Government announced funding to improve data and modelling to support climate change policy including for soil carbon and livestock methane

https://www.industry.gov.au/sites/default/files/2020-10/2020-21-department-of-industry-science-enery-and-resources-pbs.pdf.

- In response to the *Low Emissions Technology Statement* (Commonwealth of Australia 2020d) released by the Minister in September, the Government stated it will seek opportunities to partner with industry and researchers to improve soil carbon measurement to meet a 'stretch goal' to reduce soil measurement costs to below $3 per hectare per year. High soil measurement costs are a barrier to participation especially for extensive livestock producers, and this investment has the potential to accelerate financially viable activities for earning carbon credits and improving productivity. In addition, the CER is working with service providers and industry to simplify administration.

Red meat stakeholders have expressed strong interest in the prospects for new or varied ERF methods could expand options for livestock producers to also link to opportunities for generating co-benefits under Queensland's Land Restoration Fund (LRF) (See Sections 5.2 and 8.3). However, at the time of finalising this review, the Minister hadn't released his priorities for method development for 2021, except that they would include a new method for soil carbon and a Carbon Capture and Storage (CCS) method.

## 5.2 Land Restoration Fund

### *5.2.1 Purpose and structure of the LRF*

The Queensland Government's Land Restoration Fund (LRF), announced in 2017, is a $500 million commitment to build the carbon farming industry in the State by expanding environmental markets and valuing natural capital and co-benefits (https://www.qld.gov.au/environment/climate/climate-change/land-restoration-fund). By investing and working with industry, the LRF (Box 6) aims to:

- Facilitate a pipeline of qualifying Queensland-based carbon offset projects;
- Pursue environmental and economic co-benefits as defined by the Queensland government;
- Support research and development into emerging areas where the State has a comparative advantage for the purpose of establishing eligibility as ACCUs.

- The LRF builds on the carbon farming strength in Queensland demonstrated through already having 150 of the 475 projects contracted under the ERF, which is second only to New South Wales in total (CER 2020, Section 5.1.6). The LRF investment aims to expand Queensland carbon farming by supporting land-sector ERF projects in agriculture and forestry related areas, that also deliver environmental, social and economic co-benefits to the carbon abatement activities. By adding a value to the broader co-benefits of ERF carbon offsets activities, the LRF targets investments that recognise total project benefits. In doing so, the LRF seeks to ensure realization of outcomes unlikely to have been achieved without the addition of the State investment. The Fund will operate by developing long-term purchasing agreements for ACCUs with land managers and purchasing a specified number of ACCUs. It will separately pay an annual sum in return for demonstrated progress in relation to project

co-benefits milestones and a level of security offered for their long-term continuation. The Fund requires supported projects to provide assurance that co-benefit outcomes are delivered, in accordance with the LRF Co-benefits Standard.

**Box 6. How the Land Restoration Fund works**

The Land Restoration Fund (LRF) provides the opportunity for additional income as well as the potential for private benefits from increased landscape resilience and productivity gains for agricultural producers and other land managers who have ERF projects in Queensland that provide co-benefits on top of the emissions reduction or carbon sequestration.

- Under the LRF, the QLD government enters long-term contracts to purchase carbon credits from the applicant at an agreed price.
- To be eligible projects must be registered under the ERF and be assessed as providing co-benefits recognized under the LRF.
- The LRF offers additional annual payment for the delivery of co-benefits associated with the generation of ACCUs credited in ERF projects.
- The fund also offers a rebate of $10,000 for landholders to support landholders to access advice and services during project development (e.g. for carbon farming service providers, professional services, environmental consultants and other costs).
- The additional revenue from LRF annual co-benefit payments may assist project proponents to offset project implementation or transaction costs and make activities viable during the implementation stage for longer term benefits.

The LRF Priority Investment Plan (PIP) identifies priorities areas for investment in each funding round.

A key objective of the LRF is to provide to farmers and land managers new options for generating reliable carbon farming income streams from improved land management practices (eligible under an ERF method) that either increase storage of carbon in landscapes or reduce greenhouse gas emissions. A robust carbon farming industry in Queensland will help create regional jobs and contribute to reducing Queensland's carbon emissions. It can also provide ecosystem services co-benefits such as healthier waterways, more habitat for threatened species, and more resilient landscapes.

The LRF is open to land managers with the legal rights as defined by the CER for the purposes of eligibility to register a project under the ERF (www.qld.gov.au/environment/climate/climate-change/land-restoration-fund). The Queensland government expects support for the program and demand for carbon credits with added co-benefits from the private sector as well as from the LRF itself. Investment by private industry in all stages of LRF project development, implementation and credit purchase is anticipated to help ensure the ongoing viability of the scheme. For beef and sheep producers, who often manage large areas of land, this represents a genuine opportunity to generate additional, regular payments and diversifies the farm income stream while improving the efficiency and long-term resilience of their landscape and enterprise.

### *5.2.2 LRF Priorities and Co-benefits Standard*

The three priority areas identified for investment in the LRF 2020 funding round are:

1. Land restoration to improve the health of wetlands and coastal ecosystems, including the

Great Barrier Reef.

2. Land restoration for threatened species and biodiversity.
3. Land restoration for social and economic sustainability.

In contrast to the ERF which, under the CFI Act 2011, aims to achieve lowest cost GHG abatement using a reverse auction process, the LRF uses co-benefits as the key driver to obtain well-designed carbon farming projects. This enables the Queensland government to incentivise sustainable land and agricultural management practices in projects that deliver on priorities that would likely require multiple sources of public and private investments to be implemented otherwise. The LRF may also support carbon farming activities with higher costs where the ERF or secondary market carbon price is not sufficient to make the project economically viable relative to potential income from using the land for agricultural production. These carbon farming projects that are marginal on a cost-benefit analysis for the carbon price alone may become economically feasible with income from the LRF for the co-benefits associated with the ERF activity.

The LRF Co-benefits Standard (Queensland Government 2020) sets out how land managers can identify, measure, and report the co-benefits that attach to ACCUs from a project. It also outlines how the co-benefits will be verified and transparently reported. The three main categories of co-benefits of priority under the Land Restoration Fund are:

- Environmental – biodiversity, habitat for threatened species, and healthier soils, wetlands, and water systems.
- Social and Economic – improving the resilience and strength of regional communities by supporting direct and indirect jobs, and more money flowing into Queensland's regions
- First Nations – providing on-country business opportunities as well as new service delivery businesses and supporting cultural and customary connections Projects supported by the LRF may seek to claim co-benefits from one, two, or all of the main co-benefit categories.

Co-benefits that may be associated with ERF method types, as identified in the Carbon Farming Industry Roadmap (CMI 2018) include:

*Vegetation Project co-benefits:*

Diverse environmental plantings and human induced natural regrowth can restore damaged or degraded ecosystems, provide diversified revenue streams for farmers and improve climate resilience for traditional agricultural activities.

Restoration of riparian vegetation, if part of the project, can improve water quality and increase biodiversity and ecosystem services.

*Agriculture Project co-benefits:*

Soil carbon projects can improve soil health and agricultural productivity.

Methane capture projects can enable renewable energy generation and improve the efficiency of intensive farm operations like piggeries and dairies.

*Savanna Burning Project co-benefits:*

Savanna burning can provide remote Indigenous communities with a steady source of income for local employees through 'on country' jobs, support local economic activity and build on

traditional and customary practice.

As discussed in Section 3 of this review, the lack of verifiable metrics has been a barrier to developing an effective market mechanism for quantifying credits and incentivizing activities to improve and maintain ecosystem services. Guided by review of previous systems (Energetics 2017), a new framework was developed covering the carbon offset value chain to provide market confidence in co-benefits under the LRF. This LRF Co-benefits Standard extends coverage and the evidence base for environmental co-benefits by building on the Accounting for Nature Framework developed by the Wentworth Group of Concerned Scientists (2016). The Co-benefits Standard includes protocols for measuring, reporting, and third party certification of environmental outcomes to provide a metric for verified environmental co-benefits. To develop the Core Benefits Verification Framework for verifying the cultural, social and environmental value of Aboriginal carbon farming projects, the Queensland Government funded the Aboriginal Carbon Foundation to develop a Core Benefits Framework for verifying the cultural, social and environmental value of Aboriginal carbon farming projects. This Framework which provides a way of documenting and providing evidence of First Nations co-benefits from LRF projects is highly significant for Traditional Owners in Australia.

The development of the Co-benefits Standard recognises the importance in providing a credible basis for valuing environmental co-benefits for Queensland while acknowledging the lack of an available consistent, standardised metric. Under the Standard, methods will be developed for specific co-benefits. An overview of the Accounting for Nature Framework is given in Section 6.2.2, including a summary of the draft *Land Restoration Fund Native Vegetation Monitoring Method* (Butler 2020). This method would enable measurement and reporting of improvement in condition of vegetation, soil and native fauna that can be third-party certified as evidence of environmental co-benefits under carbon farming project in Queensland in the context of eligibility for crediting under the LRF.

## 5.3 Reef Credit Scheme

The Reef Credit Scheme (https://www.reefcredit.org/) is a market-based mechanism to incentivise water quality improvements across catchments of the Great Barrier Reef. The scheme enables landholders to undertake projects that improve water quality through changes in land management to generate a tradeable unit of pollutant reduction (a Reef Credit) that represents a quantifiable volume of nutrient, pesticide or sediment prevented from entering the Great Barrier Reef catchment. A Reef Credit can be sold to investors in water quality improvements such as government, private industry and philanthropists, with the relative value of pollutant reduction from nutrient, sediment or pesticide based on pollution reduction targets set out in the Reef 2050 Water Quality Improvement Plan 2017 – 2022 (State of Queensland 2018). These values are periodically adjusted by the Reef Credit Secretariat to reflect changes to pollution reduction targets.

The development of the Scheme, which commenced in 2017, represents a collaboration between government, industry groups, research organisations and regional communities, led by Natural Resource Management (NRM) groups, Terrain NRM and NQ Dry Tropics, and environmental markets investor, GreenCollar. With financial support from the Queensland Government, the

partnership is developing a framework with independent governance and auditing arrangements that will deliver high standards of environmental and financial integrity. Robust methodologies are intended to verify reductions in sediment, nutrients or pesticides into the Reef and ensure the integrity of the Reef Credits.

## 5.4 Climate Active Carbon Neutral

Carbon neutrality is achieved when GHG emissions from a particular activity, process or for an organisation have been reduced to zero. In most cases carbon neutrality involves reducing emissions as far as practically possible and then purchasing carbon offsets to compensate for any remaining emissions that can't be avoided. Offsets are carbon credits (normally in units of 1 $CO_2$-e) generated by projects that reduce or avoid emissions or that remove GHG from the atmosphere against a baseline, most often through carbon sequestration in vegetation or soils.

**Box 7. Five Founders Beef – a carbon neutral product**

*Five Founders Beef* produced by the North Australian Pastoral Company (NAPCO), that manages around 200,000 head of cattle on over 6.1 million ha of grazing land across Queensland and Northern Territory, as well as Wainui Feedlot and Farm on the Darling Downs, has been certified carbon neutral since April 2019.

NAPCO chose to produce carbon neutral beef because they identified that consumers are becoming more mindful about the food they eat, and how it is produced. Consumers are increasingly familiar with the idea of fresh and organic produce, or brands and products that offer more environmentally friendly options, although carbon neutral meat is still relatively new to the market. For consumers seeking to reduce the environmental impact of their dietary choices, while enjoying a good, tender and flavourful steak, NAPCO formed Five Founders to present a carbon-conscious choice.

NAPCO measured carbon emissions produced by Five Founders from paddock to plate including transportation of Five Founders beef from Australia to store to plate, and offset emissions not able to be avoided. Consumer research showed that animal welfare and environmental care was most important and NAPCO sought to ensure the company launched a branded beef article that matched the values of the business and the priorities of the consumer, and formed Five Founders to become Australia's first Carbon Neutral certified beef.

Five Founders Australian beef is promoted as Australia's First Carbon Neutral certified beef supported with information on company values that ensure animal welfare, land management, and regeneration is at the heart of our operation, to appeal to "carbon-conscious meat-lovers" who want to make a positive change for the future.

NAPCO sees the potential for supply chain benefits and cost savings from initiatives such as replacing diesel powered bores with solar power and other renewable energies, feed efficiency to increase live weight gain, and participating in legume trials to measure potential methane reduction. Offsets for remaining emissions come from Australian regenerative vegetation offset projects and renewable energy projects in China. Other initiatives are to reduce energy emissions on farm using solar energy and using other renewable energies where possible, increase planting of legume-based crops to sequester more carbon in the soil, and plans to trial feed additives that reduce enteric methane emissions.

Five Founders Beef is an example of carbon neutral beef certified under the Climate Active program (https://www.industry.gov.au/sites/default/files/2020-07/climate-active-carbon-neutral-standard-organisations) which is marketed by the North Australian Pastoral Company (NAPCO) (Box 7).

The Australian Government-backed Climate Active Carbon Neutral is a certification program that seeks to demonstrate in a credible and transparent way that carbon neutrality has been achieved. There are a broad range of possible applications of Climate Active certification, including products and services, organisations, events, buildings and precincts. The credibility of Climate Active certification is supported by the Climate Active Carbon Neutral Standard (previously known as the National Carbon Offset Standard), providing confidence in claims of carbon neutrality for purposes such as reporting or marketing. Use of ACCUs generated in ERF projects as offsets towards Climate Active certification further strengthens the credibility of claims.

## 5.5 Farm Biodiversity Certification Scheme

In 2019, the Australian Government announced a four year, $34 million Agriculture Stewardship Package comprise of three elements, one of which is the Australian Farm Biodiversity Scheme (https://www.agriculture.gov.au/ag-farm-food/natural-resources/landcare/sustaining-future-australian-farming). The Package also includes:

- The Australian Biodiversity Policy which seeks a national approach to biodiversity with alignment between public and agricultural sector views on biodiversity best practice and an agreed understanding of the role of agriculture in improving Australia's biodiversity outcomes; and
- The Agriculture Biodiversity Stewardship Pilot Program with funding to incentivise on-farm adoption of good practice for biodiversity and to develop methodologies to support the pilot, and monitoring and evaluation to quantify production and biodiversity benefits.

The Australian Farm Biodiversity Certification Scheme will provide a means for voluntary participants to demonstrate best practice biodiversity management of natural resources, and to inform the broader community of actions being taken. The National Farmers Federation (NFF) has been funded to lead development of the Scheme and this will occur across three phases. The first will review existing biodiversity certification and verification schemes and evaluate frameworks and practices to identify factors most likely to contribute to a successful Australian scheme. This will inform development of a certification/verification scheme (Phase 2) for trialing and assessment with farmers in the third phase.

The Scheme is consistent with the goal for rewards for the environmental services offered by farmers which is a key element of the NFF's 2030 Roadmap. While initial consultation undertaken by the Australian Farm Institute (AFI) as part of the NFF review phase for the Scheme indicated a need for clarification of certain aspects, such as how the focus on biodiversity fits with overarching goals for sustainability and with farm land and business management, there appears to be overall support by farmers and other stakeholders for the Scheme. Consultation did highlight the diversity of systems

and programs across agricultural industries, regions and supply chain segments, and the range of monitoring and reporting systems in existence, domestically and internationally. Stakeholders also expressed the need for biodiversity or sustainability programs to have stronger credibility in the market place to be accepted by consumers and environmental groups. This highlights the need for reliable objective measures or indicators of biodiversity. The Standard and Methods under development using the AfN Framework is one model for trying to achieve the rigour and confidence needed for ES credits.

An important aspect of the Australian Farm Biodiversity Scheme is funding for development of a monitoring, reporting and measurement framework by The Australian National University (ANU) to support the Pilot Program and to ensure the credibility of the Certification Scheme. Details of the ANU Framework are not yet available, but if it adopts an approach that builds on Accounting for Nature as commenced in the LRF. This would open possibilities for collaboration and consistency in the metrics used between the LRF and the Australian Farm Biodiversity Scheme, optimizing investment and potentially minimizing duplication in monitoring for farmers and graziers.

# 6. Supporting services and metrics

Market and certification schemes specify methods or frameworks for monitoring, reporting and certifying/verifying outcomes for emissions abatement or environmental services. Under each scheme (Section 5), the objective is to quantify credits for carbon or other ES to provide sufficient credibility for environmental outcomes and confidence to enable credits to be traded as units of value in markets. These markets then enable income, compliance or price premiums as incentives for activities to be adopted for environmental benefit and, as appropriate, co-benefits for productivity, health and socio-cultural priorities. An important consideration, particularly in looking at valuing co-benefits along with carbon credits is to be aware of the monitoring and reporting burden for farmers wishing to be fully recognised for the benefits of positive management activities and good practice. Farmers interested in undertaking carbon farming activities will generally have to engage a contractor to provide information on opportunities, associated cost and benefits and to understand any risk and obligations of participating in carbon credit markets (See Sections 6.1 and 6.2). The general term 'carbon service providers' or 'environmental service providers' is often used in connection with carbon markets in Australia to cover agents, project developers, aggregators, or contract authorised representatives who provide a range of services.

This section discusses considerations for engaging a service provider to assist in the contract and implementation obligations of participating in a scheme. The aim is to provide some insights into how current Australian systems for estimating ecosystem services credits relate to international units and the burden associated with creating eligible verifiable credits. Section 6.2 then outlines some accounting systems and metrics that are widely accepted and/or that underpin existing or emerging systems or standards relevant to livestock producers in northern Australia.

## 6.1 Service Providers, Aggregators and Auditors

### *6.1.1 Engaging a 'carbon service provider'*

The majority of consultant agronomists or livestock agents don't have sufficient experience or expertise in carbon abatement technologies and market mechanisms, so agricultural producers generally need to engage specialist carbon service providers. However, specialist carbon service providers do not necessarily have a good level of understanding of farm businesses and farmer land management priorities, constraints on time and other practical on-ground factors. This can affect the levels of trust between agricultural communities and private advisers.

Agricultural producers and other land managers considering carbon projects may also find that the cost of obtaining private advice can be significant, again affecting the level of confidence in proceeding with venturing into the area of carbon farming. Two factors that may be considered helpful are that (1) all carbon providers under the ERF must have an Australian Financial Services License, and (2) the majority of carbon service providers are signatories to the Australian Carbon Industry Code of Contact, a document developed by the industry under the leadership of the Carbon Market Institute (http://marketplace.carbonmarketinstitute.org/code/). The Carbon Market Institute recommends prospective participants should make sure they fully understand the commitment before commencing a carbon credit arrangement (Box 8).

**Box 8. Participating in the carbon market**

When considering engaging in the carbon market mechanism, a farmer or land manager should seek to understand what entering into a carbon credit project and/or contract means for his/her business now and in the future, how it aligns with personal values, and what obligations and responsibilities he/she will have.

The following questions are applicable to the ERF but most would be relevant to any carbon market mechanism:

- What legal, technical, financial advice will be required to support project planning?
- Will funding be required to support the project's feasibility?
- Who will be the scheme participant for the project?
- Who will be the designated project manager?
- Who will manage the compliance activities throughout the life of the project?
- Are all key stakeholders aware of the Carbon Industry Code of Conduct and where relevant, are they signatories to the Code?
- Will eligible interest holder consent be required for the project?
- Who will carry out the carbon farming project?
- Who will receive the ACCUs once the carbon abatement is achieved?

(CMI http://carbonmarketinstitute.org/wp-content/uploads/2020/04/CMI_Fact_Sheet_6_Participating-in-the-Cabon-Market.pdf)

Areas of competency that a farmer interested in opportunities for earning carbon credits in the

Australian government ERF scheme should look for when engaging a carbon service provider include :

- Providing advice on identifying and planning ERF projects on an agricultural property;
- Carrying out cost-benefit analysis for ERF projects;
- Assisting with ERF project design and activities;
- Engaging with local Natural Resource Management groups to incorporate NRM plans into ERF project design;
- Obtaining eligible interest holder consent if required (See Note 1 below);
- Preparing project registrations and auction qualifications for ERF projects;
- Assisting with reporting requirements and applying for ACCUs on behalf of project proponents;
- Managing ERF project compliance requirements including monitoring, auditing and reporting; and
- Combining multiple ERF projects to increase the scale of emissions reductions and reduce project cost, an arrangement often referred to as aggregation (See Note 2 below).

***Note 1:*** *An eligible interest holder is a person or organisation with a specific legal interest in the land on which a carbon farming project is being undertaken. Eligible interest holders vary depending on the land title and project type, and may include financial institutions, registered native title bodies corporate, or in the case of Crown land, the relevant Minister.*

***Note 2:*** *Aggregation is usually done under one of two broad categories:*

*– Project aggregation - where activities that use the same method to bring about carbon abatement are grouped into a single registered project;*

*– Contract aggregation - where projects are grouped or 'bundled' into a single bid made by the aggregator at an auction for a single Carbon Abatement Contract. An aggregated contract can include projects using different carbon abatement methods.*

Where carbon project activities also generate co-benefits, additional expertise may need to be engaged as a specialist in carbon markets may not have the level of knowledge required for nature-based accounting and crediting for ecosystem services price mechanisms such as within the LRF scheme.

As well as obtaining advice on requirements and obligations for an ES or carbon credit or certification scheme, prospective participants may need business planning advice to fully explore whether engaging in these markets is aligned with their farm business model, financial situation and personal values. These are affected by jurisdictional arrangements and restrictions, the social context in which the farmer operates, and his attitude to public co-benefits generated by adopting specific practices. Impacts of participation may be short-term such as efficiency gains and private production benefits, but confidence in this outcome deserves consideration. Others may be longer term such as permanence obligations for 25 or 100 years for sequestration projects, potentially affecting succession planning.

### *6.1.2 Carbon service providers with land sector experience*

Following are examples of carbon service providers recognised in Australia for working with land managers and agricultural producers on carbon farming projects. The selection of providers is presented alphabetically, and no recommendation or indorsement is implied by inclusion and omission of any provider should not be interpreted as a lack of confidence in that organization or individual. Most information is taken directly from publicly-accessible websites or other published information without personal experience or detailed research to verify claims made.

