



Australia's National
Science Agency



Priorities for Low Emissions Agricultural Solutions Investment

Summary Report

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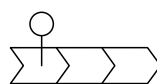
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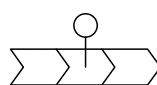


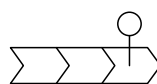
1 Introduction

1.1 What this report is about

This summary report distils the findings of a comprehensive national assessment of options to reduce on-farm (Scope 1) greenhouse gas emissions in Australian agriculture, with a focus on the technologies and enabling conditions required to move from promise to practical impact. It complements existing national and state-level plans and strategies by providing a sector-specific analysis of technologies available now and those that are emerging, and looks at which of these may plausibly scale over time. This underpins analysis of investment priorities and sequencing for accelerating credible, scalable agricultural emissions reduction across three time-horizons:

 Now to 2030

 2030-2035

 Beyond 2035

The full report examines emissions reduction technologies—not sequestration or removals—across six agricultural sub-sectors:



Red meat and sheep



Dairy



Cropping



Horticulture



Pigs



Poultry

It assesses these technologies in terms of their emissions reduction potential, as well as through the lens of feasibility, adoptability, commercial readiness, system fit and investment requirements. This perspective reflects a recognition that transitions to low-emissions agricultural industries will be shaped by what can be credibly delivered at scale and across highly diverse farming systems.



A central finding of this assessment is that scope 1 agricultural emissions reduction is constrained less by the existence of effective technologies than by challenges with system integration and the limited mechanisms to provide incentives for adoption. As a result, early emissions reductions (in Horizon 1) are expected to be modest at the sector level, even where technological readiness appears high.

This work is intended to be read alongside the *Agriculture and Land Sector Plan*¹, *Pathways to Zero Net Emissions: Stocktake Paper*², and recent state-based assessments such as the *NSW Land & Primary Industries Low Emissions Options Report*³. Differences between this work and those assessments reflect analytical purpose and resolution, rather than disagreement on direction. This work places greater emphasis on sector specific technology assessment, feasibility constraints, and the sequencing of investment and intervention over time, and at a national scale.

1.2 Why this report matters

Reducing on-farm emissions from agriculture is a long-term, system-wide challenge. Agriculture is biologically complex, spatially heterogeneous, and characterised by thin margins, high climate variability and dispersed decision-making. While significant volumes of agricultural emissions historically have been offset through land use change and sequestration, these opportunities are finite and will have diminishing returns. Over time, sustained progress toward Australia's national emissions reduction targets will

rely on contributions from direct reductions in emissions from agricultural production systems. This work focusses on these emissions, recognising that these ultimately need to be considered alongside sequestration opportunities and economy-wide transition pathways and options. Sequestration⁴ options and priorities are detailed elsewhere.

Pressures on agriculture as a sector to reduce emissions are rising. As the rest of the economy decarbonises, agriculture's relative share of national emissions proportionally increases. International markets, corporate supply chains and financial institutions are placing greater scrutiny on emissions intensity, verification and claims. Climate disclosures and Scope 3 reporting are beginning to flow through supply chains, creating new expectations for producers.

Despite the growing imperative, the available emissions-reduction technologies have not scaled. While some technologies and practices have provided productivity gains alongside abatement and have been widely adopted (win-win solutions, such as minimum till), many options deliver weak or uncertain private returns; others impose additional management complexity, rely on immature delivery mechanisms, or require regulatory approval (including those under National Electricity Rules). Many solutions require alignment of incentive mechanisms with proportional and credible monitoring, reporting and verification (MRV) systems (see explanation in **Box 1**) that do not yet exist at scale, or inadequately capture the complexity of the combinations of actions that together will reduce on-farm emissions.

¹ DAFF, 2025. Agriculture and Land Sector Plan. DAFF, Canberra, Australia.

² ZNE-Ag CRC, 2025. Pathways to Zero Net Emissions: Stocktake Paper. Zero Net Emissions Agriculture Cooperative Research Centre.