#### Agriprove

Agriprove (https://agriprove.io/) is a specialist soil carbon service that was spun off from Corporate Carbon Advisory in 2018 with the goal of enabling farmers to generate income from carbon abatement activities and secure viable returns in Australian carbon markets, while also improving the resilience of farming systems. Corporate Carbon registered Australia's first ERF soil carbon project in 2015, and Agriprove sought to promote the *Soilkee* technology demonstrated in that project as an agricultural startup company. In 2019, the first soil carbon credit payment under the ERF were paid by the Government to a *Soilkee* project in Gippsland, and this also represented the first trade in soil carbon credits eligible under a Paris Agreement NDC globally.

#### Carbon Neutral

Carbon Neutral (https://carbonneutral.com.au/) works with organisations across Australia to measure, reduce and offset greenhouse gas emissions, with specialization in biodiverse reforestation plantings and carbon sinks, claiming plantings of over 29 million trees. Carbon management services include carbon accounting and sustainability consulting, energy reduction strategies, carbon calculators, carbon neutral certification, carbon offsets, vehicle fleet offsetting, biodiverse reforestation projects, and information support activities. The company also seeks to add benefit to carbon abatement from reduced energy costs, improved stakeholder engagement (staff, customers and supply chain) and enhanced brand reputation.

#### Climate Friendly

Climate Friendly (https://climatefriendly.com/) focusses on land sector carbon projects and has a goal to achieve carbon abatement of 100 million tonnes by 2025 and to supporting rural, regional and remote Australians including farmers, foresters and traditional custodians to reduce greenhouse gas emissions and regenerate the landscape through carbon farming. Climate Friendly has over 100 registered in carbon projects across more than 8 million hectares land nationwide, with over 14 million carbon credits issued to farmers through these projects.

#### CO2 Australia

CO2 Australia (https://www.co2australia.com.au/), one of the early carbon service companies was founded in 2004, and now has offices in four states and the ACT. With a focus on carbon projects involving native regrowth regeneration to large scale reforestation, including working across projects

from planting trees to purchasing carbon credits and managing biodiversity offsets for environmental approvals for development and major infrastructure projects. Services provided include:

- Carbon project under the Emissions Reduction Fund;
- Carbon offsetting (including using the Gold Standard and the Verified Carbon Standard);
- Delivery of biodiverse, large-scale revegetation programs;
- Development and implementation biodiversity offset programs;
- Ecological surveying and monitoring;
- Environmental approvals and environmental impact assessments.

CO2 Australia has a pilot project under the Queensland LRF and other project plans.

### Corporate Carbon Advisory

Corporate Carbon (https://www.corporatecarbon.com.au/) provides services for carbon projects from project development to credit sales. Their goal is to 'enable companies to monetise carbon abatement activities and secure viable returns in the Australian market' including participation in the ERF, and have delivered more than 6 million ACCUs to the CER and commercial clients.. The company is working with a number of emissions reduction project developers and owners in Australia to help manage delivery of emissions reductions, carbon sequestration and co-benefits for the environment, individuals and businesses.

Corporate Carbon Advisory is the registered participant on ERF projects across a range of ERF methods:

- Sequestering carbon in soils in grazing systems;
- Industrial electricity and fuel efficiency;
- Land and sea transport;
- Human-induced regeneration of a permanent even-aged native forest;
- Reforestation by environmental or mallee plantings – FullCAM;
- Reforestation and afforestation;
- Savanna fire management.;
- Alternative waste treatment.

### Country Carbon

Country Carbon (https://countrycarbon.com.au/) state that they acts as a carbon credit stock agent, developing the project and selling the carbon credits to generate income on behalf of the landholder, and providing carbon offsets to businesses from Australian farmers. Country Carbon also works with clients to source Australian carbon offsets from the full range of approved methodologies under the Carbon Farming Initiative (CFI). The company deals only in carbon credits from Australian carbon offset projects and not [cheaper] overseas credits.

### GreenCollar

GreenCollar (https://greencollar.com.au/) has worked with Australian farmers, land managers, government, indigenous and non-government organizations to identify and manage carbon farming

projects since 2011. The company has contracts for about 65 million ACCUs in ERF projects and manages almost 3 million hectares of private land in carbon projects. GreenCollar ERF projects include northern New South Wales projects under the Avoided Deforestation method and projects in Queensland including under the Human Induced Regeneration method. GreenCollar has also started working in the Reef Credit Scheme to support land managers adopting practices that support improved water quality to earn reef credits. Recently (mid-2020) the private equity firm, KKR, announced a major investment in GreenCollar through its $1.3 billion Global Impact Fund. KKR invests in companies 'whose core business models provide opportunities to develop commercial solutions to an environmental or social challenge' and 'that contribute toward United Nations sustainable development goals'.

### Natural Carbon

Natural Carbon (https://naturalcarbon.com.au/ )was established in 2014 and has experience internationally and in developing carbon farming projects in Australia, from concept to sale of credits. Services include consulting for indigenous groups, farmers, and other land managers to achieve long-term economic and environmental benefits to their communities, and for leading organisations seeking to reduce their environmental impact.

Natural Carbon worked with Paraway Pastoral Company and Corporate Carbon to develop a national 'herd aggregation' project, that enables smaller graziers with 1,000 or more head of cattle to participate in the Australian carbon market by overcoming the administration and compliance cost barriers. The aggregation, which has a focus on western Queensland, was initiated by Paraway with two cattle herds at its Rocklands and Tanbar properties, to allow smaller graziers to collectively benefit from the sale of carbon credits generated by the beef cattle herd management method. The method has been found to require a herd size of over 50,000 head to be economically feasible. This project, in collaboration with Southern Gulf NRM, received a pilot grant from the LRF. Natural Carbon is also a service provider for indigenous and pastoral Savanna Burning projects on Cape York.

## 6.2 Metrics for quantifying carbon or ecosystem services credits

This section summarises a selection of widely-accepted accounting systems and metrics in use or providing a basis for quantification and reporting in existing or emerging systems or standards relevant to livestock producers in northern Australia. They inform how current Australian systems for estimating ecosystem services credits relate to international units and the burden associated with creating eligible verifiable credits.

### *6.2.1 System of Environment-Economic Accounting*

The System of Environmental-Economic Accounting (SEEA) Central Framework is a conceptual framework designed to support understanding and measurement of the interactions between the economy and the environment and the stocks, and changes in stocks, of environmental assets. The

SEEA Central Framework was adopted by the United Nations Statistical Commission as an international statistical standard in 2012 (UN 2012). The Framework uses a systems approach to organise environmental and economic information, covering, as completely as possible, the stocks and flows that are relevant to the analysis of environmental and economic issues. In using this approach, the SEEA Central Framework applies the accounting concepts, structures, rules and principles of the System of National Accounts (SNA), the internationally agreed standard set of recommendations on how to compile measures of economic activity. In practice, environmental-economic accounting includes the compilation of physical supply and use tables, functional accounts (such as environmental taxation accounts and environmental expenditure accounts), and asset accounts for natural resources.

The Framework brings together in one measurement system information on water, minerals, energy, timber, fish, soil, land and ecosystems, pollution and waste, production, consumption and accumulation. Each area has specific and detailed measurement approaches that need to be integrated to provide a comprehensive foundation for related topic and theme specific statistical publications. A SEEA module related to agriculture, forestry and fisheries ('SEEA-AFF') has been endorsed by the United Nations as an Internationally Agreed Methodological Document in support of the SEEA Central Framework. The 'SEEA-Water' module has been in operation since 2007, and a SEEA module related to energy (SEEA-Energy) was published in 2019.

The Australian Environmental-Economic Accounts (AEEA) presented by the Australian Bureau of Statistics (https://www.abs.gov.au/Environmental-Management) are based on the SEEA Central Framework. They contain data-focused accounts for key environmental themes. In the AEEA, accounts are provided for environmental assets, water, energy products, greenhouse gas emissions, and environmentally related taxes. The AEEA highlights the capacity of environmental accounts to support analyses across various environmental themes and also between environmental and economic themes. Where available, the Australian Bureau of Statistics (ABS) provides time series of information for each environmental theme, although the length of time-series varies due to incremental development of the ABS environmental accounting program. The implementation of the National Environmental economic Accounting (EEA) Strategy and Action Plan (Commonwealth of Australia 2018) will result in development of a set of integrated accounts, providing a trusted and reliable source of information for different decision-makers working at different scales.

### *6.2.2 Accounting for Nature*

In 2008, the Wentworth Group of Concerned Scientists proposed a model for national environmental accounts which was developed into the *Accounting for Nature® Framework* (AfN Framework) to produce a method to measure changes in the biophysical condition of environmental assets. Following trials at continental scale by Regional Natural Resource Management (NRM) groups with scientists, economists and statisticians a robust and practical framework and on-going national program to measure the condition of Australia's environmental assets was established, *Accounting for Nature® Framework 2016* (Wentworth Group 2016).

AfN uses the science of reference condition benchmarking to create a common unit of measure for building sets of biophysical accounts that are capable of describing the condition of any environmental asset (native vegetation, soil, rivers, fauna, estuaries, etc.), at any scale. The common measure, an *Econd™*, is an index between 0 and 100, where 100 describes an environmental asset in an undegraded state.

The AfN Framework provides:

- The ability to measure success or otherwise of public investments (Commonwealth, state, territory, regional and local government) in natural resource management;
- Increased efficiency of expenditures through better targeting of investments;
- An increasingly informed community, leading to less conflict and enhanced community effort;
- A cost-effective pathway for industry, farmers and other land managers to demonstrate the sustainability of their business practices; and
- The information that is needed for society to adapt as climate change imposes its footprint across the landscape.

Similar to a framework for financial or greenhouse gas accounting, AfN offers a system of rules and processes designed to ensure the integrity and transparency of environmental accounts, no matter the environmental asset being measured. The AfN Framework can complement and build on systems for assessing impact investment opportunities (e.g. green bond criteria), pursuing corporate sustainability outcomes and achieving global goals such as the Sustainable Development Goals and Aichi Targets. It is consistent with the United Nation's Standard for Environmental Economic Accounting (SEEA) (See Section 6.2.1).

Because the AfN Framework has been developed so that it complements other standard and certification systems, including those for carbon offset projects, the Queensland LRF elected to use the Framework in its initial phase is as a basis for the measuring, reporting, and third party certification of environmental outcomes to verify environmental co-benefits under the LRF Co-benefits Standard. Future LRF Co-benefits Standards may specify other frameworks as the range of verification and assurance options increases.

### Vegetation Condition Account Methods

The AfN Framework protocol for vegetation condition account methods seeks to establish a practical, scientifically robust process that describe the condition of any environmental asset, at any scale, and measure any change in the condition of those assets over time (Butler et al. 2020). Based on the Econd™ unit, the AfN Framework enables accounting and certification of the quality of a native vegetation asset using scientifically accredited indicators that describe its level of biological productivity, structure and interactions and resilience. Accreditation requires an environmental account that has been developed using an accredited AfN Method. Environmental condition accounts can be developed at any level or scale from a project area up to State or national scale, depending on objective and resolution and type of data. The AfN *Standard for Environmental Condition Accounting* (Accounting for Nature 2020b) describes three levels of confidence scores – Level 1 (High), Level 2 (Moderately high), and Level 3 (Reasonable) (Table 5).

*Table 5. Proposed Indicators to be assessed at the two assurance levels (High; Medium) in the Land Restoration Fund Native Vegetation Monitoring Method (Butler 2020).*

| Indicators required for Level 1 (High) Quality Assurance Rating | Indicators required for Level 2 (Medium) Quality Assurance Rating |
|---|---|
| 1. Large trees<br>2. Tree canopy height<br>3. Recruitment of canopy species<br>4. Tree canopy cover (%)<br>5. Shrub layer cover (%)<br>6. Coarse woody debris<br>7. Native plant species richness for four lifeforms<br>8. Non-native plant cover<br>9. Native perennial grass cover (%)<br>10. Litter cover<br>11. Bare ground*<br>12. Total ground cover of plants*<br>13. Site context (patch size, connectivity and context) | 1. Large trees<br>2. Tree canopy height<br>3. Tree canopy cover (%)<br>4. Shrub layer cover (%)<br>5. Non-native plant cover<br>6. Litter cover<br>7. Bare ground*<br>8. Total ground cover of plants*<br>9. Site context (patch size, connectivity and context) |

**The bare ground and total plant cover attributes must be measured but are not scored under the BioCondition method. Total ground cover of plants is the combined cover of grasses herbs and other ground layer life forms.*

In 2020 the Queensland Government released a *Land Restoration Fund Native Vegetation Monitoring Method* (Butler 2020). The Method enables measurement and reporting of improvement in condition of vegetation, soil and native fauna that can be third-party certified as evidence of environmental co-benefits under carbon farming project in Queensland in the context of eligibility for crediting under the LRF. Regional Ecosystems (REs) are the central classification for benchmarking and assessment in the native vegetation accounting and the Method can be applied to any terrestrial ecosystem or vegetated wetland that has a confirmed reference RE. The Method assesses vegetation condition against a 'native vegetation' benchmark (Butler et al 2020) but can be applied to modified ecosystems such as grazed pastures provided they can be assigned to an RE.

The reference condition for a 'native vegetation' asset, i.e. having an Econd™ score of 100 represents the appropriate undegraded state with assessment of an area-weighted condition of an asset that takes into account factors such as clearing and other types of modification, fire management, weeds and impacts of feral animals. In practice, 'vegetation condition assessment tools, including the BioCondition method applied in the [Land Restoration Fund Native Vegetation Monitoring] Method, employ pragmatic approaches such as use of sites representing 'best on offer' condition in identifying reference condition and estimating benchmark values for condition attributes (Eyre et al. 2017).' BioCondition is expanded on in Section 6.2.6 below. An account under an AfN Method must have three components : (1) an Environmental Account Summary; (2) and Information Statement; and (3) the body of the account containing the Asset Tables (condition of components, i.e. sub-assets, of the asset) and Data Tables (observations). A description of the requirements and details for implementation are set out in the Method (Butler 2020). The rules and procedures that underpin the auditing provisions outlined in the AfN Standard are described in the AfN *Audit Rules* (Accounting for Nature 2020a).

### *6.2.3 Reef credits*

Under the Reef Credit Scheme (https://www.reefcredit.org/), four foundation Reef Credit Methodologies for use under the Reef Credit Standard are being developed in parallel with the Reef Credit Standard and Program Guide that have been drafted to date. These methodologies account for reduction in nutrient (dissolved inorganic nitrogen (DIN)) and sediment under two categories: reducing pollutant run-off through practice change or ecosystem repair:

- Dissolved inorganic nitrogen (DIN) reduction
  - *Reduction in nutrient run-off through managed fertiliser application* practice change
  - *Reduction in nutrient run-off through wetland systems* ecosystem repair
- Sediment reduction
  - *Reduction in sediment run-off through gully remediation* ecosystem repair
  - *Reduction in sediment run-off through improved grazing practice* practice change

Reef Credits will enable farmers, livestock producers and other land managers are able to earn diversified and regular income over 10- 25 year time frames, and will enable investors to buy verified water quality outcomes when they are delivered and audited. The Scheme also supports consistent measurement and monitoring tools to track progress toward water quality targets across the entire Reef and complements other key services such as extension, agribusiness, catchment management and other ecosystem services.

A recent review (Taylor and Eberhard 2020) examined programs designed to promote the voluntary adoption of agricultural practices that reduce nutrient, pesticide and sediment runoff in the Great Barrier Reef catchments and policies that introduce targets to enhance active engagement of communities and land managers in these programs to improve water quality outcomes. Based on empirical evidence from the social science literature available from studies within the Reef catchments the study considered landholder decision making on practice adoption, participation and engagement in programs, and the influence of the broader policy settings and instruments to deliver government plans and investment. The findings on factors such as diverse landholder goals and motivations, social and cultural risks of participation, and the benefits of knowledge exchange over knowledge transfer in building trust and commitment amongst landholders are relevant to the development of methods to enhance participation in ecosystem services markets not only for water quality credits but other credits, including biodiversity and carbon. The review highlighted the importance of communication and maintaining collaboration and capacity in industry and natural resource management networks, and of continuous improvement through commitment to active experimentation and learning at farm and program levels. Taylor and Eberhard (2020) also identified the potential for greater participation of supply chain and private actors in program delivery with investment to address knowledge gaps, including exploring 'smart' regulation responses, and the impact of better models for local implementation.

### *6.2.4 Pasturefed Cattle Assurance System*

The Pasturefed Cattle Assurance System (PCAS) is an assurance program that enables the red meat industry to demonstrate claims relating to pasturefed or grassfed production methods. With

consumers becoming more sensitive to treatments applied to meat animals, PCAS seeks to meet the expectation that claims around products are able to be certified. Underpinning PCAS are the PCAS Standards (http://www.pcaspasturefed.com.au/ )which govern the on-farm feed requirements and traceability of the cattle as well as pre-slaughter handling practices which influence eating quality. The PCAS Standards also include two optional modules to support claims relating to the freedom from antibiotics and hormone growth promotants (HGPs).

Producers can use the term Certified Pasturefed and the suite of Certification Marks once fully certified, a process that requires registration of Property Identification Codes (PICs), an administration fee and an on-farm audit, and can use the Marks on meat products only after signing a License Agreement. These requirements help to ensure the integrity of the certification.

### *6.2.6 BioCondition Framework*

BioCondition is a vegetation condition assessment framework that provides a measure of the capacity of a terrestrial ecosystem to maintain biodiversity values at a local or property scale. It is a site-based, quantitative and repeatable assessment procedure that provides a numeric score that reflects functional through to dysfunctional vegetation condition states for biodiversity. Under the framework vegetation condition is referred to as the relative capacity of a regional ecosystem to support the suite of species expected to occur in its reference state. The reference state refers to the natural variability of the stable land-based vegetation state that is mature and relatively long undisturbed in the contemporary landscape and in 'Best-on-Offer' condition.

The components of the BioCondition framework include:

- The assessment unit, which is based on regional ecosystems by broad condition states (remnant, high-value regrowth, non-remnant).
- A suite of vegetation condition attributes based on a pressure-state-response conceptual framework as measures of species diversity and/or ecological processes.
- Benchmarks for each of the vegetation attributes for each regional ecosystem
- A scoring system that provides a condition metric.

Benchmarks provide the objective comparison of vegetation condition states within and between regional ecosystems. Queensland Herbarium has developed benchmark references available on-line for a subset of described regional ecosystems. Where benchmarks are currently not available, a method is provided for the derivation of benchmarks for the BioCondition framework.

The Framework is supported by a Biocondition manual (https://www.qld.gov.au/__data/assets/pdf_file/0029/68726/biocondition-assessment-manual.pdf) which provides an assessment protocol for a measure of how well an area of vegetation is functioning for the maintenance of biodiversity values using regional ecosystem benchmarks, and a Reference Site Manual (https://www.qld.gov.au/__data/assets/pdf_file/0027/68571/reference-sites-biocondition.pdf) that provides an approach for obtaining Benchmarks if not already available. It is based on a depth of monitoring data and has been accepted well in Queensland. BioCondition is the

proposed framework for vegetation condition assessment in the draft *Land Restoration Fund Native Vegetation Monitoring Method* (Butler 2020) as discussed above (Section 6.2.2).

### 6.2.6 IUCN Environmental Offsets

An environmental offset compensates for unavoidable impacts on significant environmental matters, on one site, by securing land at another site, and managing that land over a period of time, to replace those significant environmental matters which were lost. The framework for effective environmental offset policy is the International Union for the Conservation of Nature (IUCN) global *Policy on Biodiversity Offsets* (https://www.iucn.org/theme/business-and-biodiversity/our-work/business-approaches-and-tools/biodiversity-offsets ) which provides 'a framework to guide the design, implementation and governance of biodiversity offset schemes and projects' (IUCN 2016). In 2012, the Australian government released the EPBC Act Environmental Offsets Policy relating to all Matters of National Environmental Significance (MNES) protected under the EPBC Act and in 2014, the Queensland Government introduced the Queensland Environmental Offsets Policy, providing a single policy to streamline environmental offsets requirements across the state (Queensland Government 2019).

The Queensland government is reviewing activities that have a direct or indirect relationship with the Environmental Offsets Act 2014 to identify innovative ways to achieve conservation outcomes, and opportunities for co-benefits including social, cultural and economic enhancement. In addition, the Queensland Government continues to examine the potential for a new water-quality offsets framework, as recommended by the Great Barrier Reef Water Science Taskforce. An important aspect of the offset policy is having an effective method to quantify the environmental improvement on the ground, or in the water to assess the success of the offsets and to inform the cost and financial management of any offset.

### 6.2.7 Footprint tools and standards

The environmental footprint is the effect that an activity, person, company etc. has on the environment, e.g., the amount of natural resources that they use and the amount of harmful gases that they produce. The environmental footprint analysis ideally calculates all significant impact categories, which for agricultural products usually comprise carbon, water, land, eutrophication (nitrogen and phosphorus) and air, although water and carbon footprints are also commonly reported individually. The analysis approach is life cycle assessment (LCA) which quantifies the resource use or emissions over the entire life of the product or service from 'cradle to grave', A partial LCA constrains the impact calculation to a stage of the life cycle. For example, if the focus of a study is on greenhouse gas emissions associated with beef production, the carbon footprint of 'beef' at the farm-gate will include all emissions for inputs and on-farm grazing and feed production to the point when the animal leaves the farm (cradle to farm-gate) and is expressed as greenhouse gas emissions (kg $CO_2$-e) per kg live weight.

#### ISO environmental and carbon footprints

Since the 1990s, the International Organization for Standardization (ISO) has sought to support greenhouse gas mitigation activities by producing standards for quantifying greenhouse gas emissions and/or removals. The ISO 14060 series of standards provides clarity and consistency for quantifying, monitoring, reporting and validating or verifying emissions and removals. These standards are intended to be voluntary and regime neutral.

The growing number of standards and guidelines for calculating an environmental footprint means there is a risk that different approaches or practices can lead to a divergence in methodology and uncertainty in consistency and comparability of footprint assessments. The ISO carbon footprint standard aims to ensure the scientific integrity of the metric and consistency and transparency in the presentation of results across analyses and how results are communicated.

ISO/TS 14067:2018, *Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification and communication*, is the international standard for quantifying the carbon footprint of products (both goods and services) (CFP). It establishes principles, requirements and guidelines for the quantification and communication of the CFP based on greenhouse gas emissions and removals over the life cycle of a product and its communication to provide an accurate, relevant and fair representation of the CFP. ISO 14067:2018 is based on principles, requirements and guidelines in existing International Standards on life cycle assessment (LCA), ISO 14040 and ISO 14044 and applied to the specific requirements to provide clarity and consistency in quantifying the single impact category of climate change as a CFP or partial CFP (pCFP). Figure 29 illustrates the linkages between the ISO standards relevant to calculating and communicating the carbon footprint of a product such as meat.

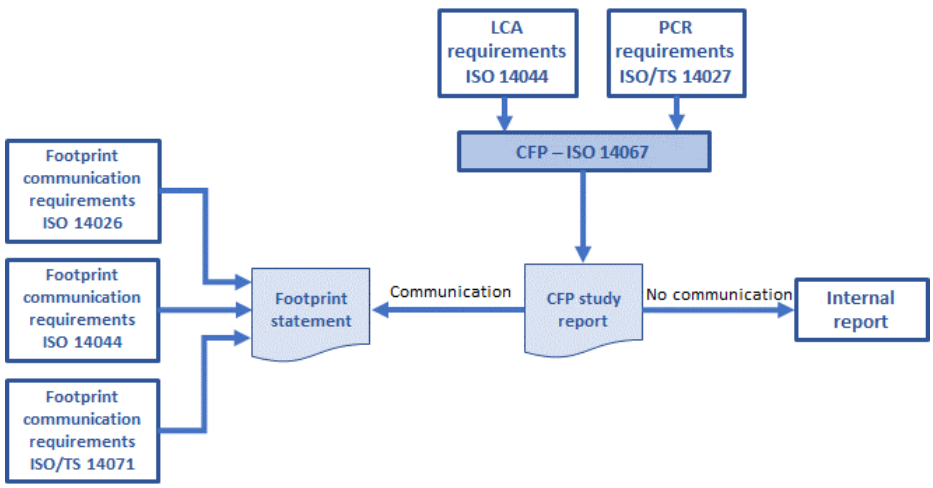



*Figure 29. Linkages between ISO 14067, the carbon footprint of a product (CFP), and related international standards for life cycle assessment (LCA) used to calculate environmental footprints, Product Category Rules (PCR) used to specifically define the environmental impacts of a specific product, and for communicating the footprint as a claim or label. (Adapted from ISO 2018https://www.iso.org/obp/ui/#iso:std:iso:14067:ed-1:v1:en)*

Formal LCA studies to estimate an environmental impact ideally seek to cover the full life cycle of a product and to quantify all significant environmental impacts to minimise the risk of unanticipated trade-offs and perverse outcomes from decisions or policies made on the basis of comparison of estimated product footprins. In reality, LCA studies are generally limited by data, time or focus to a

single impact category such as or a single impact such as a carbon footprint or water footprint and frequently to only part of the life cycle. These analyses are useful but care must be taken to recognise the limitations of the study. Assessment may also be limited by the lack of consensus in the technical community on a method to quantify effects, although progress is being made. LCA method development is advancing in areas relevant to indicators for soil health and condition (Legaz et al., 2017; Sevenster et al., 2019), biodiversity (Teixeira et al., 2016) and eutrophication (Payen and Ledgard, 2017). However, further research and testing is needed before there are sufficient data and knowledge to be able to apply and interpret these methods for Australian land management.

Australian industries, notably the Rural RDCs, have already invested in LCAs for a number of agricultural products. Methods for calculating net greenhouse gas emissions as an emissions intensity, generally align with IPCC Guidelines for national inventory reporting to the UNFCCC as also used in Australian national inventory reporting (NIR). However, there are differences between analyses in the scope, boundary, and often in impact categories and data quality. For these reasons, it is preferable to confine comparisons to results for the same product in the same or aligned studies, e.g. beef cattle live weight or carcase weight at the farm gate could be compared in a study of different feeding regimes such as grass vs grain finishing or for the change in emissions intensity over time. Several LCA studies (e.g. Wiedemann et al. 2015a) have been conducted for Australian red meat including several that include northern Australia and these provide a potential source of livestock data for Queensland.

### EU PEF Footprint Category Rules for red meat

Environmental Footprint claims and labels have the potential to influence consumer choices and market prices (Section 4.3.2). To improve understanding of the value of these LCA-based tools and the limitations on their use in claims and labels, programs and jurisdictions now aim to develop comprehensive rules for application of the footprint methodology.

Product environmental category rules provide rules (PECR), requirements, and guidelines for developing an Environmental Product Declaration (EPD) for a specific product category. An EPD is an independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products. It is a voluntary declaration of the life-cycle environmental impact, consistent with ISO 14025, but should not be interpreted as indicating environmentally superiority of a product relative to alternative products. In Europe, PECR have been developed for products in many sectors, with the objective of driving transparency and comparability in EPDs and informing business decisions, e.g. for green procurement. They also have the potential to increasingly influence consumer choice, although the capacity of consumers to interpret Footprint and fully understand the strengths and limitations of the information it provides when seeking to make 'ethical' purchases is not yet clear. Speculation has occurred as to whether environmental or carbon footprint declarations could, in future, be a component of technical barriers to trade but this remains unclear.

In July 2019, the European Livestock and Meat Trades Union (UECBV, 2019)) released Footprint

Category Rules for Red Meat *(FCR RED MEAT)* with the aim of creating a comprehensive and harmonised scientific methodology for use by industry stakeholders to calculate the environmental footprint of red meat and to determine the impact of the red meat supply chain. The FCR RED MEAT follows the European Commission's PECR guidance and LCA principles. Application of *FCR RED MEAT* is intended to allow individual companies in the red meat sector to assess environmental hot-spots along their value chain and to compare environmental performance within species, e.g. beef vs. beef, lamb vs. lamb, pork vs. pork (noting that Europe categorises pork as a red meat). The *FCR RED MEAT* provides guidance for environmental impact only, and, unlike frameworks such as the Australian Beef Sustainability Framework (ABSF) described in Section 7.2.2, does not include social and economic aspects, or animal health and welfare. Importantly also, the *FCR RED MEAT* is not sufficient to fully evaluate the environmental impact of changes in meat products and its packaging that affect the lifecycle in the consumption stage or to evaluate the outcome of dietary changes for the environment (Figure 30).

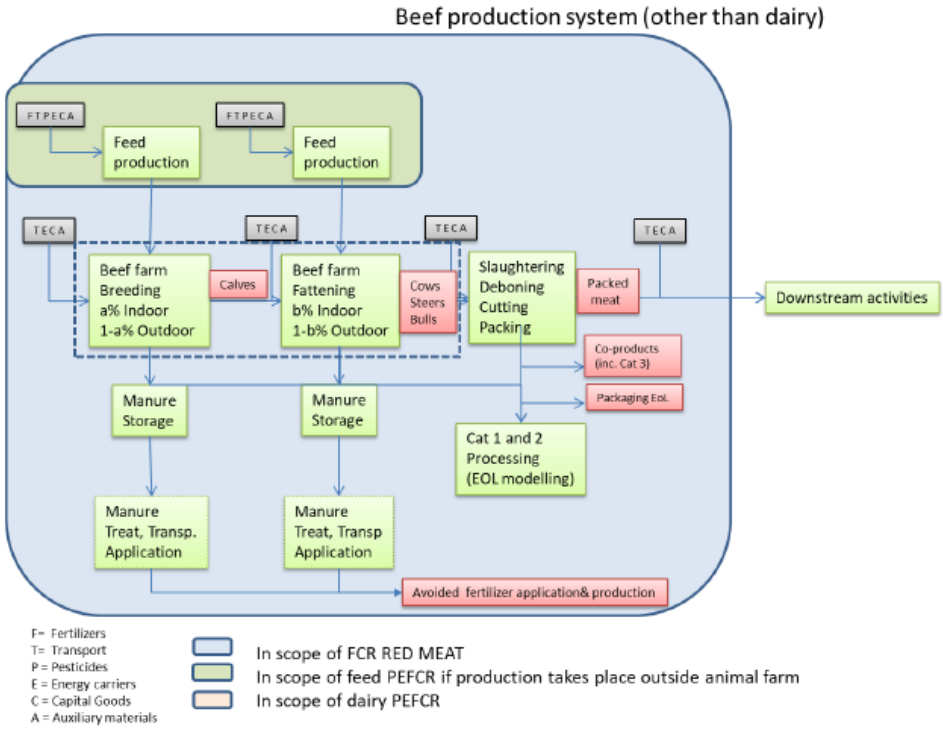



*Figure 30. Beef production system and boundary as included in the EU red meat footprint category rules (FCR Red Meat) (UECBV 2019).*

The system boundaries for the farm phase include all necessary inputs and elementary flows to breed, raise and fatten animals to the point that they can be delivered to the abattoir. In PCR, as in other C footprint or LCA analyses, the most relevant life cycle contributions are feed production (on- and off-farm), enteric fermentation and manure management. In Europe, housing is also a significant contribution.

An assessment of biodiversity and/or carbon sequestration may be part of a PEF study when the science is sufficiently mature to provide confidence in the methods. Carbon sequestration in grasslands can potentially have a positive contribution, offsetting the climate change impact (Doran-

Browne et al. 2017), and Footprint studies for meat from pasture-based systems suggest estimating the carbon stock change in grassland soils and in land used for feed production (usually a source rather than a sink), and presenting this information separately to the quantified Footprint. The method used to calculate soil carbon sequestration must be reported and scientifically published. It is also possible to include an assessment on biodiversity impacts as additional information in the Footprint report for red meat. Because biodiversity impact methodology is still evolving. The *FCR RED MEAT* recommend two methods that could be used (Goedkoop et al. 2009 and Knudsen et al. 2017) but allow for other methods to be used, provided the used methodology is reported.

The draft *FCR RED MEAT* notes that their primary purpose is for business-to-business communication. This communication is based on a complete report on the environmental footprint study, including the results on all impact categories, Data Quality Record assessment and underlying assumptions as set out in the guidance. For the EU *FCR RED MEAT*, first stage screening studies and supporting analyses have indicated that three impact categories were most reliable and relevant. These three categories, climate change (i.e. greenhouse gas emissions), terrestrial eutrophication (predominantly ammonia release in feed crops and farming), and acidification (mainly ammonia at animal farm and cultivation) were selected for communication. EU PEF guidance states that ideally only 3-4 indicators should be used for business-to-consumer communication (European Commission, 2016).

It is recommended that developments in environmental footprint methods and applications both in Australia and globally, particularly in trading partners, be monitored by agricultural industries. If data collection and practice implementation associated with carbon credits and co-benefit incentives, are sufficiently comprehensive and well-documented opportunities may emerge in future international markets and preparedness for policy developments.

# 7. Industry targets and incentives

## 7.1 Drivers of industry engagement in a ‘low-carbon-economy’

In order to meet the objectives of the Paris Agreement all signatory countries submit emissions reduction ambitions, achievement of which will require a suite of policies and programs to manage the social and economic transition of their citizens and industries. While countries have been encouraged to set a mid-century net zero emissions target, Australia has elected to not yet committed to a date but rather to a decarbonization pathway based on technology development as outlined in a Technology Roadmap discussion paper (Commonwealth of Australia 2020c). The Roadmap outlines strategies to achieve emissions reductions that aligns with the science and consider business, community and indigenous interests. Regardless of the timing of targets, the abatement should be genuine and have strong integrity, transparency and accountability.

At the same time, industries globally are increasingly recognising the real and present risks that climate change poses to businesses and financial markets, and making changes that smooth their

individual transition to the low-carbon economy and help build stronger, more resilient and more sustainable national and global positions (Michael Bloomberg, TCFD 2017). It is notable that, in July 2020, the EU laid out options for designing its plan to impose charges on imports of some goods to try to protect EU industry from being undercut by countries with weaker climate policies. At the same time, in July 2020, former US vice-president and Democratic presidential nomination, Joe Biden, announced a US$2 trillion climate change plan for green infrastructure, energy and job creation (https://www.cnbc.com/2020/07/14/joe-biden-unveils-green-jobs-and-infrastructure-plan-during-2020-election.html. Included in this plan is support for carbon tariffs on imports that produce high greenhouse gas emissions. The US is Australia's third-largest trading partner overall after China and Japan (both of which have in 2020 announced net-zero emissions targets by mid-century), and the third and second export markets for Australian beef and sheepmeat in value (MLA 2020c). This policy, consistent with discussions in Europe, is indicative of the prospects for a border carbon fee for Australian products.

The threat to trade status and risk of border adjustments are a significant, but not the only, driver of industry action. Many businesses are independently incorporating climate change mitigation and adaptation in strategic planning to manage the risks of impacts of climate changes directly, via consumer and community preferences for ethical purchasing, and as a result of compromised market position with trading partners.

## 7.2 Australian red meat industry environmental goals

Agricultural industries and individual businesses are also taking positions on climate change action. In its strategic plan, Australia's red meat industry (RMAC 2020, MLA 2020b), described five benefits for red meat producers adopting 'climate smart' practices:

- Consumer and community support leading to red meat having increased demand and/or value;
- Market access, e.g. in the EU;
- Access to funding or lower cost capital;
- Decreased risk of government regulatory burdens;
- Enhanced adaptive capacity and resilience of production systems to climate changes or extremes.

The red meat industry position is responding proactively to global and local direction by adopting a clear focus on ensuring the company's investments contribute to a 'socially, environmentally and economically sustainable Australian red meat industry'. This approach aims to 'help producers to be more productive while adapting to climate variability, delivering world-leading animal health and welfare outcomes and adopting Carbon Neutral 2030 (CN30) pathways, demonstrated through on-farm practice change to deliver a global competitive advantage'.

### *7.2.1 CN30 target*

The Australian Red Meat Industry CN30 initiative commits the sector to achieving net zero greenhouse gas emissions by 2030 (https://www.mla.com.au/research-and-development/Environment-sustainability/carbon-neutral-2030-rd/cn30/). To support this goal, MLA

has invested in a suite of research, development and adoption activities that expand industry access to, and adoption of, carbon farming practices and technologies to reduce GHG emissions and increase carbon sequestration in vegetation and soils while increasing drought resilience and profitability of the industry. There is also a focus on improving the capacity to monitor emissions and estimate change for more accurate reporting of progress (Box 9).

**Box 9. CN30 Key points**

- CN30 is an aspirational target of net zero GHG emissions for the Australian red meat industry by 2030, as reported in the Australian National Inventory.
- CN30 communicates to consumers that the red meat industry is proactively addressing GHG emissions and positions the industry as a critical contributor to meeting Australia's emissions reduction targets
- A science-based approach underpins actions to reduce the red meat industry's net GHG emissions that also provide benefits for business, people and the environment.

Based on an analysis by CSIRO commissioned by MLA, the industry developed indicative CN30 pathways for emissions avoidance from deforestation and enteric methane with carbon sequestration measures offsetting remaining emissions.

Red meat producers manage approximately 51% (around 355 million hectares) of Australia's land (ABARES 2020), providing potential for substantial carbon storage in grazing lands and associated environmental co-benefits. MLA has estimated that by improving feedbase and animal productivity and creating new revenue streams for producers through low and zero carbon red meat products, the CN30 emissions target represents a potential $300 million per annum opportunity (www.mla.com.au). To achieve CN30, the industry has developed a Roadmap for enabling red meat producers to adopt a range of tools and practices to lead towards carbon neutrality by 2030 (Figure 31). MLA is also supporting industry and government efforts to develop ERF methods to enable producers to earn carbon credits from proven practices and technologies to add to the 2015 Beef Cattle Herd method (https://www.legislation.gov.au/Details/F2015L01434/Html/Text#_Toc426038013) that credits improvements in the emissions intensity of beef production from grazing animals (See Section 5.1.4).

The initial focus of livestock method development that started in 2019 is on feedbase options and supplements where there is a sound evidence base for quantifying reduction in methane emissions and good data that there will also be improved animal production through higher growth rates and reproduction, and improving ecosystems services. The lead candidates are:

- Growing the legumes Leucaena and Desmanthus in pastures;
- Using supplements that reduce enteric methane and improve animal productivity:
    - 3-Nitrooxypropanol (3-NOP); and
    - The marine macroalgae, Asparagopsis that has been shown in trials to reduce enteric methane emissions by up to 80%, when incorporated into feedlot rations at low doses.

In addition to reducing enteric methane, the CN30 program is undertaking research to support uptake and accounting for the GHG abatement and co-benefits of a range of land and vegetation management strategies.

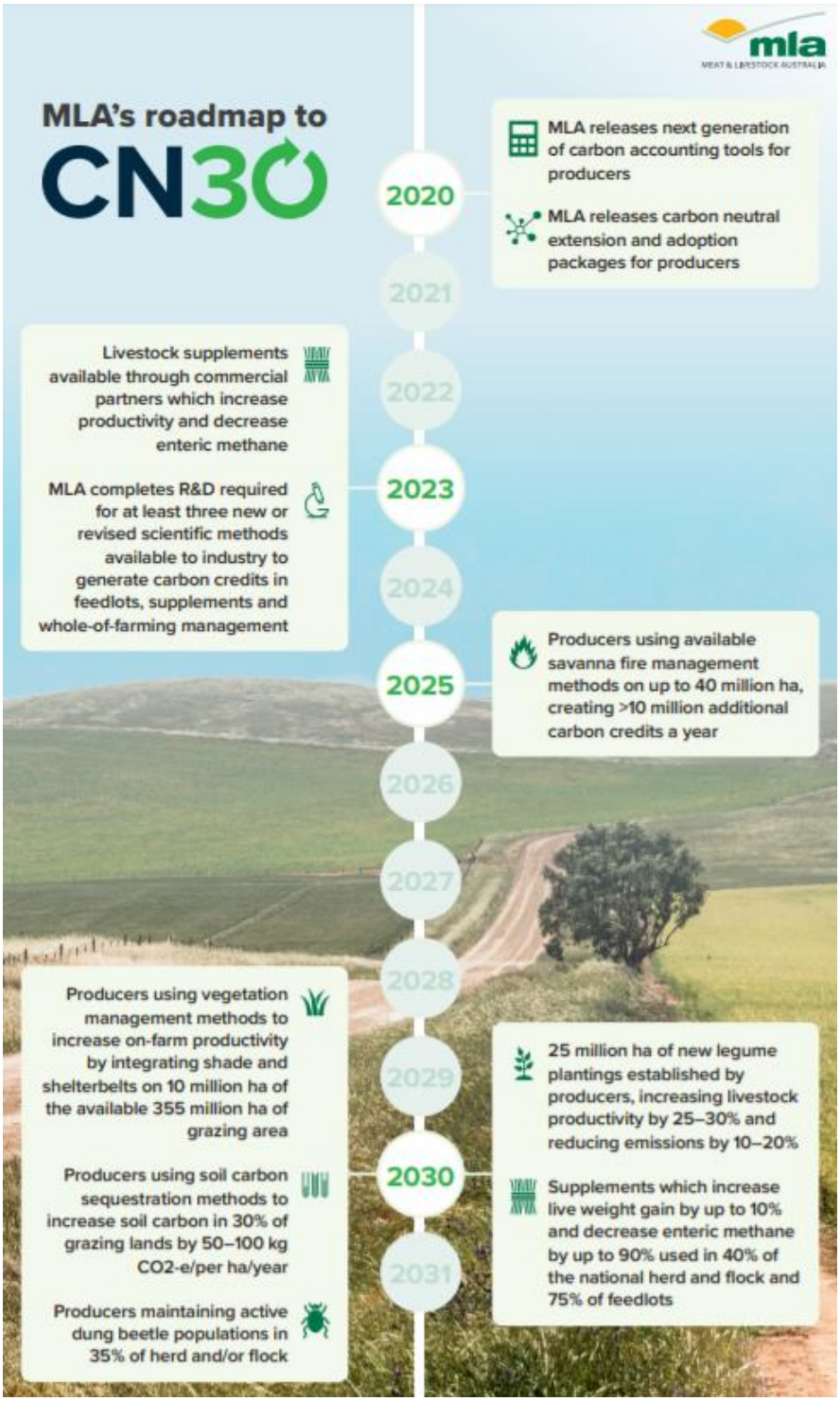



*Figure 31. MLA's Roadmap to CN30 (https://www.mla.com.au/research-and-development/Environment-sustainability/carbon-neutral-2030-rd/cn30/).*

### *7.2.2 Australian Beef Sustainability Framework*

The Australian Beef Sustainability Framework (ABSF) was initiated by the Red Meat Advisory

Council (RMAC) in 2017 (https://www.sustainableaustralianbeef.com.au/), in collaboration with industry stakeholders, to meet the changing expectations of consumers, customers, investors and other stakeholders. The Framework defines sustainable beef production and tracks performance over a series of indicators annually. The sheep industry is in the process of developing a similar framework to provide customers and other stakeholders with evidence across priority areas for sheep production. As for beef cattle, sheep producers realise the importance of investing in actions and communication activities in order to maintain customer and community support.

The ABSF reports across four themes – Animal welfare, Economic resilience, Environmental stewardship and People and community. In June 2019, the ABSF annual update (ABSF 2019a) demonstrated the industry's improvement in outcomes for natural resources, animals and people by:

- Reducing beef sector GHG emissions by 56% between the baseline year of 2005 and 2015;
- Increasing tree cover on beef-producing land;
- Increasing use of pain relief to 15%;
- Adding $152 million to farm-gate returns from Meat Standards Australia;
- Increasing poll gene prevalence to 86% across most breeds.

The ABSF Sustainability Steering Group with an Expert Working Group has developed practical and evidence-based measures for the balance of tree and grass cover as the first national environmental stewardship landscape indicators for Australian beef industry (Figure 32). These measures support evidence for GHG abatement through sequestration of carbon in trees and also co-benefits for biodiversity, animal welfare and productivity gains that have potential to be incorporated in accounting frameworks for ecosystem services markets.