³ Cowie, A., Carlson-Perret, N., Nakamichi, N., England, M., Adkins, M., Badgery, W., Cacho, O., Coleman, M., Cowley, F., Fawcett, S., Hutton, L., McCann, V., Mortimer, S., Scott, F., Simmons, A., Ximenes, F., Golding, J., Crean, J., Jenkins, B., Johnston, E., Medway, J., Sharwood, R., Wilson, B., 2025. NSW Land and Primary Industries Low Emissions Options Report: Land and Primary Industries Emissions Abatement Roadmap. NSW Department of Primary Industries and Regional Development.

⁴ Fitch, P., Battaglia, M., Lenton, A., Feron, P., Gao, L., Mei, Y., Hortle, A., Macdonald, L., Pearce, M., Occhipinti, S., Roxburgh, S., Steven, A., 2025. Australia's sequestration potential. CSIRO.

As a result, technological readiness alone has proven to be a poor predictor of adoption by producers. The scaling of options (i.e. where they can be delivered, financed, verified and sustained at sector relevant scale, under real-world conditions) is constrained by a variety of factors.

The full report responds to these challenges by making constraints explicit. Rather than assuming smooth diffusion, it highlights where delivery risks, economic barriers, system interactions and institutional gaps are likely to limit adoption and scaling, and shows how these differ across sectors and time horizons. By doing so, the report aims to support robust prioritisation and targeted investment in agricultural emissions-reduction technology scaling and adoption, as well as a clearer understanding of the trade-offs involved in accelerating agricultural emissions reduction.

Well-directed and important work is underway across industry, government and research organisations, and much of it aligns with the actions defined here. This summary report provides a big-picture overview of the detailed analysis, insights and actions in the full report.





1.3 What we did

The work underpinning this report was funded and completed by CSIRO, with the assistance of the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF), combining independent technical assessment with strategic engagement across industry, research and government.

At its core, the work applies a sector-specific technology assessment framework. Individual technologies were assessed against a consistent set of criteria, including feasible abatement potential, breadth of application, co-benefits, barriers and knowledge gaps, stacking potential, readiness levels and financial costs and benefits. These assessments were used to group technologies into archetypes reflecting their position along transition pathways, spanning from foundational research through to scaling ready deployment. These technology assessments (appendices to the full report) are preliminary and a first pass. They should be seen as a starting point for sector-wide dialogue on the evaluations against criteria, rather than definitive assessments.

Crucially, the analysis does not treat technologies in isolation. Following on from technology assessment, it explicitly examines enablers and system interactions that determine whether technologies can move from trials and pilots to widespread use. We have considered, among other things, MRV, advisory systems, regulation, finance, markets, supply chains and interactions with energy and digital infrastructure. Investment profiles were assessed to identify areas of alignment, under investment and potential missed opportunities, recognising that public and private resources can play different but complementary roles in innovation and scaling.

To identify broad investment patterns, the analysis drew on indicative RDC data covering emissions-reduction projects from 2022/23 to 2024/25, supplemented by publicly available ZNE-Ag CRC investment information. These data provide a snapshot of investment direction and relative emphasis, rather than a comprehensive accounting of all low-emissions agricultural RD&E activities. This is appropriate to understand broadly if recent investment directions are aligned with future priorities.

Findings and interpretations were iteratively tested through targeted workshops and expert review, drawing on the insights of more than 80 expert contributors across agricultural sub-sectors and states.

Importantly, this work provides an analysis that can evolve into a living, updatable knowledge base on emissions reduction technologies. The Sector Technology Assessments are presented as a structured evidence base that can be revisited and revised as uncertainties are clarified, technologies mature, markets shift, and enabling conditions change. This approach recognises that sustained progress will depend not only on making good decisions now, but on building collective capability to adapt, learn and reprioritise over the long time period of the transition to low-emissions agriculture.