*Figure 32. Indicators of environmental stewardship in Australian Beef Sustainability Framework (ABSF 2019a).*

The ABSF 2019 Annual Update included mapping of the Framework to the UN Sustainable Development Goals (SDGs) (See Box 1). Companies now using the ABSF to support internal environmental sustainability commitments or business and shareholder reporting and communications include McDonalds Australia, Greenham, NAPCO, Teys Australia, RaboBank, Woolworths and OBE Organic. While the ABSF is not linked with the Global Roundtable for Sustainable Beef (GRSB), it does align with it and is recognized by some companies (e.g. McDonald's, See Section 7.3.1).

## 7.3 Livestock Product and Market Initiatives

In addition to climate change and ES initiatives for red meat production and processing, the red meat industry is responding to supply chain and retail priorities to ensure they are able to satisfy consumer preferences and maintain social license. Key industry initiatives illustrate this response.

### *7.3.1 McDonald's*

As a company, McDonald's has prioritized seven areas of focus to meet the organisation's sustainability goals:

- Advance economically viable farming;
- Preserve forests;
- Address climate change;
- Reduce food and packaging waste;
- Respect human rights;
- Promote the health and welfare of animals; and
- Protect water.

McDonald's Beef business has developed a sustainability program to support its social license to operate, in part recognizing increasing consumer concerns over recent years about the environmental harm, including for the Earth's climate, caused by cattle production. The elements of the company's sustainability program are given in Box 10.

Two key areas of focus for McDonald's global program of importance to the northern Australian beef industry are addressing climate change and avoiding deforestation. To address climate change the company is seeking to reduce emissions throughout the supply chain, including improving energy usage at supplier facilities, transportation efficiency and reducing food waste. The on-farm target areas are:

- *Farm Management*: A farm's carbon footprint is an indicator of its overall efficiency and therefore its profitability. When farmers are able to optimize their resources, they also improve their economic viability and minimize their carbon footprint.
- *Rebuilding Soils*: Progressive grazing techniques and other agricultural practices can bolster soil's ability to store carbon while at the same time optimizing its capacity to provide nutrition for animals. We are supporting initiatives to both help farmers to adopt management practices

which improve soil health and at the same time ensure that farming systems which actively sequester carbon can be recognized in greenhouse gas measurements.

- *Conserving Forests*: Forests play a vital role in absorbing greenhouse gas emissions and creating oxygen, yet forests around the world are under threat from deforestation and degradation. We're verifying that beef production in our supply chain is not putting forests at risk, and we're working with partners to halt deforestation, which is estimated to account for 15 percent of global GHGs and presents a real risk to our business, supply chain and customers.

**Box 10. Elements of McDonald's Beef Sustainability Program**

McDonald's beef sustainability program has committed to work with 10 key countries to:
***Accelerate industry progress:*** Source a portion of our beef from suppliers participating in sustainability programs aligned with the GRSB principles and criteria, and that meet McDonald's requirements for each applicable market.
***Pioneer new practices:*** Set up McDonald's Progressive Farm Partnerships to trial and discover new practices related to our Priority Impact Areas.
***Share knowledge and tools:*** Engage with local farmers through farmer outreach projects to help develop and share best practices related to our Priority Impact Areas.
***Promote flagship farmers:*** Select and showcase McDonald's Flagship Farmers to demonstrate leading best practices related to our Priority Impact Areas.
***Preserve forests:*** In regions with identified risks relating to the preservation of forests, verify that the beef sourced from those regions comes from farms where primary forests and high conservation value lands are preserved.

Within Australia, McDonald's supports the RMAC's sustainability steering group in the development of the ABSF.

To preserve forests, McDonalds have declared an aim to eliminate deforestation from their global supply chains by 2030. The company's Commitment on Forests with its supporting addendum sets out a stepwise vision to achieve this. Starting by 2020 with raw materials used in the greatest volume providing an opportunity for the biggest impact – beef, chicken (including soy in feed), palm oil, coffee and fibre used in customer packaging. The commitment extends beyond forests, to areas of high conservation value, and to the individuals and communities around the world who depend on forests. McDonalds worked with WWF to identify priority forest areas for conservation. In the WWF Living Forest report, Australia, and specifically Queensland beef production lands, was identified as a 'deforestation hotspot' (https://wwf.panda.org/our_work/forests/forest_publications_news_and_reports/living_forests_report/). As the largest single customer of Australian beef, McDonald's commitment on deforestation is important especially with growing interest from some consumer groups to decrease meat consumption in favour of plant-based alternative proteins. Fourteen of the industry's largest global retail customers have also made a similar public commitment to eliminate deforestation from their

supply chains as a member of the Consumer Goods Forum.

Industry response in Australia includes working through the ABSF to support research to refine indicators for the balance of tree and grass cover to enable reporting and verification of actions to maintain or increase woody vegetation cover (ABSF 2019b) as noted in Section 7.2.2. In addition, the red meat sector's CN30 program includes a goal for producers to integrate shade and shelterbelt trees on 10 million ha land on beef production properties by 2030. With appropriate balance between trees and grass cover and ecosystem services methods, there are opportunities for producers to increase production, improve resilience to climate extremes and to receive income from carbon and biodiversity credits.

### *7.3.2 Major Supermarkets*

#### Woolworths

The Woolworths Group has undertaken several steps to demonstrate a commitment to the environment and to show a reduction in its environmental footprint. In April 2019, Woolworths Group became the first retailer in Australia, and the first supermarket globally, to issue Green Bonds certified by the Climate Bonds Initiative (CBI) (https://www.woolworthsgroup.com.au/page/media/Latest_News/woolworths-group-first-globally-to-issue-certified-green-bonds-for-a-supermarket/).

As a major retailer of red meat, Woolworths became a member of the ABSF Consultative Committee and has made a commitment to working with their farmers and suppliers on good animal welfare. The *Woolworths Animal Welfare Policy* (https://www.woolworthsgroup.com.au/icms_docs/195572_animal-welfare-policy.pdf) sets out a minimum sourcing requirements and expectations, and state that they consult with veterinarians, academics, government representatives, training providers, RSPCA, Animals Australia and Compassion in World Farming to align policy and standards with Compassion in World Farming. They are working towards a Tier 1 Score on the Business Benchmark for Animal Welfare. Cattle from feedlots are accredited by the National Feedlot Accreditation Scheme (NFAS) as well as meeting Woolworths own standard.

#### Coles

Through a 'sustainable environment practices' Coles is investing in environmental projects and partnerships to reduce their environmental impact and protect the environment. The focus is on recycling, waste reduction and sustainable packaging, and looking at opportunities to become more energy efficient and reduce greenhouse gas emissions. Coles advertises that it is offering products that are sourced in an ethical, transparent and responsible way. With respect to Coles Own Brand beef, the claim is that, since 2011, it has been 100 per cent Australian sourced with no added hormones so that 'the cattle grow and mature naturally'.

#### Other supermarkets and retailers

*ALDI* states a commitment to high industry standards of animal welfare across their supply chain,

and to continuously review and improvement of internal standards and policies guided by the 'Five Freedoms' proposed by the Farm Animal Welfare Council (FAWC).

***IGA (Independent Grocers of Australia)*** has a general commitment to sustainability that 'means that we seek to improve our economic, social and environmental, performance without harming the ability of future generations to enjoy the same economic, social and environmental conditions that we do today'. This commitment refers also to reducing GHG emissions (although not specifically related to livestock products).

# 8. Opportunities and barriers for participation

## 8.1 Opportunities for livestock producers

Based on this review of the programs and market mechanisms currently operating and emerging in Australia there are opportunities with the potential to enable livestock producers in northern Australia to diversify their income through actions that mitigate greenhouse gas and/or enhance ecosystem services in the landscapes they manage. This potential is supported by recent federal government changes to enhance partnerships with private industry, streamline method development for the ERF, reduce administrative burdens for participation in the government carbon crediting and pricing market and support research and data collection for methods such as soil carbon sequestration.

Many of the legislated methods enabling participation in the ERF scheme also provide pathways to improving the efficiency and profitability of livestock businesses. Eligible activities commonly support personal goals around environmental sustainability and maintaining resource condition, support industry commitments to climate change mitigation and adaptation and environmental stewardship and provide broader public good by improving ecosystem services, including biodiversity and water quality on agricultural land, and socio-cultural priorities. Methods being developed for the LRF similarly align with broad sustainable development goals and with long-term productivity.

In Queensland the opportunities for producers are theoretically substantial. Livestock producers manage more than 80% of the State's land area of 1,727,000 square kilometres, mostly for grazing on native pastures, with only about 10% of total pasture area improved through use of fertilisers and/or irrigation (Queensland Government 2011). Similarly, the opportunities are extensive nationally for cattle, sheep and goat producers managing approximately 550,000 rural properties greater than 10 ha in area within the grazing land use zone (ABSF 2019a) (Figure 33). At any time, there are also more than a million cattle in feedlots in Australia. MLA gives the capacity nationally as 1.4 million head with the number at any time dependent on seasonal conditions and prices. Feedlots offer an opportunity to reduce enteric methane using strategies such as feed additives suited to more intensive management.

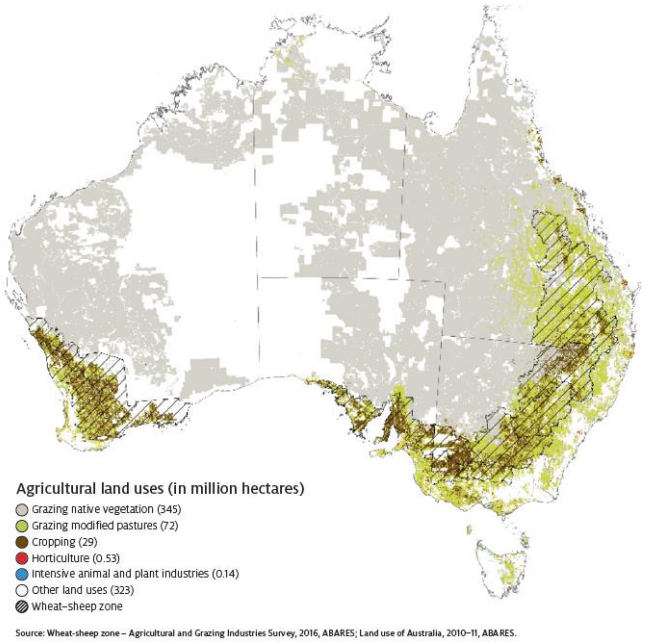



*Figure 33. Agricultural production zones in Australia (ABARES 2020). Approximately 355 million hectares lands, predominantly native grasslands and woodlands, are used for grazing to produce red meat.*

An ambitious approach to environmental and socio-economic sustainability is set out in the Australian red meat industry strategic plan (RMAC 2020) and in the CN30 commitment to reducing GHG emissions while supporting the long-term productivity and profitability of livestock producers. Progress towards carbon neutrality for red meat production also provides a public good in helping Australia to meet its 2030 commitment under the Paris climate agreement and State government to meet 2050 net-zero targets, and, through good management practices, providing ecosystem services co-benefits such as biodiversity and water quality improvements on the large areas of land under grazing use.

While the potential opportunities for livestock producers are great, there are a number of barriers to fully realising those opportunities that have resulted in limited participation in markets to date, and the proportion of livestock producers realising the potential value of markets offered by current schemes is small. Implementation of accounting, reporting, validation protocols and certification procedures by early movers have helped to improve methods and streamline administration so that experienced service providers are better able to support scheme entry. As markets grow, better understanding of the business proposition and benefits on-farm such as increased efficiency, enhanced productivity and greater resilience to weather and climate events is also expected.

Investment by government and industry in overcoming constraints on uptake of existing schemes will provide more financially attractive and practical opportunities for the benefit of producers and the environment. Initial uptake of relatively low cost options such as vegetation methods may provide an entry point for participation in carbon markets. For carbon markets, methods not attractive at today's carbon price may be more viable in future, particularly with strategies such as leveraging additional income for biodiversity and other ecosystem services under Queensland's LRF or the national biodiversity certification scheme. Price premiums may also become more accessible over time for traditional beef and sheep meat markets. The potential for lowering barriers to scheme

participation through supporting services for producers such as educational programs, advisory services and reduced administrative and transaction processes is also explored.

## 8.2 Barriers to participation in ecosystem service markets

To a substantial extent, the success of market mechanisms depends on supply and demand pressures that drive price. For specific schemes such as the ERF, success depends on the extent of voluntary participation and uptake of activities that increase abatement to help meet the scheme objective of achieving Australia's international climate change targets. Hence, the legislation (the CFI Act) places a value on carbon credits to drive changes, aiming at lowest cost abatement.

However, for farmers and other land managers, success of carbon market mechanisms depends on receiving a reliable source of income for undertaking activities that are compatible with the farm business model and ideally also provide private good such as enhanced productivity or contribute to meeting personal goals for ecosystem values or long-term sustainability. The majority of farmers wish to protect and improve the condition of the land they manage but actions may be constrained by time and financial limitations. Experience shows it is possible to maintain or increase profitability and be consistent with personal or community environmental, social and cultural values.

Adoption of new management practices and participation in ecosystem services markets is influenced by more factors than simply financial returns (Macintosh et al. 2019). There is potential for trade-offs, but the design of markets and supporting frameworks intended to incentivise on-ground action should start with understanding farmer perspectives and answer the question they must ask before adopting new practice – 'what's in it for me?'. Greiner et al. (2009) found that graziers in the Burdekin River catchment in Queensland with strong economic and social motivations were less likely to adopt conservation practices than those with strong conservation and lifestyle motivations. Similar findings have been reported in other studies (Blackmore and Doole 2013). Page and Bellotti (2015) concluded adoption of new practices by farmers was more likely if they aligned with the farmer's financial situation and personal values, the social context in which the farmer operates, and the public co-benefits generated by adopting the practice and there was also sufficient confidence that they would provide private production benefits. Participation in market mechanisms and environmental programs is strongly influenced by the characteristics of the scheme and policy related factors such as availability of information, the scheme complexity, transaction costs, and the degree of uncertainty in policy and prices (Griener et al. 2009, Kragt et al. 2017).

A survey of broad-acre farmers in the wheat belt in Western Australia indicated that the adoption of new practices that reduced carbon emissions and increased removals was driven by reduced erosion, increased productivity, income diversification, and the desire to conserve biodiversity (Drumbell et al. 2016, Kragt et al. 2017). Significantly, farmers rated the capacity for the practice to provide public co-benefits such as biodiversity more highly than being able to earn income from selling carbon credits (Drumbell et al. 2016). Important barriers to adoption occurred if the new practices were not compatible with current farm management strategies or farmers lacked the necessary skills to readily implement them. The survey also showed that barriers to participation in the ERF were primarily

related to policy (particularly real or perceived high levels of uncertainty), high transaction costs, lack of information, an absence of applicable methods, and the duration of permanence periods.

Understanding the motivations for, and barriers to, participation by industry leaders and service providers in carbon markets is also important for success. A recent survey designed to understand the motivations for, and barriers to, participation by industry leaders and service providers in Australia's ERF carbon pricing mechanism (Macintosh et al. 2019) found that there was no one factor that was predominantly responsible for limiting uptake of carbon market opportunities by agricultural producers, although the low carbon price was a major concern. Farmers identified a range of other factors that varied in importance depending on project and farm type, noting that the survey covered cropping and livestock farming. Based on the survey, Macintosh et al. (2019) suggested increasing participation would require improvements in design, usability (including simplifying transaction procedures and costs), and cost-benefit ratio, and that these changes would require policy reform of the scheme and training support.

The studies and surveys reviewed above indicating farmer preferences suggest some opportunities to strengthen aspects of the ERF that currently present barriers to participation:

- Clear communication of the potential for ERF projects to increase productivity yield or efficiency on farms and co-benefits for biodiversity, water quality or other ecosystem services, and how this potential could be assessed and optimised.
- Improving the design of the market mechanism to give greater price certainty and forward stability from carbon credits for new management practices, even where there is a degree of policy uncertainty.
- Increase collaboration between levels of government, such as that occurring with the Queensland LRF, for arrangements that facilitate uptake of carbon farming activities by adding investment that supports co-benefits of importance to agricultural efficiency and productivity and align with community and state priorities, thus achieving multiple positive outcomes. By leveraging support at different levels of government the LRF has the potential to achieve not only climate and ecosystem services benefits but also economic and socio-cultural advantages.
- Increase collaboration across industry, research, community and groups within local government to add efficiency and coordinate participation in ERF, LRF and other market mechanisms, such as is now increasing with ERF method development and is occurring in the context of achieving abatement from livestock production to meet the CN30 goal of the red meat industry.

Even with scheme design, administrative and usability improvements, the widespread adoption of new practices needed for achievement of outcomes may not reach the critical mass of market demand and supply for some years. Agriculture is affected by a number of factors that are effectively beyond the control of farmers. Factors such as domestic and export prices for agricultural products, weather and fire patterns and trends, and pests and disease, and these can impact productivity and

profitability, and the capacity to invest time and resources in new practices. Carbon and other ecosystem service markets add another element of uncertainty to risk mitigation and prioritisation of long-term sustainability goals. For example, practice changes such as planting forage legumes or multi-paddock fencing may involve a risk of debt due to additional up-front costs and, in the case of legumes, a risk of poor establishment or weediness, especially where agronomists or other farm advisers are also inexperienced in the new practice. With practices such as supplement use there may be uncertainty about market or consumer acceptance and a general lack of trust and confidence in 'new', unproven data on community response.

## 8.3 Opportunities and barriers for specific methods

Method development and implementation for the Australian ERF scheme provides up to a decade of experience for understanding the opportunities and barriers for livestock producers interested in the potential to earn ACCUs to diversify income from adopting carbon abatement activities, hold credits to offset emissions with potential to attract premium prices or participate in ES schemes such as the LRF offering added value for co-benefits. The high integrity of emissions abatement units generated through the legislated crediting determinations is recognized in a range of market mechanisms.

### *8.3.1 General barriers to method uptake*

Beyond the overall scheme factors, participation in carbon markets is contingent on the availability of applicable methods. Projects cannot be registered and cannot generate offset credits under Australia's ERF scheme, unless undertaking an activity eligible in a legal instrument called a method determination. There are currently 37 active methods under the ERF, 21 of which relate to agriculture and land. They cover aspects of the four activities that are responsible for most agricultural-related emissions, but coverage is incomplete and some activities covered by methods have no uptake. There are a number of well-documented agriculture related abatement activities for which there is currently no method legislated under the ERF. This directly prevents these activities contributing to Australia's emissions reduction target. In addition, most current ERF projects use a small number of methods and represent a limited geographical spread relative to agricultural land management. These observations identify that there are further carbon farming opportunities if the barriers to broader method and location uptake can be overcome and this is supported by carbon service industry survey (http://carbonmarketinstitute.org/). Amongst carbon service providers, aggregators nominated 'absence of methods and other rules that render projects ineligible' (scope of methods) as the most significant barrier to the uptake of agriculture emissions avoidance projects.

Where a method determination has not been made for an activity of interest, this could be due to a number of factors. There may not be robust evidence that an abatement technology is effective in reducing emissions or increasing carbon sequestration or, if there is a proven technology, investment in developing a method may not be justified because the activity would be uneconomic at current and most likely future carbon prices, i.e. the activity would not be cost effective. This has turned out to be the case for some current methods such as the feeding dietary additives to dairy cattle method.

Other reasons for the absence of a method may be that there is no effective, practical and appropriately priced technique to measure abatement with sufficient accuracy. In some cases, resourcing for development of a specific method may be delayed because of higher priority activities.

Where an ERF method has been made, there may still be low or no projects using the method, due to absence of the technical expertise to implement the activity and meet requirements under the legislation, or to high costs making participation unattractive, or to a perception that there was insufficient benefit for the farm business. Some aspects of these factors are summarized.

*Technical capability:* Many methods for abatement activities are highly technical, and landholders, particularly family farmers, do not necessarily have the skills and capabilities required. Carbon farming is a relatively recent part of land management and more traditional farm advisers also may not have the skills to provide reliable advice and support. It may take time for 'new' providers from the carbon service industry to gain the trust of agricultural producers and land managers.

*Costs:* The price of carbon credits in the ERF and secondary market mechanisms may be too low to provide an incentive for farmers to participate in carbon farming activities. In addition to implementation costs, which can be high for methods such as the soil carbon measurement method where baseline sampling and analysis involves high initial investment, plus transaction costs are not insignificant. The time commitment and impact on farm management must also be considered. Carbon service providers have proposed options to overcome this barrier such as simplifying transaction processes so they are less costly, making reporting and/or aggregation of small projects less complex, making policy changes that increase demand for credits relative to supply effectively raising the price of ACCUs, and working in collaboration with other schemes such as the LRF to value co-benefits.

*Low awareness of benefits:* As discussed above with reference to scheme-wide barriers, producers are more likely to make practice changes that achieve carbon credits if they are confident that productivity and efficiency would be increased, lowering any economic risk due to making a change when future carbon markets are uncertain. For example, eligible activities under the beef cattle herd management method can provide better financial returns with improvements in efficiency due to increased weaning rates or culling of unproductive cows.

These barriers are real and the government is actively seeking to increase participation in carbon farming activities in Australia and to increase abatement from the ERF and the CSF. The report of the King Review released in March 2020 (See Section 4.1.3) made 26 recommendations on low cost carbon abatement opportunities and within the government and CER, work has already begun on a number of the 21 recommendations that were agreed or agreed-in-principle. Many of the recommendations related to enhancing the ERF to encourage greater participation and incentivising, on a broader scale, voluntary emissions reductions.

### 8.3.2 Opportunities for current ERF methods with co-benefits

The experience of Queensland livestock producers in ERF carbon offset markets has demonstrated that there are opportunities for positive income diversification, particularly for regeneration

vegetation projects in semi-arid regions of south and south-west Queensland and for savanna burning projects in the north. There has been less participation by producers in other geographic regions for these methods, and low uptake across the state in agricultural methods generally, with few ACCUs issued. Table 6 summarises the ERF projects and ACCUs issued for Queensland ERF projects, as described in more detail in Section 5.1.6 and Figure 28). There are several ERF methods appropriate for implementation by beef cattle and sheep producers that also provide in Queensland's LRF.