1.4 Strategic insights

The work identifies a set of insights that underpin recommendations and will be critical to development and scaling of emissions reduction technologies in coming years and decades. In sum, these insights highlight how intermediating functions (such as coordination across industry and government and across sectors) and market incentives can work together to create an environment that supports innovation and scaling for emissions reduction, and net-zero transitions more broadly (**Figure 1**).

Early emissions reductions will be gradual, while system readiness develops:

In the near term, the principal value of investment lies in building the foundations for technologies to scale—confidence, coordination and learning. These investments position agriculture to deliver material, repeatable abatement as technologies, markets and capability mature over time.

Monitoring, reporting and verification underpins market function and scale:

Fit-for-purpose monitoring, reporting and verification (MRV) systems provide the foundation for incentives, procurement, insetting and finance. MRV that is proportional (that is, where process burden is consistent with risk), interoperable and capable of handling stacked actions enables markets and policy mechanisms to operate efficiently and with confidence (see **Box 1**).

Demand side mechanisms play a decisive role in uptake:

Where private returns are weak or risks are concentrated, adoption will rely on demand-side interventions that distribute costs and rewards across supply chains. Procurement preferences, insetting arrangements, concessional finance and related market mechanisms would be integral to scaling many currently mature technologies that cannot pay for themselves.

Real world impact depends on delivery conditions and incentives: The effectiveness of emissions-reduction technologies is shaped by support and delivery systems, farm system fit, commercial readiness, and market drivers. Adoption and impact are determined at least as much by these conditions as by the efficacy of technologies themselves.

Sequenced investment reduces risk and strengthens legitimacy: Staged and coordinated intervention—building delivery capacity, assurance and value capture mechanisms before large scale deployment—reduces the risk of stranded assets, loss of confidence or misalignment across the system, and supports sustained progress.

Integrated and farm-system-aligned technology stacks are central to pathways that deliver significant abatement: Across agriculture, emissions reductions will rely on combinations of multiple practices and technologies that fit with farming systems. Blanket approaches will not work. Designing, validating and deploying technology stacks that work together under real operating conditions is a critical focus for investment.

Coordination is the critical enabler of progress: Emissions reduction in practice will be accelerated by aligning action across research, policy, markets, advisory services and supply chains. Strengthening direction-setting, coordination, learning and legitimacy across the innovation system is essential to convert technological potential into durable, sector-wide outcomes.