The King Review report (Commonwealth of Australia 2020b) stated:

> *The Queensland Government will use the ERF's certification scheme as the cornerstone of the program, with project proponents being paid for the delivery of ACCUs at set dates from ERF projects that are assessed as providing designated co-benefits. Proponents will receive additional payments above the ACCU price if they are able to demonstrate the co-benefits have been achieved.*
>
> *These types of initiatives demonstrate how collaboration between governments, either on a bilateral or multilateral basis, can generate positive results. Collaboration enables governments to utilise and leverage their different capabilities to reduce the cost of achieving climate and other policy objectives. It can also avoid the unnecessary duplication and complication that arises from uncoordinated efforts being taken by different governments and government agencies.*

*Table 6. Status of Queensland ERF projects under method types most relevant to ruminant livestock production.*

| Method type | Projects[1] | ACCUs issued[1] | Location in Qld | Comments |
|---|---|---|---|---|
| *Vegetation* | 155<br><br>HIR-118<br>NFMR-33<br>Environmental Plantings | 10,897,186 | Contracted regeneration projects mainly in SW, & central W | Opportunities:<br>Increase in high productivity regions (smaller areas/more ACCUs);<br>Link to LRF (AfN) & Reef credits<br>Barriers: Need for new/varied regeneration method |
| *Agriculture (all methods)*<br>*Beef Herd* | 11<br><br>7 | 261,896<br><br>176,216 | S & E regions (Includes piggery methane projects)<br>2 contracted projects | Interest increasing in soil C |
| *Savannah Burning* | 39 | 2,150812 | Cape York (75 in total for N Australia) | |

[1] Data as at 14 April (Source: CER)

It is also noted that similar questions relating to the financial and practical aspects of implementing activities discussed for the ERF and LRF are also relevant to producers interested in accounting and offsets for 'carbon neutral' red meat products. In this case rather than sell ACCUs under contract to the CER or Queensland government, livestock producers with registered ERF projects may elect to either sell ACCUs in commercial markets (if eligible, at a premium price for ecosystem services co-benefits) or to market branded meat at premium price (e.g. https://fivefounders.com.au/).

To illustrate the potential opportunities and better understand the barriers that may have to be addressed, this section reviews available information on the economics and practical usability of methods, selected for data availability.

### Native forest regeneration

While the volume of trades in carbon credits plus co-benefits has remained small to date, a few studies have provided insights into how restoring native forests can deliver biodiversity co-benefits as well as carbon sequestration (e.g. Bryan et al., 2014; Butler, 2009; Carwardine et al., 2015; Evans et al. 2015; van Oosterzee et al. 2020) and the potential for economic advantage. These projects are relevant to the more than 150 registered projects under the Human Induced Regeneration and Native Forest from Managed Regrowth methods on land previously cleared for grazing and reforestation by environmental plantings methods. Ecologists recognise managed regrowth as a cost-effective forest restoration method that increases carbon stocks, and potentially restore biodiversity and ecosystem services in areas with some level of degradation. This type of forest regeneration is facilitated by low-cost techniques to assist the natural re-establishment of vegetation from residual seeds and increasing plants on site through activities such as restricting livestock grazing; stopping clearing using burning or mechanical means; the use of vegetation and fencing to reduce grazing by native or feral animals. To date ERF projects have been in low rainfall areas with low Net Primary Productivity (Table 6; Figure 26). Cockfield et al. (2019) modelled farm enterprise financial impacts of vegetation projects under Human Induced Regeneration and Avoided Deforestation projects in north-western NSW rangelands. These areas are comparable in terms of climate and land types to rangeland areas of Queensland with HIR and NFMR projects. The authors found that carbon farming projects provided a potential financial advantage in those parts of the region where livestock carrying capacity was low to medium and where woody vegetation biomass potential was medium to high. Conversely where land was more favourable for livestock production the higher opportunity costs entering into a carbon sequestration contract was less attractive.

Evans et al. (2015) examined the economic viability of carbon farming in 30.6 million hectares of relatively recently deforested agricultural landscapes in Queensland. They found the average minimum carbon credit price required to make managed native regeneration viable was about AU[34]$66, while for environmental plantings $109 would be needed. According to this study, using a combination of revegetation methods, a low carbon price of $5/ t CO2-e was sufficient for carbon farming to be a viable land use in over 2.3% of the 30.6 million ha study area, and at a price of $50/ t $CO_2$-e on up to 34% (10.5 million ha).

The carbon prices estimated by Evans et al. (2015) highlight the reason that the relatively low-cost regeneration projects have received greater uptake than projects requiring investment in planting and maintaining a new native forest. A more recent, detailed analysis based on experience in the Thiaki Rainforest Restoration Project (TRRP) in the Atherton Tablelands region by van Oosterzee et al. (2020). TRRP has had an ERF project since 2014 using the *Reforestation by Environmental or Mallee Plantings – FullCAM* method (https://www.legislation.gov.au/Details/F2018C00118) provides data on costs of environmental plantings under several scenarios on a cattle grazing property. Despite the study trialing a low-cost method for reforestation (around an order of magnitude lower than the estimates of Evans et al. (2015)) and the high productivity of the region, modelling based on real costs and returns showed that carbon farming required a markedly higher price than currently offered for

[34] All currency values are given in Australian dollars.

ACCUs in the latest CER auction and secondary markets of $16 to $17. At the minimum planting density of 200 trees per hectare, as estimated to give the required 20% crown cover for forest under the ERF method, a price of at least $37 per tonne of abatement was needed to produce a higher net present value (NPV) than grazing cattle on the property (Table 7).

*Table 7. Estimated NPV (AU$) at 5% discount rate over 100 years, consistent with the permanence period of ERF sequestration projects. Modeled scenarios are for environmental plantings on a 50 ha grazing property on the Atherton Tableland. Scenarios shown are for 3 carbon credit prices ($20, $50, $100); 2 reforestation densities (200, 1000 trees/ha); three reforestation options (C only – all 50 ha planted to trees; Mixed – 10 ha planted to trees and 40 ha grazed by cattle; Cattle only – no reforestation). Source: Adapted from van Oosterzee et al. 2020; Table 4).*

| Management on 50 ha property | Tree plantings (trees/ha) | 100 years NPV C price $100 | 100 years NPV C price $50 | 100 years NPV C price $20 |
|---|---|---|---|---|
| ***Cattle only*** | 0 | | 1,824,765 | |
| ***Carbon only*** | 200 | 1,961646 | 865,500 | 207,813 |
| | 1000 | 1,841,646 | 745,500 | 87,813 |
| ***Mixed (80% cattle)*** | 200 | 1,852,141 | 1,632,912 | 1,501,375 |
| ***Mixed (80% cattle)*** | 1000 | 1,828,141 | 1,608,912 | 1,477,375 |

At 1000 trees per hectare, at least $44 /t was needed. Importantly, because of the high up-front costs of establishing the reforestation, break-even took many years – at least five years under the lowest planting cost scenario of 200 trees/ha at a price of $100/t and did not occur at all under high cost low price scenarios. Income generated by continued grazing at lower stocking rates within reforestation areas could help make environmental planting projects financially viable (Table 7). However, the analysis by van Oosterzee et al. (2020) indicates that without higher prices, income from carbon credits alone cannot justify a cattle producer reforesting land through environmental plantings.

The minimum ACCU price of $37 required to match NPV of grazing in the Atherton Tablelands is likely to apply in other regions of Queensland where environmental plantings could potentially occur with livestock production. This finding is important in considering ERF vegetation projects in areas where forest will not regenerate through natural regrowth assisted by low cost activities such as managing weeds, feral animals and grazing pressure in HIR and NFMR projects. While income from ecosystem services credits under the LRF (or a price premium for certified carbon neutral products with co-benefits achieved with ACCU carbon offsets) at even a modest price could be linked to carbon sequestration rates for regeneration projects, it is likely that a co-benefit payment for reforestation projects would need to take into account the additional costs of planting. The LRF AfN vegetation method (Butler 2020) provides the accounting context and opportunity for biodiversity co-benefits. Van Oosterzee et al. (2020) also propose that biodiversity could be enhanced through creating corridors and that spatial planning could enable site selection for forest restoration that also benefited erosion control and water course management.

Current regeneration methods HIR, NFMR and the Avoided Clearing (AC) method (which has only four projects with a total of 290,464 ACCUs issued up to July 2020) do not allow for planting to regenerate forest. As noted above this ensures the projects are lower cost to implement but it can result in regeneration and carbon increase in project areas being low, and that projects are restricted

to certain regions and native forest/woodland ecosystems. Some service providers have recommended the government explore a potential variation in the methods to develop a method with application in higher rainfall regions such as reef catchments as 'permanent forest C sinks'. They envisage that the method would allow more flexibility in eligible activities and that the regenerating forest cover [in more productive regions] would provide greater ACCUs per hectare, and potentially also be eligible to earn co-benefit (biodiversity) credits under the LRF.

## Beef cattle herd method

In discussing ERF methods that credit activities that reduce enteric methane emissions from beef cattle production the focus has been on the herd method. There are three method determinations under the CFI legislation:

1. The *Beef Cattle Herd Management method*, which credits improvements in the emissions intensity of beef production from grazing animals;
2. The *Beef Nitrates method*, which credits emissions reduction from replacing urea supplements with nitrate supplements in grazing animals; and
3. The *Dairy Supplements method*, which credits emissions reduction from feeding dietary supplements to dairy cattle.

Neither the beef nitrates nor dairy supplements methods have had any projects registered, and both carbon service providers and the industry have indicated that projects are unlikely without a substantial increase in the price of ACCUs. A large productivity benefit would be needed to overcome the cost of undertaking the activities and registering a projects, while the price remains well-below $20 per ACCU. Further discussion will be restricted to the beef cattle herd method where there have been two projects registered. In summary, the approach in the beef herd method is an emissions intensity calculation applied against a relative baseline. The method estimates emissions reductions as change in emission intensity independent of changes in the quantum of emissions, thus incentivising practices that reduce emissions without constraining production independent of market and climate interactions. Enteric methane avoidance may be due to increasing the ratio of weight to age of the herd, reducing the average age of the herd, reducing the proportion of unproductive animals in the herd, or changing the ratio of livestock classes within the herd to increase total annual liveweight gain of the herd.

There are only limited data from implementation of the beef cattle herd method (2 projects registered; approximately 177k ACCUs issued). Carbon service providers have indicated that the net profit from ACCU's sold after project implementation costs would be only about $2 per head and that projects were financially unviable at a herd size of <50,000 head (DISER personal communication). Therefore, although the beef herd method estimates abatement on an emissions intensity rather than absolute basis so that production to take advantage of the efficiency gains from implementing emissions reduction herd management activities, there is little incentive for producers to participate in the ERF carbon market. Some practices that improve the efficiency of the herd (and reduce emissions intensity) such as managing reproductive efficiency and weaning percentages, have not improved markedly in norther Australia over the past three decades or more (Wiedemann et al. 2015a). With

the low carbon credit achieved and without a greater incentive than the <5% increase in profit, there is little indication of uptake of the current method. Therefore, in the context of potential for co-benefit payments under the LRF making ERF projects more economically attractive for livestock producers in Queensland, there is value in looking at possible opportunities for future development of new or varied method(s). It should be noted that eligible activities that could be candidates for an ERF method development must provide abatement that is capable of being counted in Australia's national accounts (See Section 5.1.4 and Appendix 3).

The ERF beef cattle herd management method attributes reductions in GHG emissions to changes in herd structure and productivity. Animal census data underpinning the inventory would reflect changes in herd size and structure but would not account for changes in animal weight or growth rate. There is industry interest in the development of ERF methods able to account for provision of alternative feeds or supplements that reduce or inhibit methane production in the rumen during fermentation (MLA 2015; Mayberry et al. 2018). In 2019, the DISER initiated collaboration with the livestock industry (focusing on the red meat sector), researchers and service providers to evaluate opportunities to increase uptake of the current method(s) to avoid enteric methane emissions through varying the existing beef herd method or developing a new method. This collaboration is ongoing in 2020.

Reasons given for the low uptake of the current beef herd method as well as low ACCU prices include the complexity and limited functionality of the calculator that must be used to estimate emissions avoidance. The industry proposes simplifying the calculator and also include in the calculator factors for feed quality or type where sufficient evidence for a dose-response relationship with enteric methane can be established. This is part of the current collaborative work being explored by DISER, with four mitigation strategies having been identified in the first stage of review of scientific literature and stakeholder consultation. Four activities were identified as most promising for emissions reduction method development in cattle in the short to medium term: (i) grazing northern pasture cattle on Leucaena; (ii) grazing northern pasture cattle on Desmanthus; (iii) using 3-NOP as a feed supplement; and (iv) using Asparagopsis (Red Algae) as a feed supplement.

Each of these activities has demonstrated the potential to substantially reduce enteric methane emissions in both laboratory and field testing with no apparent negative impact on productivity. Each requires developmental work, establishing acceptance with producers and viability in the marketplace, and community consultation. For example, developing a new method for feeding legume to grazing cattle, research is needed to establish the dose response relationship, a cheap, reliable method is needed to map and monitor the extent of map the extent of Leucaena and Desmanthus using remote sensing sensors, and data collection and reporting burdens for individual producers need to be assessed for feasibility. Community consultation would also be importance to ensure acceptance, especially if there were concerns regarding environmental issues such as weediness of these or other forage plants. Consultation may also enable cooperative project development and aggregation by producers for efficiency and cost-savings. This would be an advantage in the case of projects eligible for LRF co-benefit credits, particularly if an NRM-wide

aggregation were possible to optimise co-benefits.

Simulations on a case-study farm in central Queensland evaluated the influence of management changes to achieve emissions mitigation, increased productivity, or increased gross margin (Harrison et al. 2016). Practice change included replacing urea supplementation with nitrate, finishing cattle on Leucaena, optimizing herd structure (reduced ratio of breeding cows to steers and unmated heifers), increased female fecundity, and a Leucaena finishing enterprise maintained net farm emissions equal to the baseline. The first insight from this work to be noted was that introducing additional practice changes with the potential to profitably enhance liveweight turnoff allowed a greater reduction in emissions intensity, but only when each intervention worked synergistically with those already in place. This emphasizes the importance of good understanding of the business outcomes when planning emissions avoidance methods that affect farm profitability. A second finding was that using supplements to reduce emissions showed good promise but that there is a need for further research on delivery and commercial scale supply and on an accounting approach as there are currently no ERF methods for the feedlot sector. Both issues are currently in planning as part of a new or expanded livestock method evaluation for enteric methane avoidance.

## Soil carbon sequestration

There are two methods for crediting soil carbon sequestration under the ERF. The model-based soil carbon method that estimates sequestration of carbon in soil using default values has had no uptake. The measurement method for soil carbon sequestration in agricultural systems has 34 projects excluding those that have been revoked (at July 2020). One, located in Victoria, has been issued with credits. There has been a substantial amount of interest in the prospects for soil carbon sequestration as a greenhouse gas abatement strategy, from farm to policy levels and there have been a number of factors contributing to limit adoption within the ERF. Stakeholders report that the lack of uptake of the default value method is due to the conservative nature of the model and the method's eligibility restrictions, while they argue that registration of projects in the direct measurement method has been limited by high measurement costs, and discounts applied early in the crediting period to maintain conservativeness and avoid the risk of over-crediting. The King Review (Commonwealth of Australia 2020b) recommended establishing a scheme to subsidise the costs of baseline measurement of soil carbon sequestration projects to overcome this barrier to uptake, and the CER has recently (July 2020) introduced an advance payment of up to $5000 to eligible ERF proponents to assist with the upfront costs of soil sampling (http://www.cleanenergyregulator.gov.au/About/Pages/News%20and%20updates/NewsItem.aspx?ListId=19b4efbb-6f5d-4637-94c4-121c1f96fcfe&ItemId=812).

Lower or subsidised measurement costs and improved modelling capabilities could increase the uptake of soil carbon projects but for livestock producers in Queensland there remains a degree of uncertainty about climate and biophysical constraints on building and maintaining soil carbon stocks over the long-term, i.e. over a 25 or 100 year permanence period. The levels of soil organic carbon over time are a function of biomass inputs to the soil, and rate of loss which is a function of soil

properties and the level of microbial activity. Where these factors are stable, the levels of soil organic carbon will tend to graduate towards an equilibrium reflecting the balance of inputs and losses. However, they are seldom stable due to climate variations and land management practices and land use changes disturbances of the balance, resulting in shifts in soil organic carbon levels.

Livestock production in Queensland experience high variability in seasonal conditions. Climatic factors such as temperature and rainfall affect soil carbon levels by influencing plant growth and decomposition rates and are often greater drivers of change than management (Allen et al. 2014; Henry et al. 2018). Research suggests that, on a per hectare basis, the scope for management-induced increases in soil organic carbon on croplands and grazing lands is relatively limited (Lam et al., 2013). However, on degraded lands, management changes can sequester significant amounts of carbon in soils. In making the ERF soil carbon sequestration measurement method, the government suggests prospective proponents should consider factors that influence the likelihood of soil organic carbon stock change and consult with agronomic experts prior to engaging in a soil carbon project. Table 8 lists examples of factors that influence the likelihood of soil organic carbon stock change.

*Table 8. Examples of factors that may affect the likelihood of soil carbon sequestration in agricultural land.*

| | Increase in soil organic carbon likely[1] | Increase in soil organic carbon unlikely[2] |
|---|---|---|
| **Location factors** | | |
| Native soil type | High clay content<br>High soil fertility<br>High porosity | Low clay content<br>Low soil fertility<br>Low porosity |
| Annual average rainfall | High (> 600 mm) | Low (< 600 mm) |
| Seasonal climate and rainfall (throughout project) | Rainfall consistent with average conditions<br>Moderate temperatures | Flood<br>Drought<br>Frost<br>Extreme heat or cold |
| **Initial conditions** | | |
| Pre-project SOC stocks | Low* | Medium to high* |
| Management history | Low inputs of biomass or large removal of biomass from system<br>*(Eg. Low yields, stubble burning, poor grazing management, low ground cover)*<br>Tillage history with high amount of soil disturbance<br>*(Eg. Conventional tillage, disc ploughs)*<br>Poor nutrient and soil chemical environment management *(acidity, salinity, sodicity).* | High amount of biomass input to the soil<br>*(Eg. High yields, stubble retention, good grazing management, maintain high ground cover)*<br>Minimal soil disturbance by tillage<br>*(Eg. Direct drilling, minimal disturbance at sowing, perennial pastures)*<br>Maintain or improve soil nutrient levels and address barriers to soil chemical health *(acidity, salinity, sodicity).* |
| **Proposed new management** | | |
| Activities influencing organic matter inputs | Major increase in amount of biomass entering the soil<br>Large increase in ground cover | Minimal change to amount of biomass entering the soil<br>Minimal increase in ground cover |

* relative to the expected long term equilibrium levels of SOC for the soil type, climate and proposed land management.

[1] when a specific site has all or most of the factors as classified in this column, chances of an increase in soil organic carbon are maximised. Note: no site is likely to fall into either column entirely.

[2] when a specific site has all or most of the factors as classified in this column, chances of an increase in soil organic carbon are minimised. Note: no site is likely to fall into either column entirely.

Scientific debate continues on the risk to stored soil carbon of global warming. A recent study from the University of Exeter raises the need for caution with predictions that an average global temperature rise of 2°C (the upper level in the Paris Agreement goals) would lead to around 230 billion tonnes of carbon being released from the world's soil (Varney et al. 2020). The research

indicated a higher level of sensitivity of soil carbon turnover to global warming than previously found and claimed future climate change projections had half the uncertainty. The risk of lack of permanence in sequestered soil carbon must be taken into consideration but while consensus has yet to be reached amongst scientists in the impacts of climate change on rate of loss, there is strong agreement that practices recommended for sequestering carbon provide soil health and climate resilience benefits and often increases in yield (https://www.wri.org/blog/2020/08/insider-further-explanation-potential-contribution-soil-carbon-sequestration-working).

While engaging in an ERF soil carbon project should involve careful consideration of the factors above, eligible activities under these methods may also provide co-benefits for soil health and productivity that can be recognised under Queensland's LRF. Further research is needed to evaluate these possible opportunities.

## Savanna burning methods

ERF savanna methods enable ACCUs to be issued for managing fire in savannas in northern Australia to reduce the frequency of late dry season fires, thus reducing GHG emissions and retaining more carbon in dead organic matter compared to fires in the cooler, moister early dry season period.

The two methods currently for savanna fire management are the sequestration and emissions avoidance method which credits both sequestration and emissions avoidance from improved fire management, and the emissions avoidance method. Most savanna burning projects in Queensland were registered under the 2015 method that has been revoked.

Projects that undertake planned burning in the early dry season or other times of the year frequently use traditional techniques used in indigenous management and take into account landscape features within the project area and local weather conditions. Planned burning that avoids hot late season fires benefits reduces GHG emissions with co-benefits for biodiversity.

## Future method developments for livestock producers

Section 5.1.7 provides a discussion of scheme-wide opportunities that could benefit Queensland's livestock sector and open additional market options. Responses to announcements of changes to priorities and processes for method development will be acted on in the fourth quarter of 2020 and in 2021. Review and variations of individual methods some of which are discussed above will continue to ensure ongoing compliance with the Offsets Integrity Standards and to respond to scientific advances and practical implementation of activities that provide abatement.

In addition to the 2020-21 Budget and *Low Emissions Technology Statement* announcements discussed in Section 5.1.7, recommendations in the King Review directed at expanding abatement under the ERF (Commonwealth of Australia 2020b) are being progressed. It is suggested that the red meat industry monitor these developments and seek to engage in consultation processes and working

groups for new method development where it is of value for the livestock sector. Table 6.1 from the King Review report lists stakeholder suggestions for new or varied methods, that include:

- Development of a method for 'blue carbon' (i.e. the sequestration of carbon in coastal and marine ecosystems, including mangroves);
- Development of a method to provide more complete coverage of livestock feed supplements;
- Reducing the discounting applying under the Measured Soil Carbon Method.