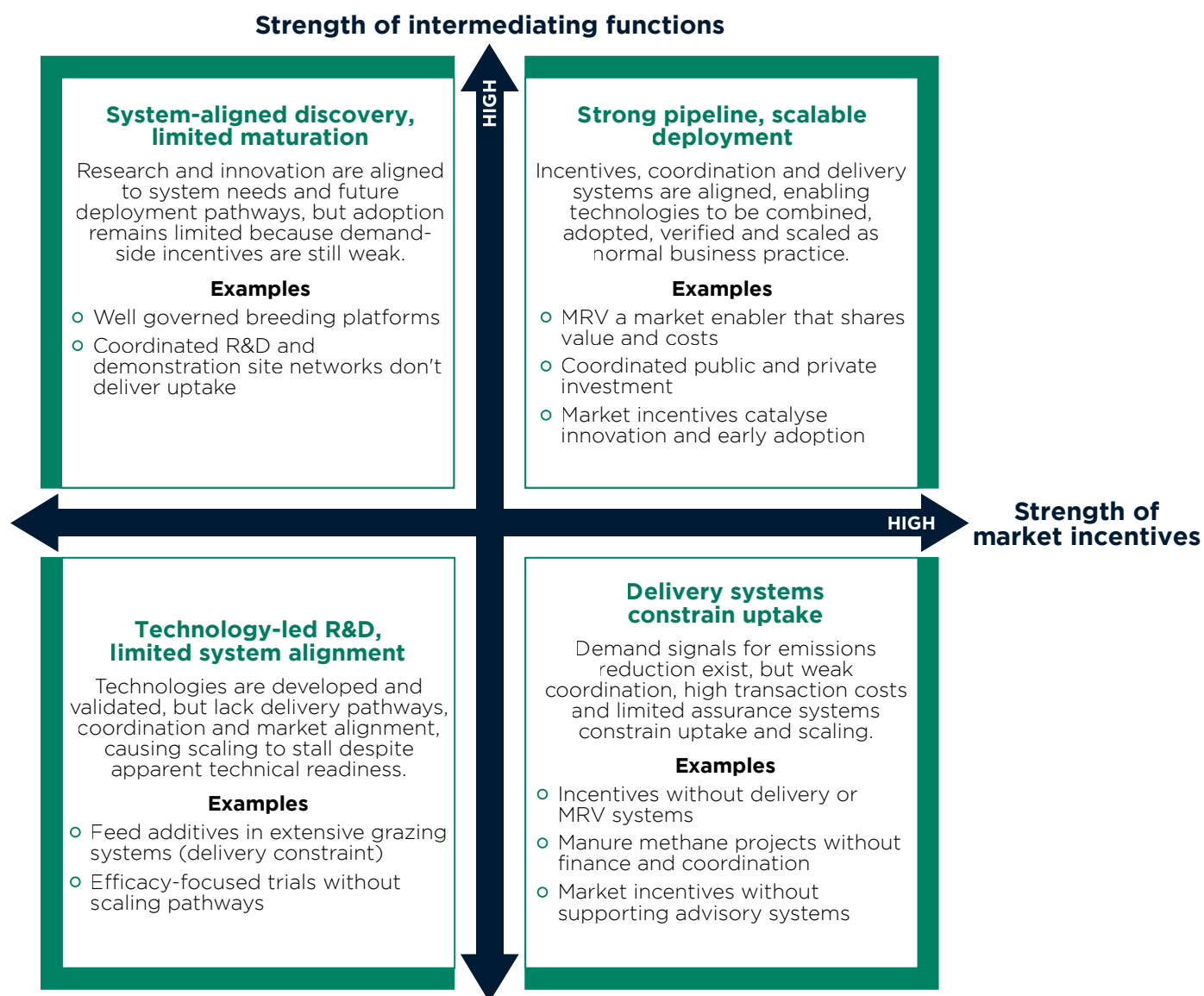


Figure 1. Diagnostic synthesis of constraints to technology development, scaling and embedding across Australian agricultural industries examined in this report. These relate to the strength of market incentives (x-axis, e.g. procurement, premiums, contracts, finance, cost-sharing mechanisms), and strength of intermediating functions (y-axis, e.g. MRV, advisory systems, coordination, standards, sequencing of action and investment).



2 Investment, intervention and action across the three time horizons

This section provides an overview of the sequencing of action, intervention and investments across three distinct time-horizons that could accelerate scaling and adoption of solutions, and underpin a transition to low-emissions agriculture in Australia.

2.1 Horizon 1 (2025-2030): Deploy scalable technologies, mature the next generation, and build foundations

Horizon 1 focuses on two action areas that are industry-specific and a third critical area that supports adoption and scaling across industries:

- a) Industry-specific: Deploy currently scalable emissions reduction technologies that deliver profitability and other co-benefits;
- b) Industry-specific: Deliberately mature the next generation of likely-to-succeed and key high-risk, high reward technologies required for later scaling through targeted investment; and,
- c) Cross-industry: Build foundations through confidence, capability and enabling infrastructure (MRV, incentives, etc) that will ensure promised technologies can move from pilots to credible, investable options in later time horizons.

This phase also seeks to create “spill in” opportunities from transitions underway in other sectors, particularly energy systems, transport and digital infrastructure. For example, technologies, data systems, and supply chains associated with energy transitions are changing fast, and can accelerate progress towards low-emissions agriculture, and provide opportunities for new products and roles for agriculture in supporting the nation’s economy and sovereignty (e.g. through biofuels).

Total emissions reduction in this phase is expected to be modest at the sector level. However, targeted opportunities, such as emissions intensity reductions associated with improved animal health and productivity in dairy, cattle and sheep, or productivity gains in parts of the northern beef herd, may be significant where conditions are favourable and key risks can be managed. Such actions will be important to build momentum and show positive intent.

The strategic value of Horizon 1 action lies in positioning the sector and capability across industry, research, policy and advisory systems, to ensure scaling of emissions reduction can be achieved in horizons 2 and 3.





2.2 Horizon 2 (2030-2035): Creating an enabling environment and scaling next generation technologies

Horizon 2 is oriented to active scaling of next generation technologies that were deliberately matured during Horizon 1. Continued focus on an enabling policy, market, advisory and institutional environment, and robust MRV and accounting systems underpin scaling. By this period, targeted investment and learning have reduced technical and delivery risks, allowing a shift from proving technologies to deploying enterprise- and region-specific technology stacks at scale.

Robust data, accounting and MRV systems, together with clearer cost-sharing arrangements, enable profitable adoption pathways to be developed. These can be designed to share costs and benefits across supply chains and markets. For example, targeted procurement strategies, or contractual preferences are starting to be used within corporate programs to pay farmers a premium for products grown using specified methods or with clear outcomes. Such programs can reduce costs and accelerate uptake as technologies reach commercial scale.

Investment in MRV (e.g. standards, cost reduction, interoperability of measures, and stacking of methods – see **Box 1**) developed in Horizon 1 will be a foundation for investment in emissions reduction technologies that were previously priced out of the market. By the end of Horizon 2, a strong innovation environment will be established, with connected policy-industry-research capability not only supporting emissions reduction, but increasingly transferable to other systemic challenges facing agriculture. Total agricultural scope 1 emissions begin to drop in line with or exceeding Agriculture and Land Sector Plan ambitions, depending on market incentives. Without Horizon 1 and 2 investment, technologies that appear ready may remain stuck in pilot or niche deployment.

2.3 Horizon 3 (2035 onwards): Integrating emissions reduction into markets and consolidating low emissions agriculture

Horizon 3 focuses on embedding emissions reduction into the normal functioning of financial, commodity and supply-chain markets, rather than relying on stand-alone programs or incentives. Sustained and visionary investment in high-risk, high-reward science and technology, supported by international collaboration, regionally-focused development, trialling and extension, unlocks new approaches to emissions reduction and drives down the cost of emissions abatement.

By this stage, private sector investment in commercialisation and rapid scaling is supported by a stable policy and investment environment, and by widespread confidence among growers, financiers and supply-chain actors in technologies and MRV systems. Aggregators and downstream agents play a routine role in supporting farmers to adopt, optimise and verify low-emissions practices. Foundational work in earlier time horizons means that emissions reduction technologies can move faster from the R&D pipeline to implementation and scaling.

Australian agriculture continues to operate at world-leading reduced emissions intensity, reinforcing market access and competitiveness in global markets, access to all markets, and contributing to national and international climate ambitions. The feasibility of Horizon 3 outcomes is contingent on earlier sustained and coordinated investment in shared infrastructure, regulatory alignment, and learning and capability.

Box 1

Explanatory note on proportional MRV and incentives: aligning assurance with function and risk

This work uses monitoring, reporting and verification (MRV) in a broad sense, recognising that MRV is required for a wide set of decision, market and regulatory purposes. These include corporate reporting, supply-chain participation, financial decisions and participation in carbon markets. Each application requires credible data, but these may differ in precision, cost and verification approach⁵. The credibility of MRV depends on auditing, compliance processes and enforcement powers to maintain confidence in both markets and policy mechanisms⁶.