These proposals will be considered in the context of priorities, which are set by the Minister, and the integrity of individual methods and the ERF scheme. For example, the King Review report notes that proposals such as reducing the discounting in the Measured Soil Carbon Method, which was applied to address the high levels of uncertainty associated with the impacts of land management changes on soil carbon stocks in the early sampling rounds, would raise material integrity issues and would be difficult to accommodate within the ERF's integrity framework are difficult to accommodate. However, the Minister has indicated that expanded opportunities for soil carbon sequestration activities is a priority paving the way for accelerating development of a new soil carbon method with lower sampling costs and improved accuracy (Section 5.1.7).

Other recommendations from the King Review aimed to facilitate small-scale projects under the ERF through reducing price risk and marketing costs, e.g. a fixed priced purchasing desk and lower transaction costs using streamlined measurement, reporting and verification requirements could enable small agriculture projects to engage in the ERF. This could benefit livestock producers directly through carbon markets and also facilitate engagement in ecosystem services markets such as the LRF.

For some time, stakeholders have proposed to the DISER and the CER that being able to undertake multiple projects on agricultural land with combined monitoring, reporting and auditing would allow greater participation in the ERF by reducing costs and enabling greater levels of abatement. This is commonly referred to as 'method stacking'. The King Review report recommends that facilitating 'method stacking', to enable multiple ERF projects on the same property using different methods, be considered. Rule changes would be needed to allow proponents of stacked projects to submit a single, aggregated offsets report covering each individual component of the stacked project; and stacked projects' audits to cover all projects at one time rather than auditing each individual component at different times.

# 9. Conclusions and Recommendations

## 9.1 Summary Points

**Engagement and communication**: The importance of communication and maintaining collaboration and capacity in state government, industry and natural resource management networks, especially in the field of ecosystem services (including carbon, biodiversity and water quality) came through in many articles reviewed. This also flows through to developing strategies to encourage the higher participation required to make any market mechanism feasible. Making economically correct

decisions for a farm business requires strong understanding of the short and long-term economic impacts of various decisions and also of the short and long-term implications for environmental and personal values.

- A barrier to participation is insufficient knowledge and confidence to make a decision – requires understanding the benefits and risks and 'what's in it for me'.
- Schemes such as ERF and LRF and the methods for credits are complex. Producers often do not have a high level of trust in private advisers. Service providers charges can also be a barrier.
- Training advisers that already are accepted and trusted to provide advice on markets or are willing to work with carbon and ecosystem services experts may facilitate cooperation.

**Methods**: ERF methods provide the entry point for carbon credits and LRF participation. They also contribute to carbon neutrality offsets. The rigour and complexity of ERF methods and governance make participation in the ERF administratively complex and costly. Maintaining the integrity of ERF offsets (ACCUs) is critical for some markets but can preclude Small-Medium farm business and land managers. In looking to make methods more useable it is important to look firstly at those that are for activities that provide the most certainty of productivity and efficiency gains, thus providing greater prospects for adoption.

- Overcoming high transaction costs and managing the complexity: Low participation could be partly addressed by aggregation and partly by having methods that were simpler and required less time and expense for auditing and reporting.
- Aggregation: The Paraway led Herd Method aggregation is a good example of what can be done to provide a way for small (<1000 hd) producers to participate. It indicates the value of a 'leader' organisation that is trusted (and probably not (or additional to) a commercial service provider. Some NRM bodies may be in a position to fill this role – they seem to have done this in development of Reef Credits and are also able to manage the development of LRF Biodiversity or other co-benefit credits. The model will need training.
- Simplified ERF methods: Development of simple methods for S-M businesses has been raised previously. They would need to be heavily discounted because of the higher uncertainty in ACCUs delivered but could provide an entry point for additional income form LRF credits and for offsets towards carbon neutrality while avoiding high transaction costs.
- Soil Carbon Measurement method is an example of a method with high overheads due to the costs (and time) for sampling and measurement. The King Review has proposed that a model where the government shares the costs for measurement may be funded under the CSF. This could facilitate soil carbon sequestration projects in more productive land but is still unlikely to be feasible in extensive grazing country (especially semi-arid/arid regions where SOC gains are low and climate variability makes the risk of loss high).
- Vegetation projects: The requirements for eligibility makes some vegetation methods not useable in Queensland's grazing country. A more comprehensive avoided clearing method across native vegetation - 'forest', remnant woodlands and regrowth regeneration - areas

would make it easier for cattle and sheep producers to have projects. Whether the government is willing to move on such a method could be explored.

- Planting trees on farm for shade, shelter belts and riparian rehabilitation has value in many circumstances for production, animal welfare, biodiversity and landscape condition. These trees may not meet the thresholds for 'forest' under the national accounts. Explore how the carbon sequestration and ecosystems services in these plantings could be credibly counted as offsets towards carbon neutrality and market claims (eg as compliant with the ABSF and McDonald's reporting).
- Herd method – Engaging in the development of an expanded beef cattle ERF method initially for Leucaena and Desmanthus in pastures could assist producers to engage in projects with productivity benefits and possibly ecosystem services credits.
- Feedlots – Development of a method for carbon credits in feedlot cattle (and sheep) is an important step. Possible development of options to count supplementation (3-NOP and Asparagopsis) or feed additives should be explored and where there is an opportunity, contributions made based on useability in Queensland.

## 9.2 Recommendations

- **Recommendation 1:** Identify gaps relevant to northern livestock producers and invest in research for new and improved methods for carbon and ecosystem services co-benefits.

*Investment in research to fill gaps in data and calculations of emissions abatement, certification information or quantifying co-benefits will improve usability and accuracy of methods. More accurate, less conservative crediting ensures greater confidence in the method and encourages adoption. Collaborative arrangements across government, research and industry interest groups should be facilitated to reduce duplication and accelerate progress in method development for carbon crediting schemes such as the Emissions Reduction Fund (ERF) and voluntary trading such as the Verra framework. Similarly, collaboration should be sought in the less mature area of method development for ecosystem services, including for the Queensland Land Restoration Fund (LRF) and the Australian Farm Biodiversity Scheme. Consistency in the metrics used between schemes and markets, where appropriate to the objectives and priorities, will help to optimise returns on investment and minimise costs and duplication in monitoring.*

- **Recommendation 2:** Engage with certification and standard bodies and with scheme managers including Commonwealth and state governments to propose and explore development of new or varied crediting methods and certification protocols appropriate to northern beef enterprises.

*There is a clear recognition that land sector carbon offsets and agricultural emissions reduction will be needed, at least in the short to medium term, to meet global and Australian climate change goals and to address environmental sustainability challenges such as soil degradation and biodiversity loss. However, methods and certification schemes often have accounting, reporting, verification and auditing requirements that are costly and time-consuming. This along with the lack of methods to enable crediting of certain beneficial activities or a*

*lack of flexibility to enable application to individual farm management or business circumstances are substantial barriers to adoption by livestock producers. The Climate Active program has undergone revision and there is recognition in recent reviews and analyses of the ERF of the need for more practical methods covering more land sector activities. Early industry input to development of methods for the LRF and Farm Biodiversity Scheme may avoid the need for similar future revisions. As the largest contributor to agricultural emissions, the ruminant livestock subsector has potential to significantly contribute experience and expertise, and collaboration should be encouraged at industry and individual level. Participating in co-design of new ERF methods with the CER or review of methods drafted by Verra and Gold Standard could help to optimise credits generated for government and private markets and encourage development of methods that are practical and cost-effective for livestock production systems in northern Australia.*

- **Recommendation 3:** The importance of communication and maintaining collaboration and capacity in industry and natural resource management networks should not be overlooked as a way to encourage and support producers to participate in ecosystem services markets.

*Review of methods and their uptake indicated the significance of factors such as diverse landholder goals and motivations, social and cultural risks of participation, and the benefits of knowledge exchange over knowledge transfer in building trust and commitment amongst landholders when developing methods. Considering these factors at the method development stage can enhance participation in ecosystem services markets. Good communication and of maintaining collaboration and capacity in industry and natural resource management networks is fundamental for uptake. The review also pointed to the need for continuous improvement through commitment to active experimentation and learning from experience at farm and program levels during implementation.*

- **Recommendation 4:** Ensure trainers/advisers are able to support market participation by northern livestock producers by supporting access to up-to-date understanding and skills to assist needed to take advantage of carbon and ecosystem services market opportunities. Training of advisers in methods for crediting agricultural or vegetation projects and certification protocols for products as well as market and pricing mechanisms is an ongoing requirement to ensure producers have access to accurate information.

*Choosing and implementing a carbon or ecosystem services crediting method is complex and requires expertise across a range of disciplines, including business management, contracting, data collection and storage, monitoring, reporting and auditing. Service providers with appropriate skills can support registering and implementing projects but trusted farm advisers trained in market mechanisms may be better able to advise producers on the financial and legal aspects of what to do with credits once issued e.g. whether to sell in government or commercial markets or whether to use as offsets for carbon neutral certification.*

- **Recommendation 5:** Communicating the 'sustainability story' and maintaining confidence in verified carbon and co-benefit credits and certified labels.

*Land sector offsets that come with environmental, social and/or cultural co-benefits are generally favoured in international carbon markets. This value is yet to be sufficiently realized in domestic market mechanisms, but there are indications of growing interest based on company board and government commitments. Sustainability*

*claims based on the ERF crediting and integrity standards and on the LRF AfN Standard provide strong credibility for the 'sustainability story' of the offsets generated. If communicated well and more consumers are willing to pay for high quality carbon and ecosystem services offsets verified based on credible standards, income and premium pricing is more likely.*

- **Recommendation 6:** As stewards of large areas of grazing land, the red meat industry and northern Australian producers should seek to fully understand methods and opportunities for vegetation projects that align with farm business goals. Experience has shown that relatively low input cost projects that regenerate native forests or farm forestry plantations on part of extensive grazing properties have the potential to generate income in ecosystem services markets, e.g. for carbon offsets, biodiversity credits and reef credits, while providing multiple benefits on-farm, including climate resilience.

*Beef cattle and sheep producers in Queensland manage large areas of land with potential for strategic forest activities under ERF regeneration, environmental planting or farm forestry vegetation methods able to generate carbon credits with biodiversity or other co-benefits, while supporting livestock production. Analysis using the state's remote sensing capability could identify the most suitable areas to ensure positive impacts on productivity and to provide an indication of the potential volume of credits to inform decisions.*

- **Recommendation 7:** Develop educational and training materials and ensure service providers and farm advisers are equipped to understand red meat industry and producer priorities and regional community and indigenous interests. Most producers will need to engage specialist services in methods and market mechanisms for ecosystem services crediting and pricing and for understanding certification schemes for premium pricing of products. Engaging with these providers will help to ensure producers receive practical, relevant advice.

*Industry and peer leadership is well-positioned to train and support trusted advisers to link carbon and ecosystem services methods and market understanding to livestock production systems. Case study demonstrations with cost-benefit or NPV analysis based on available markets and methods would provide a powerful tool. For example, an ERF regeneration method such as a HIR earning ACCUs and co-benefits estimated with the pilot LRF AfN vegetation method for biodiversity credits integrated into a northern beef production property could demonstrate realistic and independent assessments of obligations, costs and risks before project registration or contracting entering into contracts.*

# References


Aboriginal Carbon Foundation (2019). *Core benefits verification framework: for the environmental, social and cultural values of Aboriginal carbon farming.* Published March 2019, Aboriginal Carbon Foundation, Cairns, Queensland. https://www.qld.gov.au/__data/assets/pdf_file/0018/105750/core-benefits-verification-framework.pdf (accessed April 2020).

ABS (2019). Australian Bureau of Statistics *Value of Agricultural Commodities Produced, Australia, 2017-18*. Commonwealth of Australia, Canberra.

ABSF (2019a). Australian Beef Sustainability Framework *2019 Australian Beef Sustainability Annual Update*. Published by RMAC https://www.sustainableaustralianbeef.com.au/annual-update

ABSF (2019b) Australian Beef Sustainability Framework *Regional change in tree and grass cover* analysis www.sustainableaustralianbeef.com.au/vegetation-trends

Accounting for Nature (2020a). *Audit Rules Version 1.2*. April 2020. Available at: www.accountingfornature.org

Accounting for Nature (2020b). *Standard for Environmental Condition Accounting Version 2.1*. April 2020. Available at: www.accountingfornature.org

AgriFutures Australia (2020). *United Nations sustainable development goals: Telling Australia's rural industries story.* AgriFutures Australia Publication No. 20-055, May 2020.

ALFA/MLA (2020). ALFA / MLA, June 2020, National Accredited Feedlot Survey. https://e4953904-add8-4a29-93de-26cd7ec2bac9.filesusr.com/ugd/f25d7a_4f7cd9760a34405a8f26fd570988d022.pdf

Allen, D.E., Pringle, M.J., Bray, S., Hall, T.J., O'Reagain, P.O., Phelps, D., Cobon, D.H., Bloesch, P.M., Dalal, R.C. (2014). What determines soil organic carbon stocks in the grazing lands of north-eastern Australia? *Soil Research*, 51, 695-706.

Allen, M. R., Shine, K. P., Fuglestvedt, J. S., Millar, R. J., Cain, M., Frame, D. J., Macey, A. H. (2018). A solution to the misrepresentations of $CO_2$-equivalent emissions of short-lived climate pollutants under ambitious mitigation. *Npj Climate and Atmospheric Science*, *1*(1), 1-8.

Anderson K., Valenzuela E. (2020). International agricultural subsidies and their impact on Australian agriculture. Published April 2020, AgriFutures Australia, Canberrra

Aster N. (2020). *Why Airlines Need Carbon Credits*. Published by South Pole 17 Feb 2020; https://www.southpole.com/blog/why-airlines-need-carbon-credits (Accessed March 2020).

BEUC (2020). *One bite at a time: consumers and the transition to sustainable food. Analysis of European consumers on attitudes towards sustainable food.* Published by The European Consumer Organisation (BEUC), June 2020

Blackmore, L., Doole, G.J., 2013. Drivers of landholder participation in tender programs for Australian biodiversity conservation. Environ. Sci. Policy 33, 143–153.

BOM (2019) Bureau of Meteorology: Special Climate Statement 70—drought conditions in eastern Australia and impact on water resources in the Murray–Darling Basin. Commonwealth of Australia Published 29 November 2019. http://www.bom.gov.au/climate/current/statements/scs70.pdf

BOM (2020) Bureau of Meteorology: Special Climate Statement 73—extreme heat and fire weather in December 2019 and January 2020. Commonwealth of Australia Published 17 March 2020.

http://www.bom.gov.au/climate/current/statements/scs73.pdf

Bryan, B.A., Nolan, M., Harwood, T.D., Connor, J.D., Navarro- Garcia, J., King, D., Summers, D.M., Newth, D., Cai, Y., Grigg, N., Harman, I., Crossman, N.D., Grundy, M.J., Finnigan, J.J., Ferrier, S., Williams, K.J., Wilson, K.A., Law, E.A., Hatfield-Dodds, S. (2014). Supply of carbon sequestration and biodiversity services from Australia's agricultural land under global change. Global Environ. Change 28, 166–181, http:// dx.doi.org/10.1016/j.gloenvcha.2014.06.013.

Burgess PJ, Harris J, Graves AR, Deeks LK (2019) Regenerative Agriculture: Identifying the Impact; Enabling the Potential. Report for SYSTEMIQ. 17 May 2019. Bedfordshire, UK: Cranfield University.

Burkhard, B., Kroll, F., Müller, F., & Windhorst, W. (2009). Landscapes' capacities to provide ecosystem services-a concept for land-cover based assessments. *Landscape online*, *15*, 1-22.

Butler, D.W. (2009). Planning iterative investment for landscape restoration: choice of biodiversity indicator makes a difference. Biol. Conserv. 142, 2202–2216.

Butler D. (2020). *Land Restoration Fund (LRF) Native Vegetation Monitoring Method* Accounting for Nature Accredited Method, 15 April 2020. Available at: https://www.accountingfornature.org/methods

Butler D, Thackway R, and Cosier P (2020). Technical Protocol for Constructing Native Vegetation Condition Accounts Version 1.0 - May 2020. Accounting for Nature Limited, Sydney, Australia.

Campagne, C. S., Roche, P., Müller, F., & Burkhard, B. (2020). Ten years of ecosystem services matrix: Review of a (r) evolution. *One Ecosystem*, 5, e51103.

Carwardine, Josie, Charlie Hawkins, Phil Polglase, Hugh P. Possingham, Andrew Reeson, Anna R. Renwick, Matt Watts, and Tara G. Martin (2015). "Spatial priorities for restoring biodiverse carbon forests." *BioScience* 65, 372-382.

CER (2019). *Clean Energy Regulator Statement of opportunities in the ACCU market – March 2019*. Commonwealth of Australia. Published 27 September 2019 http://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-market-updates/statement-of-opportunities-in-the-accu-market-%E2%80%93-march-2019. (Accessed March 2020).

CER (2020a). *Clean Energy Regulator Quarterly Carbon Market Report: March Quarter 2020.* Commonwealth of Australia. http://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/Quarterly-Carbon-Market-Reports.aspx (Accessed May 2020).

CER (2020b). *Guidelines for the eleventh Emissions Reduction Fund auction*, viewed 17 September 2020, http://www.cleanenergyregulator.gov.au/DocumentAssets/Documents/Guidelines%20for%20the%20eleventh%20Emissions%20Reduction%20Fund%20auction.pdf.

CER 2020c, *Auction results*, viewed 21 September 2020, http://www.cleanenergyregulator.gov.au/ERF/Auctions-results.

CER (2020d). *Clean Energy Regulator Quarterly Carbon Market Report: June Quarter 2020.* Commonwealth of Australia.

Climate Change Authority (2020) *Review of the Emissions Reduction Fund October 2020* Commonwealth of Australia (The Climate Change Authority) 2020 https://www.climatechangeauthority.gov.au/sites/default/files/2020-

10/ERF%20Review%20Final%20Report%2020201009.pdf

ClimateWorks (2020a). Decarbonisation Futures: Solutions, actions and benchmarks for a net zero emissions Australia. ClimateWorks Australia March 2020. https://www.climateworksaustralia.org/resource/decarbonisation-futures-solutions-actions-and-benchmarks-for-a-net-zero-emissions-australia/ (Accessed March 2020).

ClimateWorks (2020b). Land Use Futures. https://www.climateworksaustralia.org/project/land-use-futures/ (Accessed September 2020).

CMI (2018). *Carbon Farming Industry Roadmap*. Carbon Market Institute https://www.qld.gov.au/__data/assets/pdf_file/0026/105749/carbon-farming-industry-roadmap.pdf (Accessed March 2020)

Commonwealth of Australia (2018). *Environmental Economic Accounting: A Common National Approach Strategy and Action Plan*. Prepared by the Interjurisdictional Environmental-Economic Accounting Steering Committee for the Meeting of Environment Ministers, Commonwealth of Australia 2018.

Commonwealth of Australia (2020a). National Inventory Report Volumes 1-3, Australian Government Department of Industry, Science, Energy and Resources. (https://www.industry.gov.au/data-and-publications/national-greenhouse-gas-inventory-report-2018) (Accessed March 2020).

Commonwealth of Australia (2020b) *Report of the Expert Panel examining additional sources of low cost abatement*. Department of Industry, Science, Energy and Resources. Published 14 February 2020. (Panel chaired by Grant King; Review referred to as "The King Review")

Commonwealth of Australia (2020c) *Technology Roadmap Discussion Paper*, Australian Government Department of Industry, Science, Energy and Resources, May 2020.

Commonwealth of Australia (2020d) *Technology Investment Roadmap: First Low Emissions Technology Statement*, Australian Government Department of Industry, Science, Energy and Resources, September 2020.

Cooper Energy (2020) Cooper Energy to be carbon neutral in 2020. Media Release 12 October 2020. https://www.cooperenergy.com.au/Upload/Documents/AnnouncementsItem/06-2020.10.12-Cooper-Energy-Carbon-Neutral-Media-Release.pdf

Crowder DW, Reganold JP (2015) Financial competitiveness of organic agriculture on a global scale. PNAS, 112, 7611-7616.

Dasgupta (2020). Interim Report – The Dasgupta Review: Independent Review on the Economics of Biodiversity. www.gov.uk/official-documents (Accessed 6 May 2020).

DEE (2019a) National Inventory Report Volumes 1-3, Australian Government Department of the Environment and Energy, Canberra.

DEE (2019b). *Australian Greenhouse Emissions Information System (AGEIS*. Australian Government Department of the Environment and Energy, Canberra. Available at http://ageis.climatechange.gov.au/UNFCCC.aspx (accessed March 2020).

DEE (2019c) Full Carbon Accounting Model update and transitional options for Emissions Reduction Fund vegetation projects DISCUSSION PAPER November 2019. Australian Government Department of the Environment and Energy, Canberra. https://publications.industry.gov.au/publications/climate-change/system/files/consultations/d875ebe9-ef8c-400c-9430-8c36dd217e39/files/fullcam-update-

discussion-paper.pdf Accessed March 2020.

DEFRA (2020). Department of Environment Food & Rural Affairs *Enabling a Natural Capital Approach: Guidance.* Published March 2020, UK Government © Crown copyright 2020. (Accessed May 2020).

Diffenbaugh, N.S., Field, C.B., Appel, E.A., Azevedo, I.L., Baldocchi, D.D., Burke, M., Burney, J.A., Ciais, P., Davis, S.J., Fiore, A.M. and Fletcher, S.M. (2020). The COVID-19 lockdowns: a window into the Earth System. *Nature Reviews Earth & Environment*, 1-12.

Donofrio, S., Maguire, P., Merry, W., & Zwick, S. (2019). Forest Trends' Ecosystem Marketplace. *Financing Emission Reductions for the Future: State of Voluntary Carbon Markets 2019*. Washington DC: Forest Trends, 2019.

Doran-Browne, N., Wootton, M., Taylor, C., & Eckard, R. (2018). Offsets required to reduce the carbon balance of sheep and beef farms through carbon sequestration in trees and soils. *Animal Production Science*, 58, 1648-1655.

Dumbrell, N. P., Kragt, M. E., & Gibson, F. L. (2016). What carbon farming activities are farmers likely to adopt? A best–worst scaling survey. Land Use Policy, 54, 29-37.

Eady, Sandra. (2017). Greenhouse gas emissions from the cultivation of canola oilseed in Australia. CSIRO Repository: CSIRO; 2017. https://doi.org/10.4225/08/5a3feb2748f36

Energetics (2017). *Unlocking value for the Queensland economy with land and agriculture offsets*. Published 15 September 2017, Energetics, Sydney. https://www.qld.gov.au/__data/assets/pdf_file/0017/67310/unlocking-value-qld-from-offsets.pdf (accessed April 2020).

European Commission. (2016). Guidance for the implementation of the EU Product Environmental Footprint (PEF) during the Environmental Footprint (EF) pilot phase - draft version 5.2.

Evans, M. C., Carwardine, J., Fensham, R. J., Butler, D. W., Wilson, K. A., Possingham, H. P., & Martin, T. G. (2015). Carbon farming via assisted natural regeneration as a cost-effective mechanism for restoring biodiversity in agricultural landscapes. *Environmental Science & Policy*, *50*, 114-129.

Eyre T.J., Kelly A.L. & Neldner V.J. (2017). *Method for the Establishment and Survey of Reference Sites for BioCondition. Version 3.* Queensland Herbarium, Department of Science, Information Technology and Innovation, Brisbane.

FAO (2012). *Livestock and Landscapes.* http://www.fao.org/3/ar591e/ar591e.pdf (accessed April 2020).

FAO (2018). World Livestock: Transforming the Livestock Sector through the Sustainable Development Goals. FAO, Rome, Italy, pp. 222. http://www.fao. org/3/CA1201EN/ca1201en.pdf.

GAIN (2020). *Animal-source Foods for Human and Planetary Health: GAIN's Position*. Global Alliance for Improved Nutrition (GAIN). Briefing Paper Series #2. Geneva, Switzerland, 2020. DOI: https://doi.org/10.36072/bp.2

Gidley-Baird, A. (2020). *Unlocking Climate-Friendly Meat; Supply Chain Initiatives Will Be Key*. RaboResearch, Food & Agribusiness https://research.rabobank.com/far/en/sectors/animal-protein/unlocking-climate-friendly-meat.html Rabobank.

Goedkoop, M., Heijungs, R., Huijbregts, M., Schryver, A. De, Struijs, J., & Zelm, R. Van. (2009). *ReCiPe 2008 A life cycle assessment method which comprises harmonised category indicators at the midpoint and the endpoint level. Report 1 Characterisation*. Den Haag.

Greiner, R., Patterson, L., Miller, O. (2009). Motivations, risk perceptions and adoption of conservation practices by farmers. Agric. Syst. 99, 86–104.

Harrison, M. T., Cullen, B. R., Tomkins, N. W., McSweeney, C., Cohn, P., Eckard, R. J. (2016). The concordance between greenhouse gas emissions, livestock production and profitability of extensive beef farming systems. *Animal Production Science*, *56*(3), 370-384.

Harrison P, Dunford R, Barton D, Kelemen E, Martín-López B, Norton L, Termansen M, Saarikoski H, Hendriks K, Gómez-Baggethun E, Czúcz B, García-Llorente M, Howard D, Jacobs S, Karlsen M, Kopperoinen L, Madsen A, Rusch G, van Eupen M, Verweij P, Smith R, Tuomasjukka D, Zulian G (2017) Selecting methods for ecosystem service assessment: A decision tree approach. *Ecosystem Services* 29: 481-498. https://doi.org/ 10.1016/j.ecoser.2017.09.016

Henry B., Murphy B., Cowie A. (2018). Sustainable Land Management for Environmental Benefits and Food Security. A Synthesis Report for the Global Environment Fund. United Nations Environment Program www.unep.org/ .

Herrero, M., Thornton, P. K., Gerber, P., Reid, R. S. (2009). Livestock, livelihoods and the environment: understanding the trade-offs. Current Opinion in Environmental Sustainability, 1(2), 111-120.

ICIN (2020). *Seeking FPIC from Indigenous Communities for Carbon Projects: A Best Practice Guide*. Paper prepared by Indigenous Carbon Industry Network, 2020. https://a62efcec-3d67-4043-80a5-4dbbe9fe53f1.usrfiles.com/ugd/a62efc_4025ec9b11524ab2ae415882e1f92bbf.pdf Accessed May 2020.

IPCC (Intergovernmental Panel on Climate Change). (2019). Climate Change and Land: an IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial (Summary for Policymakers) ecosystems. IPCC 2019.

IUCN (2016). International Union for the Conservation of Nature *IUCN Policy on Biodiversity Offsets*, www.iucn.org/theme/business-and-biodiversity/our-work/business-approaches-andtools/biodiversity-offsets

Jackson, T., Zammit, K., Hatfield-Dodds, S, (2020). Snapshot of Australian Agriculture 2020, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0. https://doi.org/10.25814/5e3a4ad8f80e7

Jacobs, S., Burkhard, B., Van Daele, T., Staes, J., Schneiders, A. (2015). 'The Matrix Reloaded': A review of expert knowledge use for mapping ecosystem services. *Ecological Modelling*, *295*, 21-30.

Kompas, T., Witte, E., Keegan, M. (2019). Australia's Clean Energy Future: Costs and Benefits, (No. 12). (https://sustainable.unimelb.edu.au/publications/issues-papers/australias-clean-economy)

Knudsen, M. T., Hermansen, J. E., Cederberg, C., Herzog, F., Vale, J., Jeanneret, P., ..., Kainz, M. (2017). Characterization factors for land use impacts on biodiversity in life cycle assessment based on direct measures of plant species richness in European farmland in the 'Temperate Broadleaf and Mixed Forest'biome. *Science of the Total Environment*, *580*, 358-366.

Kragt, M.E., Dumbrell, N.P., Blackmore, L, (2017). Motivations and barriers for Western Australian broadacre farmers to adopt carbon farming. Environ. Sci. Policy 73, 115–123.

Lechner, A. M., Foody, G. M., Boyd, D. S. (2020). Applications in Remote Sensing to Forest Ecology and Management. *One Earth*, *2*(5), 405-412.

Legaz, B. V., De Souza, D. M., Teixeira, R. F. M., Antón, A., Putman, B., Sala, S. (2017). Soil quality, properties, and functions in life cycle assessment: an evaluation of models. *Journal of cleaner production*, *140*, 502-515.

Liu X, Zhang B, Henry B, Zhang J, Grace P. (2017). Assessing the impact of historical and future climate change on potential natural vegetation types and net primary productivity in Australian grazing lands. The Rangeland Journal 39, 387-400.

Lynch, J., Cain, M., Pierrehumbert, R., Allen, M. (2020). Demonstrating GWP*: a means of reporting warming-equivalent emissions that captures the contrasting impacts of short-and long-lived climate pollutants. *Environmental Research Letters*, *15*(4), 044023.

Macintosh, A., 2013. The Carbon Farming Initiative: removing the obstacles to its success. Carbon Management 4, 185-202.

Macintosh Andrew, Roberts Geoff and Buchan Sarah (2019). Improving carbon markets to increase farmer participation. AgriFutures Australia Publication No. 19-026. Commonwealth of Australia July 2019. (www.agrifutures.com.au) (Accessed January 2020).

Mayberry, D., Bartlett, H., Moss, J., Davison, T., Herrero, M. (2019). Pathways to carbon-neutrality for the Australian red meat sector. *Agricultural Systems*, *175*, 13-21.

Mayberry Dianne, Bartlett Harriet, Moss Jonathan, Wiedemann Stephen, Herrero Mario (2018). Greenhouse Gas mitigation potential of the Australian red meat production and processing sectors. Report for MLA Project B.CCH.7714, 3 May 2018. www.mla.com.au

McKeon G.M., Hall W.B., Henry B.K., Stone G.S. and Watson I.W. (2004). *Pasture degradation and recovery in Australia's rangelands: Learning from History.* NRSc publishing, Queensland Natural Resources, Mines & Energy.

Millennium Ecosystem Assessment. (2005). *Millennium Ecosystem Assessment Program Ecosystems and human well-being*. Washington, D.C: Island Press.

MLA (2015). More meat, milk and wool: less methane. MLA. https://publications.mla.com.au/login/redirectFrame

MLA (2019). *2019 State of the Industry Report: The Australian Red Meat and Livestock Industry.* https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/soti-report/mla-state-of-industry-report-2019.pdf

MLA (2020a). Industry Projections 2020: Australian cattle – April update (www.mla.com).

MLA (2020b). *Strategic Plan 2025*. Meat & Livestock Australia, Sydney, June 2020. https://www.mla.com.au/globalassets/mla-corporate/about-mla/documents/planning--reporting/Strategic-Plan-2025.pdf

MLA (2020c). *Market Snapshot Beef and sheepmeat – North America.* https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/os-markets/red-meat-market-snapshots/2020/north-america_2020-mla-mi-snapshot-28092020_distribution.pdf

Murray J. S. (2020). 'The world is ready': Campaigners and academics call on government to scale up Nature Based Solutions. 6 May 2020. https://www.businessgreen.com/news/4014868/world-ready-campaigners-academics-government-scale-nature-solutions?utm_source=CP+Daily&utm_campaign=4304b2d543-CPdaily06052020&utm_medium=email&utm_term=0_a9d8834f72-4304b2d543-110249429

MSSI Issues Paper 12, Melbourne Sustainable Society Institute, The University of Melbourne.

Newell, R. G., Pizer, W. A., & Raimi, D. (2013). Carbon markets 15 years after Kyoto: Lessons learned, new challenges. Journal of Economic Perspectives, 27, 123-46.

NFF (2019). National Farmers Federation, 2030 Roadmap – Australian Agriculture's Plan for a $100 billion Industry, viewed 13 December 2019 from https://www.nff.org.au/get/news/6187-0.pdf

OECD/FAO (2020). *OECD-FAO Agricultural Outlook 2020-2029*, FAO, Rome/OECD Publishing, Paris, https://doi.org/10.1787/1112c23b-en

O'Reagain, P. J., Bushelle, J., Pahl, L., Scanlan, J. C. (2018). *Wambiana grazing trial Phase 3: stocking strategies for improving carrying capacity, land condition and biodiversity outcomes*. Project B.ERM.0107 Report to Meat & Livestock Australia http://era.daf.qld.gov.au/id/eprint/6338/1/B.ERM.0107_Final_Report.pdf

Page, G., & Bellotti, B. (2015). Farmers value on-farm ecosystem services as important, but what are the impediments to participation in PES schemes? Science of the total environment, 515, 12-19.

Payen, S., Ledgard, S. F. (2017). Aquatic eutrophication indicators in LCA: Methodological challenges illustrated using a case study in New Zealand. *Journal of Cleaner Production*, *168*, 1463-1472.

Queensland Government (2011). *Managing grazing lands in Queensland*. Queensland Department of Environment and Resource Management 2011. https://www.qld.gov.au/__data/assets/pdf_file/0033/67488/managing-grazing-lands-in-qld.pdf

Queensland Government (2019). A review of Queensland's environmental offsets framework a discussion paper. Published by the State of Queensland, February 2019. https://www.qld.gov.au/__data/assets/pdf_file/0018/94131/qld-enviro-offsets-framework-discuss-paper.pdf

Queensland Government (2020). Land Restoration Fund Co-benefits Standard. Queensland Government, January 2020. https://www.qld.gov.au/__data/assets/pdf_file/0025/116548/lrf-co-benefits-standard-exposure.pdf (Accessed May 2020).

RMAC (2020). *Red Meat 2030*. Red Meat Advisory Council, Sydney. 2020. http://rmac.com.au/misp2030-staging/wp-content/uploads/2019/10/RedMeat2030.pdf

Reputex Energy (2020). *The Australian carbon price & net-zero emissions: Where to under the Paris Agreement?* (Webinar, March 2020)

Sanderman J, Farquharson R, Baldock JA. (2010). Soil carbon sequestration potential: a review for Australian agriculture. A report to the Australian Department of Climate Change and Energy Efficiency. CSIRO, Urrbrae. Available at: https://www.csiro.au/resources/Soil-Carbon-Sequestration-Potential-Report.html

Sevenster, M., Luo, Z., Eady, S., Grant, T. (2019). Including long-term soil organic carbon changes in life cycle assessment of agricultural products. *The International Journal of Life Cycle Assessment*, 1-11.

Simmonds JS, Sonter LJ, Watson JE, Bennun L, Costa HM, Dutson G, Edwards S, Grantham H, Griffiths VF, Jones JP, Kiesecker J. Moving from biodiversity offsets to a target-based approach for ecological compensation. Conservation Letters. 2019 Dec 9: e12695.

Smith, J., 2017. The role of livestock in development countries: misperceptions, facts and consequences. Presentation at Workshop on Extinction and Livestock: Moving to a Flourishing Food

System for Wildlife, Farm Animals, and Us. October 5-6, London, UK, https://www.slideshare.net/ILRI/extinction-livestock-smithoct17.

State of Queensland (2018). *Reef 2050 Water Quality Improvement Plan 2017 – 2022.* https://www.reefplan.qld.gov.au/__data/assets/pdf_file/0017/46115/reef-2050-water-quality-improvement-plan-2017-22.pdf (Accessed March 2020).

Taylor, B. M., & Eberhard, R. (2020). Practice change, participation and policy settings: A review of social and institutional conditions influencing water quality outcomes in the Great Barrier Reef. *Ocean & Coastal Management*, *190*, 105156.

Teixeira, R. F., de Souza, D. M., Curran, M. P., Antón, A., Michelsen, O., i Canals, L. M. (2016). Towards consensus on land use impacts on biodiversity in LCA: UNEP/SETAC Life Cycle Initiative preliminary recommendations based on expert contributions. *Journal of Cleaner Production*, *112*, 4283-4287.

UECBV (2019). *Footprint Category Rules for Red Meat (FCR RED MEAT).* Rev. Version 1.1 (1/2020) July 2019. http://www.uecbv.eu/UECBV/documents/FootprintCategoryRulesRedMeat16661.pdf

UN DESA (2019). United Nations Department of Economics and Social Affairs, June 2019. *World Population Prospects 2019.* https://www.un.org/development/desa/en/news/population/world-population-prospects-2019.html

UN Statistics Division (2018). The Sustainable Development Goals Report 2018. Retrieved from. (https://unstats.un.org/sdgs/report/2018/overview/).

UN (2012). United Nations, European Commission, Food and Agriculture Organisation, International Monetary Fund, Organisation of Economic Co-operation and Development, World Bank *System of Environmental-Economic Accounting: Central Framework.*

UNGC (2020). United Nations Global Compact *Uniting Businesses and Governments to Recover Better - In a time of global disruption, ambitious climate action is as urgent as ever*. Statement 25 May 2020. https://ungc-communications-assets.s3.amazonaws.com/docs/publications/recover-better-statement.pdf (Accessed 26 May 2020).

van Oosterzee, P., Liu, H., Preece, N. D. (2020). Cost benefits of forest restoration in a tropical grazing landscape: Thiaki rainforest restoration project. *Global Environmental Change*, *63*, 1-6.

Varney, R.M., Chadburn, S.E., Friedlingstein, P. *et al.* (2020). A spatial emergent constraint on the sensitivity of soil carbon turnover to global warming. *Nat Commun* 11**,** 5544. https://doi.org/10.1038/s41467-020-19208-8

von Unger, M. Emmer, I. (2018). Carbon Market Incentives to Conserve, Restore and Enhance Soil Carbon. Silvestrum and The Nature Conservancy, Arlington, VA, USA. (https://www.nature.org/en-us/what-we-do/our-insights/perspectives/carbon-market-incentives-to-conserve-restore-enhance-soil-carbon/)

Wentworth Group of Concerned Scientists (2016). *Accounting for Nature: A scientific method for constructing environmental asset condition accounts*. Published November 2019, Wentworth Group of Concerned Scientists, Sydney. https://wentworthgroup.org/wp-content/uploads/2017/07/Wentworth-Group-2016-Accounting-for-Nature.pdf (accessed April 2020).

Wiedemann S., Henry B.K., McGahan E., Grant T., Murphy C., Niethe G. (2015a). Resource use and greenhouse gas intensity of Australian beef production: 1981 to 2010. Agricultural Systems 133: 109-

118.

Wiedemann S., Ledgard S., Henry B.K., Yan M., Mao N., Russell S.J. (2015b) Application of life cycle assessment to sheep production systems: Investigating co-production of wool and meat using case studies from major global producers. *Int J LCA* 20: 463-476.

Willett, Walter, Johan Rockström, Brent Loken, Marco Springmann, Tim Lang, Sonja Vermeulen, Tara Garnett et al. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* 393, no. 10170 (2019): 447-492.

World Bank Group. 2019. State and Trends of Carbon Pricing 2019. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/31755 License: CC BY 3.0 IGO.

World Bank Group. (2020). "State and Trends of Carbon Pricing 2020" (May), World Bank, Washington, DC. Doi: 10.1596/978-1-4648-1586-7.

# Appendices
## Appendix 1. Glossary

*This glossary has drawn on, and adapted, a number of other glossaries including but not restricted to as primary sources: Department of Environment and Energy; Clean Energy Regulator; United Nations Framework Convention on Climate Change; UN's The Economics of Ecosystems and Biodiversity.*

Biodiversity – the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD), i.e. biodiversity is the variety of life in all its forms, and at all levels including genes, species, and ecosystems.

Biomass – the mass of non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms in a given area or volume.

Biophysical environment – The biotic and abiotic surroundings of a population

Biosphere – The combination of all the ecosystems in the world, the living organisms within them and the spaces they occupy, including on part of the Earth's crust (the lithosphere), in the oceans (the hydrosphere) and in the atmosphere.

Carbon – The word "carbon" may refer to the element carbon or to a group of compounds containing carbon. The context within which the word carbon is used will determine which definition is appropriate.

Carbon credit – a unit, commonly 1 tonne CO2-e, of reduction in emissions, or increase in sequestration, relative to a baseline measure.

Carbon dioxide equivalents (CO2-e) – expresses the warming effect of different greenhouse gases as an equivalent amount of carbon dioxide. It is the amount of carbon dioxide that would give the same warming effect as each greenhouse gas that is emitted or stored by an activity.

Carbon farming – land- based practices that either avoid or reduce the release of greenhouse gas emissions, or actively sequester carbon in vegetation and soils, primarily in agricultural landscapes.

Carbon Market - defined framework for the exchange of carbon units, representing greenhouse gas emissions reductions or removals.

Carbon sequestration – The process of transferring carbon dioxide from the atmosphere into plant biomass or, through plant residues and other organic materials, into the soil. The carbon must be stored or retained as organic carbon with a long mean residence time so that it is not re-emitted back into the atmosphere.

Carbon Offset – A carbon credit from a project that reduces emissions or increases removals through carbon sequestration eligible to be used as an offset for emissions from another source for meeting a compliance or voluntary commitment.

Climate change – As defined in Article 1 of the United Nations Framework Convention on Climate Change, "a change of climate which is attributed directly or indirectly to human activity that alters

the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

Cost-Benefit Analysis – Quantification in monetary terms of all possible costs and benefits of a proposal, including those that do not have substantive market values attached to them

Ecosystem – A dynamic complex of living things (animals, plants and micro-organisms) and their physical environment interacting as a functional unit

Ecosystem services – Functions of the natural environment, that directly or indirectly provide benefits for people

Environmental plantings – a mixture of locally indigenous tree and shrub species that are planted or seeded on cleared land, and are not normally harvested

Natural capital – Stock of natural assets which provide benefits to people in the form of tangible things which are typically marketed (such as timber, fish stocks, minerals) and less tangible services (such as air purification, recreational settings and flood prevention)

Provisioning services – The products obtained from ecosystems for example, genetic resources, food and fibre, and fresh water

Regulating services – The benefits obtained from the regulation of ecosystem processes, for example, the regulation of climate, water, air quality, human diseases and erosion control

Resilience – The magnitude of disturbance that an ecosystem or society can undergo without crossing a threshold to a situation with different structure or outputs i.e. a different state. Resilience depends on factors such as ecological dynamics as well as the organisational and institutional capacity to understand, manage, and respond to these dynamics.

Social costs and benefits – The total costs and benefits of an action to society – including private costs/benefits to individuals as well as additional costs/benefits to society as a whole

Soil carbon stock the mass of soil carbon per ha, which is calculated from the concentration and the soil bulk density and reported as tonnes/ha or kg/m2 to a specified depth, most often 30 cm to comply with reporting requirements under international rules for national greenhouse gas inventories.

Soil organic carbon (SOC) A measure of carbon contained within soil organic matter, defined as the organic fraction of the soil ground to <2 mm and excluding >2 mm plant and/or animal residues.

Soil natural capital  Soil's stock of natural assets yielding a flow of either natural resources or ecosystem services.  Value can be assigned to the soil natural capital by quantifying the ecosystem services it provides.