Within these constraints, MRV can be understood as proportional to the function it serves, within an overarching framework that maintains consistency, transparency and integrity across the national system. Systems already incorporate differentiated approaches. These can be illustrated via a simple MRV-incentive ladder:

	Low - moderate assurance	Moderate assurance	High assurance
Focus	Management, learning and finance access	Supply chain differentiation and reporting	Crediting, compliance and regulated markets
Purpose	Inform decisions; enable participation; reduce uncertainty; support early action	Support product claims; benchmarking; transparent reporting across value chains	Support tradable units; enforce compliance obligations; ensure environmental integrity
Mechanisms	Advisory tools; benchmarking; concessional finance; internal decision support	Supply chain programs; procurement policies; climate disclosures	ACCU scheme (carbon markets); Safeguard Mechanism; regulated disclosures
MRV features	Modelled estimates; proxy data (e.g. inputs, productivity); simplified methods	Standardised methods; auditable datasets; increasing use of facility level data; alignment with life cycle assessment frameworks	Method based accounting (e.g. ACCU methods); strict baselines; additionality requirements; independent auditing and verification
Example applications	Lenders or corporates using emissions intensity metrics derived from standard methods to inform risk and investment decisions	Facility level emissions data informing corporate disclosures or supply chain reporting	ACCU projects requiring approved methods, audit schedules and regulatory oversight

⁵ CCA, 2023. 2023 Review of the National Greenhouse and Energy Reporting Legislation. Climate Change Authority, Commonwealth of Australia, Canberra, Australia

⁶ ANAO, 2024. Issuing, Compliance and Contracting of Australian Carbon Credit Units, Auditor-General Report No. 24 of 2023-24. Australian National Audit Office, Canberra, Australia.

Proportional MRV should be designed to:

- Maintain integrity across all levels (recognising that credibility is foundational to both reporting systems and markets) and harmonise core methods, which are prerequisites for effective proportional MRV.
- Align assurance with risk and use, with higher-stakes applications requiring more rigorous measurement, verification and audit
- Enable participation across diverse producers and systems by allowing lower-cost approaches where appropriate, recognising that parallel MRV systems can impose multiple reporting requirements on producers, reduce comparability, and dilute incentives for mitigation
- Facilitate interoperability and data reuse across assurance levels, recognising that multiple accounting ledgers (national inventories, Scope 3 reporting, product footprints and project-level accounting) increasingly rely on shared farm-level data foundations⁵.
- Support consistency and comparability, particularly where data contributes to or is derived from national reporting frameworks and international obligations⁵.

In summary, proportional MRV is a structured approach to aligning the level of assurance, cost and verification with the function, risk and value of different applications within an overarching requirement for system integrity and consistency.

This perspective on MRV aligns with ongoing efforts across jurisdictions and industries, particularly the Australian Government's development of Voluntary Emissions Estimation and Reporting Guidelines (VEERG).





3 Best-bet actions and investments

Best bet actions are drawn from the sectoral and system pathways identified in the full report. They focus on removing the key constraints to scaling identified in the analysis. The summary report provides an overview of industry-wide and sector-specific actions, focusing particularly on those that influence delivery feasibility, MRV, coordination and weak value capture. This builds on high-level overviews of the three Horizons in section 2. Across sectors, the highest leverage near term investments are those that enable multiple technologies to scale over time, rather than those that pick individual technological winners. These investments are specified under Horizon 1, and generalised in later horizons, reflecting uncertainties. An overview of key sector-wide actions and their sequencing across all three time horizons is presented at the end of this section in **Figure 2**. Each industry pathway is presented in **Appendix 1**. Many key actions in Horizon 1 have already commenced.