Species diversity – Biodiversity at the species level, combining aspects of species richness, relative abundance, and dissimilarity

Supporting services – Ecosystem services that are necessary for the production and maintenance of all other ecosystem services. For example, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat. These services often reflect the function and condition of natural

capital stock

Sustainability – Meeting the needs of the existing population without compromising the ability of future generations to meet their own needs

Use value – Value derived from using or having the potential to use a resource. This is the net sum of direct use values, indirect use values and option values

# Appendix 2. Note on accounting for short-lived greenhouse gases

IPCC Guidelines for greenhouse gas accounting have been developed as a consensus document of leading experts specialising in the wide range of scientific disciplines needed to understand climate science and estimate sectoral emissions (https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/). The guidance enables parties to the UNFCCC to estimate and report national emissions and inform policies on addressing the threat of dangerous climate change. Periodic updates reflect new research and knowledge, with the most recent being the 2019 refinement of the 2006 IPCC Guidelines. A metric, the Global Warming Potential (GWP), was adopted by the IPCC to allow different greenhouse gases to be combined and for comparisons of global warming impact which depends on the radiative efficiency of each gas and how long it stays in the atmosphere. GWP is a measure of how much energy the emissions of 1 tonne of a gas will absorb over a given period of time, relative to the emissions of 1 ton of CO2. The time period used in national inventories for GWPs is 100 years ($GWP_{100}$). $CO_2$, by definition, has a GWP of 1 regardless of the time period used, while, over 100 years methane ($CH_4$) has a GWP of 28 – 36 and nitrous oxide ($N_2O$) of 265 – 298. Whereas $CO_2$ stays in the atmosphere for centuries and $N_2O$ for more than 100 years on average, methane lasts only 10 to 12 years, on average.

Research and debate have been growing over several years on how to better represent short-lived greenhouse gases in emissions reporting and climate change policies and programs than using $GWP_{100}$ which many believe does not fairly represent the contribution of emissions from ruminant methane emissions to global warming. This short summary of the complex issue of equivalence metrics is included in this Appendix to acknowledge the importance of the debate. However, the debate is not key to understanding opportunities and barriers for the red meat industry or farmers wishing to realise benefits from carbon credits, which is the focus of the review.

An alternative to $GWP_{100}$, GWP*, has been proposed to better reflect the climate impact of gases such as methane (Allen et al. 2018, Lynch et al. 2020). GWP* aims to more clearly quantifying the amount of climate change resulting from emission scenarios for greenhouse gases with different atmospheric lifetimes. It also seeks to more accurately quantify the effect of different emission pathways on future temperature change and therefore the relative importance of alternative mitigation activities. This is useful for purposes such as policy assessments such as NDCs under the Paris Agreement.

In comparison to pulse-based emissions metrics such as the standard GWP, using GWP* indicates there should not be strong pressure to reduce livestock numbers or reduce red meat consumption for climate change benefits. Leading climate experts continue to debate the choice of metrics for comparing production systems that give rise to emissions of different greenhouse gases and for informing policy, and the technical arguments will not be discussed in detail in this review. Rather it focuses on market mechanisms for ecosystems services. Decisions such as use of GWP* vs $GWP_{100}$ in methods accounting for carbon credits will be made according to the purpose of the market mechanism. Different metrics may have complementary roles in providing more accurate understanding of climate change and fairer more beneficial climate policy, but this is yet to be fully resolved.

# Appendix 3. Emissions Reduction Fund Offset Integrity Standards

The Offsets Integrity Standards[35]

**A2.1 Additionality**

The additionality standard is contained in paragraph 133(1)(a), which states:

> *The application of:*
>
> *(i) the requirements set out in; and*
>
> *(ii) the method specified in, or ascertained in accordance with;*
>
> *a methodology determination, in relation to projects of the kind specified in the determination, should result in carbon abatement that is unlikely to occur in the ordinary course of events (disregarding the effect of this Act).*

'Carbon abatement' is defined for these purposes as:

*(a) The removal of one or more greenhouse gases from the atmosphere; or*

*(b) The avoidance of emissions of one or more greenhouse gases from the atmosphere.*

The Committee interprets this standard as requiring the substantial majority of the abatement likely to be credited under the method would not occur in the absence of the incentive provided by the scheme.

In applying this standard, the Committee's general approach is to apply two tests:

- a project test, which looks at whether the activities covered by the method would occur in the absence of the incentive provided by the scheme; and
- a baseline test, which looks at what the net emission outcomes would be if the activities were not undertaken.

This two-stage approach promotes a structured evaluation of the additionality risks associated with the method and the mechanisms in the method, Act and accompanying legislative instruments for addressing them.

Methods can use a number of mechanisms to reduce additionality risks, including eligibility requirements and baselines. In addition to the mechanisms in the method, section 27 of the Act contains three project-level additionality requirements that must be satisfied for projects to be registered:

- the newness requirement – the project must not have begun to be implemented;
- the regulatory additionality requirement – the project must not be required to be carried out by or under a law of the Commonwealth, a State or a Territory; and

[35] This discussion of the offsets integrity standards is drawn from ERAC (2019) "Information Paper: Committee considerations for interpreting the Emissions Reduction Fund's Offsets Integrity" available from the Department of Industry, Science, Energy and Resources: https://publications.industry.gov.au/publications/climate-change/system/files/resources/fb21a1e1-1692-4f74-b71b-9bfcfddc6f85/files/erac-offset-integrity-standards-paper.pdf

- the government program requirement – the project must not be likely to be carried out under another Commonwealth, State or Territory government program or scheme in the absence of the project being eligible and earning credits under the Act.

These three standard project-level additionality requirements can be displaced by 'in lieu requirements' contained in the methods and legislative rules. Any in lieu requirements must be considered by the Committee in its assessment of the method. For example, if the Committee is aware that an activity in a proposed method would be funded by a government program that is not listed in the legislative rules, it may decide the method does not satisfy the additionality standard.

In applying the project test, the Committee's general approach is to consider:

- whether and to what extent potential eligible projects under the method are already required to be carried out by or under a law of the Commonwealth, a State or a Territory;
- whether and to what extent projects that are eligible under the method are likely to be financially viable without the incentive provided by the scheme;
- whether projects that are eligible under the method are likely to be financially viable without the incentive provided by the scheme;
- whether and to what extent there are relevant alternatives to the project activities that are likely to generate higher financial returns but result in more emissions or less carbon sequestration;
- whether and to what extent there are any non-financial barriers that might obstruct the projects from being undertaken, which the incentive provided by the scheme can help overcome; and
- whether the project activities are common practice in the relevant industry or region.

The Committee generally considers these issues at the point of time of the assessment[36]. For example, are eligible projects *currently* required to be carried out by applicable laws, and are they financially viable under *current* market conditions? In addition, the Committee may also consider the situation in the foreseeable future. For example, the Committee may have regard to information about the likelihood of the introduction of new technology that could significantly alter the financial viability of eligible activities.

In applying the baseline test, the Committee generally considers whether the baseline level of net emissions, which is used to determine the abatement credited under the method, accurately reflects the likely level of net emissions from within the project boundary over the crediting period in the absence of the incentive provided by the scheme. The application of this test typically requires the Committee to consider whether relevant abatement activities would be undertaken over the crediting period under business-as-usual conditions, not merely whether projects are likely to be additional at the time of registration.

The Committee is aware that, for sequestration projects to give rise to climate benefits that are

[36] Under the Act, the Committee's function include monitoring the compliance of methods with the offsets integrity standards and to undertake reviews of methods.

equivalent to those associated with emissions avoidance projects, they must be additional for all time. For example, if a sequestration project would have been undertaken in 50 years without the incentive provided by the scheme, and the project sequesters 1,000 tonnes of carbon dioxide in vegetation and soils, the climate benefit associated with bringing the project forward 50 years is not the same as avoiding 1,000 tonnes of carbon dioxide from an emissions avoidance project. Notwithstanding this, the Committee does not believe the additionality standard was intended to be interpreted as requiring the Committee to be satisfied the substantial majority of projects under sequestration methods would not occur at any time, now or in the future, without the incentive provided by the scheme. The Act evidences a clear intent on behalf of the Parliament to incentivise sequestration projects, provided the abatement from these projects can be used to meet Australia's mitigation targets. Due to this, in applying the additionality standard to sequestration methods, the Committee generally considers whether the events that give rise to the relevant sequestration are likely to occur now or in the foreseeable future in the absence of the incentive provided by the scheme rather than whether they will ever occur without the incentive. The relevant sequestration events need not be the product of direct human-invention. Climate or other natural changes can prompt relevant increases and decreases in vegetation and soil carbon stocks.

**A2.2 Measurable and verifiable**

The measurable and verifiable standard is contained in paragraph 133(1)(b), which states:

> *to the extent to which a method specified in, or ascertained in accordance with, a methodology determination in accordance with paragraph 106(1)(c) involves ascertaining any of the following:*
>
> *(i) the removal of one or more greenhouse gases from the atmosphere;*
>
> *(ii) the reduction of emissions of one or more greenhouse gases into the atmosphere;*
>
> *(iii) the emission of one or more greenhouse gases into the atmosphere;*
>
> *the removal, reduction or emission, as the case may be, should be:*
>
> *(iv) measurable; and*
>
> *(v) capable of being verified.*

The Committee interprets this standard as requiring three things:

- all removals, emissions reductions and project emissions (emissions within the project boundary caused by undertaking the project) associated with eligible projects must be able to be measured or estimated, and those measurements and estimates must be able to be verified;
- the method must contain a rigorous and reliable way of measuring or estimating relevant removals, emission reductions and project emissions; and
- the method must provide a robust approach to verifying relevant measurements and estimates.

In assessing these issues, the Committee generally considers the following factors.

- How emissions and emissions reductions are calculated in the method. Emissions reduction calculations may be achieved by a number of means including: direct measurement;

calculating through models; comparing the project emissions with a control group; or using emissions code ratings developed by industry.

- Whether there is sufficient evidence the preferred measurement or estimation approach is a robust technique. Evidence needs to demonstrate how the preferred measurement or estimation approach accounts for the removal, reduction or emission of greenhouse gases.
- Whether the measurement or estimation approach sufficiently controls for the impacts of factors unrelated to the project on relevant removals and emissions.
- How verification is achieved in the method. For example, verification may be achieved through audits, models, self-verification, satellite imagery or other measurement technologies.
- Whether and how any tools or calculators used in the method can be audited.
- Variability in measurement and verification outcomes.
- The interaction of the measurement and verification standard with:
    - the evidence-based standard – the measurement or estimation approaches must be supported by clear and convincing evidence;
    - the project emissions standard – methods do not need to account for project emissions if they are not material; and
    - the conservative standard – the measurement or estimation approaches must provide conservative estimates of the abatement from eligible projects.

### A2.3 Eligible carbon abatement

The eligible carbon abatement standard is contained in paragraph 133(1)(c), which states:

> *a method specified in, or ascertained in accordance with, a methodology determination in accordance with paragraph 106(1)(c) should provide that carbon abatement used in ascertaining the carbon dioxide equivalent net abatement amount for a project must be eligible carbon abatement from the project.*

'Eligible carbon abatement' is defined for these purposes as:

> *… carbon abatement that:*
> *(a) results from the carrying out of the project; and*
> *(b) is able to be used to meet Australia's climate change targets under:*
> *(i)the Kyoto Protocol; or*
> *(i)an international agreement (if any) that is the successor (whether immediate or otherwise) to the* Kyoto Protocol.

The Committee interprets the eligible carbon abatement standard as requiring the method to only credit abatement that:

- results from the project; and
- is capable of being used to meet Australia's mitigation targets under the Kyoto Protocol and Paris Agreement.

When first made, the offsets integrity standards required that methods 'not be inconsistent with the

methods set out in the National Inventory Report'.[37] This form of wording implies there should be a degree of consistency between the methods used in the National Inventory Report to report on emissions and removals from particular sectors, and the methods that credit abatement from the same sectors under the Fund. The wording of the current eligible carbon abatement standard is less restrictive. On its face, it merely requires the relevant carbon abatement to be able to be used to meet Australia's international mitigation targets.

The standard should be interpreted in a manner that best promotes the objects of the Act, which include helping Australia to meet its international mitigation obligations. The issuance of credits to abatement that is not included in Australia's National Inventory Report does not help Australia to meet these obligations. Due to this, the Committee interprets the standard as requiring the abatement credited under the Fund's methods to be from sources and sinks that are accounted for by Australia under the Kyoto Protocol and Paris Agreement. However, the Committee does not require methods to use approaches that are consistent, or even 'not inconsistent', with those contained in the National Inventory Report. The methods contained in the National Inventory Report are designed to estimate emissions and removals at a national scale, while methods are designed to estimate abatement at a project-scale. The differences in focus and scale necessitate different approaches. The Committee is of the view that the standard only requires the abatement to be from sources and sinks that are accounted for by Australia under the Kyoto Protocol and Paris Agreement and that is capable of being used to meet Australia's mitigation targets.

A potential source of ambiguity in the standard concerns situations where Australia formally accounts for emissions or removals from a particular sector but, in practice, the relevant emissions and removals are not (or are only partially) accounted for in the National Inventory Report. Gaps in the coverage of emissions and removals can occur because of the complexity of national-level reporting, and the evolving nature of the methods in the National Inventory Report (i.e. they are constantly updated and improved). The Committee does not believe the eligible carbon abatement standard requires the National Inventory Report to account for the relevant emissions or removals covered by the method. All that is required is that the abatement must be capable of being used to meet Australia's mitigation targets under the Kyoto Protocol and Paris Agreement.

The Act requires one of the members of the Committee to be from the Department. Under section 123C, if the Departmental member advises that the carbon abatement under a proposed method or variation is not (or would not be) eligible carbon abatement, the Committee must assume the method does not satisfy the eligible carbon abatement standard.

**Method example – Soil Carbon Sequestration in Agricultural Systems**

The soil carbon method allows landholders to earn carbon credits for undertaking land management activities that increase the amount of carbon stored in soil under pastures or cropland. This occurs when management practices either increase the amount of biomass (such as plant material) that is incorporated into the soil and/or reduce the amount of organic matter that is released from soils (for example, by reducing soil disturbance).

[37] *Carbon Credits (Carbon Farming Initiative) Act 2011*, s 133(1)(c) as at 15 September 2011.

In 2013, the Government elected to account for cropland and grazing land management activities under the second commitment period of the Kyoto Protocol. Subsequently, emissions reductions achieved under this method can be counted towards Australia's emissions reduction targets.

### A2.4 Evidence-based

The evidence-based standard is contained in paragraph 133(1)(d) of the Act, which states:

> *a method specified in, or ascertained in accordance with, a methodology determination in accordance with paragraph 106(1)(c) should be supported by clear and convincing evidence.*

The Committee interprets this standard as requiring there to be clear and convincing evidence of:

- the impact of the abatement activity on emissions and removals (the activity incentivised under the method must be capable of reducing emissions or increasing removals relative to what would have occurred without the incentive provided by the scheme);
- the robustness of the approach to the exclusion of non-additional projects and non-additional abatement;
- the robustness of the approach to measurement and verification; and
- the robustness of the approach to the treatment of project emissions and leakage (see below).

The application of the evidence-based standard to additionality issues, which involve counterfactuals, is problematic because, by their very nature, counterfactuals cannot be proven or disproven. There can be no clear and convincing evidence of the validity or accuracy of a counterfactual, only a judgment of whether it is reasonable. Due to this, when applying the standard to questions concerning the additionality of projects and abatement under methods, the Committee seeks to ensure the approaches adopted are robust, having regard to what is known about the trends and drivers of emissions and removals from the relevant sources and sinks.

Developing methods based on high quality evidence is essential for the integrity of the Fund. In developing methods, the Department draws from a range of sources and engages with experts including from industry and academia. It also commissions independent technical experts to test the technical accuracy of methods.

The Committee undertakes public consultation on draft methods. This ensures members of the public have an opportunity to evaluate and comment on methods.

The nature of scientific progress means evidence will change over time. This means assumptions made when a method was developed may become outdated. To address this concern, the Committee undertakes regular reviews of methods to ensure they continue to meet this standard. A number of methods have been varied since the scheme's inception to incorporate new knowledge and updates in scientific evidence.

In applying the evidence-based standard, the Committee generally considers the following factors.

- The sources of evidence used to build assumptions and calculations in a method. Evidence may include peer-reviewed literature, industry publications, government publications,

business documents from Australia or internationally.

- If there is variability or tension between evidence sources and how accepted the evidence is in the relevant scientific community.
- Whether the balance between modelled and directly measuring emissions estimates is appropriate and supported by evidence.
- The feedback received from technical experts, industry or through public submissions.

### A2.5 Project emissions

The project emissions standard is contained in paragraph 133(1)(e) of the Act, which states:

> *a method specified in, or ascertained in accordance with, a methodology determination in accordance with paragraph 106(1)(c) should provide that, in ascertaining the carbon dioxide equivalent net abatement amount for a project, there is to be a deduction of the carbon dioxide equivalent of any amounts of greenhouse gases that:*
>
> > *(i) are emitted as a direct consequence of carrying out the project; and*
> >
> > *(ii) under the determination, are taken to be material amounts.*

Project emissions refer to increases in emissions within the project boundary that occur as a consequence of undertaking the relevant abatement activity. For example, a project designed to capture and combust methane from livestock manure may require a diesel generator to operate fans and other related equipment. The operation of the generator would not have occurred in the absence of the project and will give rise to project emissions that offset the climate benefits associated with the destruction of the methane.

Leakage refers to increases in emissions or reductions in removals that occur outside the project boundary as a consequence of the project activity. Leakage comes in two forms: direct and indirect.

Direct leakage, also known as activity shifting, refers to instances where the project proponent physically moves the emitting activity to another location, outside the project boundary, while claiming credits for the reduction in emissions inside the project boundary.

Indirect leakage refers to instances where the benefits of the abatement within the project boundary are negated by market-induced increases in emissions or reductions in removals outside of the project boundary. For example, in an offset project involving reforestation of grazing land, indirect leakage could involve an increase in deforestation triggered by higher meat prices that arise from the loss of grazing land and associated reduction in meat production.

The Committee interprets the project emissions standard as requiring methods to contain appropriate deductions for all material project emissions. Deductions are considered appropriate if project emissions are required to be estimated in a robust manner that is supported by clear and convincing evidence (i.e. in a manner consistent with the measurable and verifiable standard and evidence-based standard). The estimates of project emissions that provide the basis for deductions also have to result in net abatement being conservative, which in this context means erring on the high side (i.e. likely

to over-estimate rather than under-estimate the project emissions, consistent with the conservative standard).

The Committee considers project emissions to be material if, cumulatively, they are likely to exceed five per cent of the net abatement amount of projects taken under the method.

The Committee does not believe the standard requires deductions to be made for either direct or indirect leakage as they do not occur as a 'direct consequence of carrying out the project'. Direct leakage arises as a consequence of non-project activities. Similarly, indirect leakage arises as a consequence of the interaction of a number of direct and indirect factors, many of which lie outside of the control of the project proponent. While leakage emissions are not covered by this standard, the Committee considers them in the context of the conservative standard.

The Committee prefers deductions for project emissions to be done on a net basis; that is, calculated having regard to what the relevant emissions would have been in the baseline case without the project activity. However, methods that do not calculate project emissions on a net basis will not necessarily fail to meet the standard.

**A2.6 Conservative**

The conservative standard is contained in paragraph 133(1)(g) of the Act, which states:

> *to the extent to which a method specified in, or ascertained in accordance with, a methodology determination in accordance with paragraph 106(1)(c) involves an estimate, projection or assumption—the estimate, projection or assumption should be conservative.*

The Committee interprets this standard as requiring all estimates, projections and assumptions that have an influence on the calculation of the net abatement amount of eligible projects to be conservative. Conservative in this context means estimates, projects and assumptions that are cautious and likely to avoid the over-estimation of the abatement from projects taken under the method.

This standard must be interpreted in a way that best promotes the objects of the Act to incentivise offset projects that help meet Australia's international mitigation targets. Requiring every estimate, projection and assumption in a method to be conservative, in the sense of having a high probability of being an under-estimate, would lead to highly conservative estimates of the net abatement amount from eligible projects. This would undermine the incentive for people to undertake offset projects.

Due to this, the Committee does not require every estimate, projection and assumption to be conservative in the sense of having a high probability of being an under-estimate. How conservative each estimate, projection and assumption is required to be is interpreted in the context of the method, with the intent of ensuring the cumulative impact of all relevant estimates, projections and assumptions is to provide a conservative estimate of the net abatement amount.

Having said this, the Committee is mindful of the need to do justice to the term 'conservative'. The fact that the application of the method is likely to under-estimate the net abatement amount does not mean individual estimates, projections and assumptions can be overestimates. Each individual

estimate, projection and assumption must at least have a reasonable probability of being an underestimate (other than in relation to deductions, where they should be likely to be overestimates).

Like all of the standards, the conservative standard is applied at the method-level. Methods must be likely to provide a conservative estimate of the net abatement amount of most projects taken under the method. If methods are likely to overestimate the abatement from some projects, across all projects likely to be initiated under the method, the method must be likely to underestimate the aggregate net abatement amount. Similarly, in relation to each individual estimate, projection and assumption, while they may constitute an overestimate in relation to some projects, they must at least have a reasonable probability of being an underestimate for most projects likely to be taken under the method.

In applying the standard, the Committee may consider explicit and implicit estimates, projections and assumptions. The fact that a method does not explicitly identify an estimate, projection or assumption does not mean it has not been relied on in constructing the method, or that it is not relevant to the assessment of how conservative the estimates of the net abatement amounts are. Consistent with this, in applying the conservative standard, the Committee generally considers:

- the potential for direct and indirect leakage to arise as a consequence of project activities; and
- the risk of non-permanence for sequestration projects and whether, having regard to the permanence period discount, the net abatement amount is sufficiently conservative.
- Non-permanence refers to the risk that carbon sequestered as a consequence of sequestration offset projects will be fully or partially released as a result of future events.

**Method example – Soil Carbon Sequestration in Agricultural Systems**

The Soil Carbon Sequestration in Agricultural Systems Method credits projects that undertake activities that sequester soil carbon under pasture, crops, horticultural or mixed farming systems. This is achieved by increasing the amount of organic matter in the soil or decreasing the amount of organic matter that is released from soils.

The method requires regular measurements of soil carbon in each carbon estimation area in the project, in the baseline period and during the project period. Carbon abatement is the difference between the soil carbon content during the project and baseline.

Natural variability in soil carbon content occurs from changes in climate and management practices. A 50 per cent discount factor is applied to abatement estimates until the third measurement is made. This is designed to account for the uncertainty as to whether the abatement that is evident has resulted from the changed management practices or is part of natural variability.

With more measurements later in the project period, the abatement estimates become more reliable and the discount factor is removed from calculations.