3.1 Horizon 1 (now-2030)

3.1.1 Whole of agriculture and cross-sector priorities

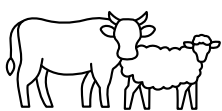
Within agriculture and food sectors

- Invest in robust farm-level emissions accounting platforms and proportional MRV to support market-based mechanisms and accounting, and thereby incentives for adoption and scaling.
- Test and develop demand-side mechanisms (such as procurement, contracting or insetting - see Section 3.4, full report) in targeted contexts where delivery and MRV are credible, to reduce risk and create viable scaling pathways for mature technologies with low / negative return on investment
- Build digital support and foundational data infrastructure to improve outreach and adoption, including looking at how to harness emerging AI capabilities (intermediated by Agtech sector capacity).
- Upskill advisors and farming system groups through well-targeted processes and programs, especially via long-term investment in a hub-and-spoke model centring on state-owned research farms, data and knowledge sharing, and as critical, long-term infrastructure supporting development of regionally focused technology stacks and solutions and extension.
- Use grants, concessional loans and other mechanisms to reduce early-stage risk and crowd in private investment.
- Streamline regulatory approvals (across all areas that pertain to emissions reduction including national grid regulations) and harmonise standards to fast-track pilots.
- Establish baseline emissions data and digital platforms to support learning and continuous improvement beyond pilots.

Across sectors: agriculture-energy nexus

- Establish coordinated, place-based pilot and demonstration programs that integrate energy solutions with local agricultural systems.
- Support renewable diesel opportunities, to build familiarity, demand, and reduce vulnerability to global diesel supply shocks and price volatility.
- Consider grants or concessional finance for on-farm fuel storage to buffer against supply disruptions and improve logistics flexibility.
- Support electrification rebates and incentives for stationary equipment such as pumps, grain handling and dairy infrastructure.
- Reform electricity distribution and connection rules to enable local generation and use of biogas from anaerobic digestion, particularly in intensive systems.
- Trial fringe-of-grid energy distribution and storage solutions to improve resilience of agricultural supply chains and remote producers to grid constraints.





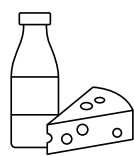
3.1.2 Red meat and sheep

Deploy current scalable, and underutilised technologies

- Improve herd and flock efficiency (animal health, fertility, mortality reduction, herd structure) and pasture and grazing management, supported by advisory systems and MRV recognition.
- Improve pasture and grazing management to lift feed quality and utilisation.
- Selectively pilot existing feed supplements in delivery-feasible settings (e.g. feedlots and semi-confined systems) to build evidence on delivery, safety, MRV and value capture.
- Improve operational efficiency (energy use, logistics, management practices).
- Improve access to measurement infrastructure to support feed supplement testing and dossier preparation.

Progress next generation technologies

- Develop methane-reducing feed interventions suitable for grazing systems, with particular focus on delivery, persistence, cost, safety and accompanying MRV.
- Continue genetic and breeding approaches targeting lower methane emissions, while improving recognition of genetic gains in MRV and claims frameworks.
- Integrated nutrition-genetics-management stack designs for different grazing systems.
- Develop MRV approaches suitable for extensive, variable landscapes and capable of accounting for stacked and interacting technologies.
- Partner internationally on high-upside biological solutions, including vaccines and novel interventions, to accelerate learning, share risk, and avoid duplication of global R&D.



3.1.3 Dairy

Deploy current scalable, and underutilised technologies

- Improve greenhouse gas efficiency through milk yield, herd health and longevity, including through improved genetics.
- Scale optimised nitrogen use, nitrification and urease inhibitors through advisory support, regional demonstration and MRV recognition.
- Selectively pilot methane-reducing feed additives where reliable delivery is feasible, while continuing to optimise feed and ration management.
- Improve energy efficiency and electrification in sheds and on-farm operations.
- Support manure and infrastructure options where commercially viable, including through targeted incentives and concessional finance where investment barriers remain.

Progress next generation technologies

- Develop methane-reducing feed additives and delivery systems suitable for pasture-based systems, with attention to delivery, persistence, safety and MRV.
- Convert breeding investment into recognised, system-level abatement outcomes.
- Develop whole-farm dairy technology stacks integrating feed, genetics, nitrogen, manure and energy.
- Develop proportional, low-friction MRV capable of capturing whole-farm emissions intensity.
- International partnerships on advanced biological solutions, including vaccines and novel rumen interventions, where upside is large but development costs and risks are high.



3.1.4 Cropping

Deploy current scalable, and underutilised technologies

- Develop nutrient management-related technologies through regionally targeted testing, demonstration and scaling (including enhanced efficiency fertilisers, precision nitrogen applications, and legume integration where proven).
- Continue to develop regional MRV linked to real farm systems, applications and decision-contexts.
- Improve machinery efficiency, through precision farming, control traffic and operational practices.
- Strengthen advisory capacity and expand regional demonstration and learning networks.
- Investigate and develop incentives or protected niche opportunities where mature technologies could scale and cost/benefit ratios improve.

Progress next generation technologies

- Accounting and attribution methods for stacking technologies, and measuring cumulative and long term outcomes, including regional benchmarks.
- Precision agriculture tools requiring multi-year validation.
- Breakthrough pathways (e.g. biological nitrification inhibitors, biostimulants) via international research collaboration, and standard setting to build market confidence.
- Digital platforms integrating soil, climate and management data for future stack deployment.



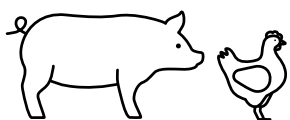
3.1.5 Horticulture

Deploy current scalable, and underutilised technologies

- Support the embedding/adoption of electric variable-speed drive irrigation pumps and small machinery.
- Improve energy and operational efficiency through investments in farm electrification RD&E (including robotics and AI to reduce costs and emissions of agrichemical use, and other input footprints).
- Expand precision fertigation and input optimisation (intensive annual horticulture).

Progress next generation technologies

- Modular, crop-specific technology stack designs.
- Low-cost/friction digital monitoring, control and benchmarking systems.
- MRV approaches suited to diverse crops and production systems.



3.1.6 Pigs and poultry

Deploy current scalable, and underutilised technologies

- Implement covered anaerobic lagoons and solids separation (where scale allows).
- Improve energy efficiency and integrate renewables.
- Improve litter, manure and shed management.
- Deploy low-protein diets with amino-acid supplementation and precision feeding.

Progress next generation technologies

- Integrated facility-level stack designs.
- Advanced waste, energy and nutrient recovery systems.
- MRV embedded at shed and facility scale.
- Digital optimisation platforms for intensive systems.





3.2 Best bet actions Horizon 2 (2030–2035)

In this period, material, repeatable enterprise-scale abatement is expected. Technologies, deliberately matured during Horizon 1, are scaled, supported by enabling policy, markets and infrastructure.

Core actions across agriculture cannot currently be specified in detail, or at an industry level with much granularity and are included here as a direction-setting agenda. Actions include:

- Deploy enterprise- and geography-specific technology stacks across sectors.
- Embed MRV and digital systems as routine infrastructure, reducing transaction costs.
- Establish cost-sharing and benefit-distribution mechanisms that make adoption profitable.
- Build on and extend from Horizon 1 pilots to create market-based incentives (e.g. procurement, concessional finance, etc) to lower costs, build economies of scale in input manufacturers and service providers, and accelerate adoption.
- Align policy, finance and markets so emissions performance is rewarded consistently.
- Catalyse spill-in from other sectors (energy, transport, digital) and across agricultural industries as technologies reach scale.
- Strengthen connected policy-industry-research capability to rapidly identify and address emerging system challenges.

3.3 Best bet actions Horizon 3 (post 2035)

Actions in this phase are very much future-state aspirations, framed as the system we are seeking to enable. In this horizon, low-emissions performance becomes normal business practice.

- Emissions intensity embedded in commodity pricing, procurement standards and contracts.
- MRV functions as shared market infrastructure, supporting finance, claims and trust.
- Advisors have integrated capability to support producers with trialling, evaluation, valorisation and adoption and optimisation of technology stacks as part of normal farm business.
- Private capital drives commercialisation and rapid scaling in a stable investment environment.
- High-risk, high-reward technologies matured earlier are deployed where viable, within system that supports rapid scaling.
- Australian agriculture maintains world-leading emissions intensity, supporting global competitiveness and national ambitions.

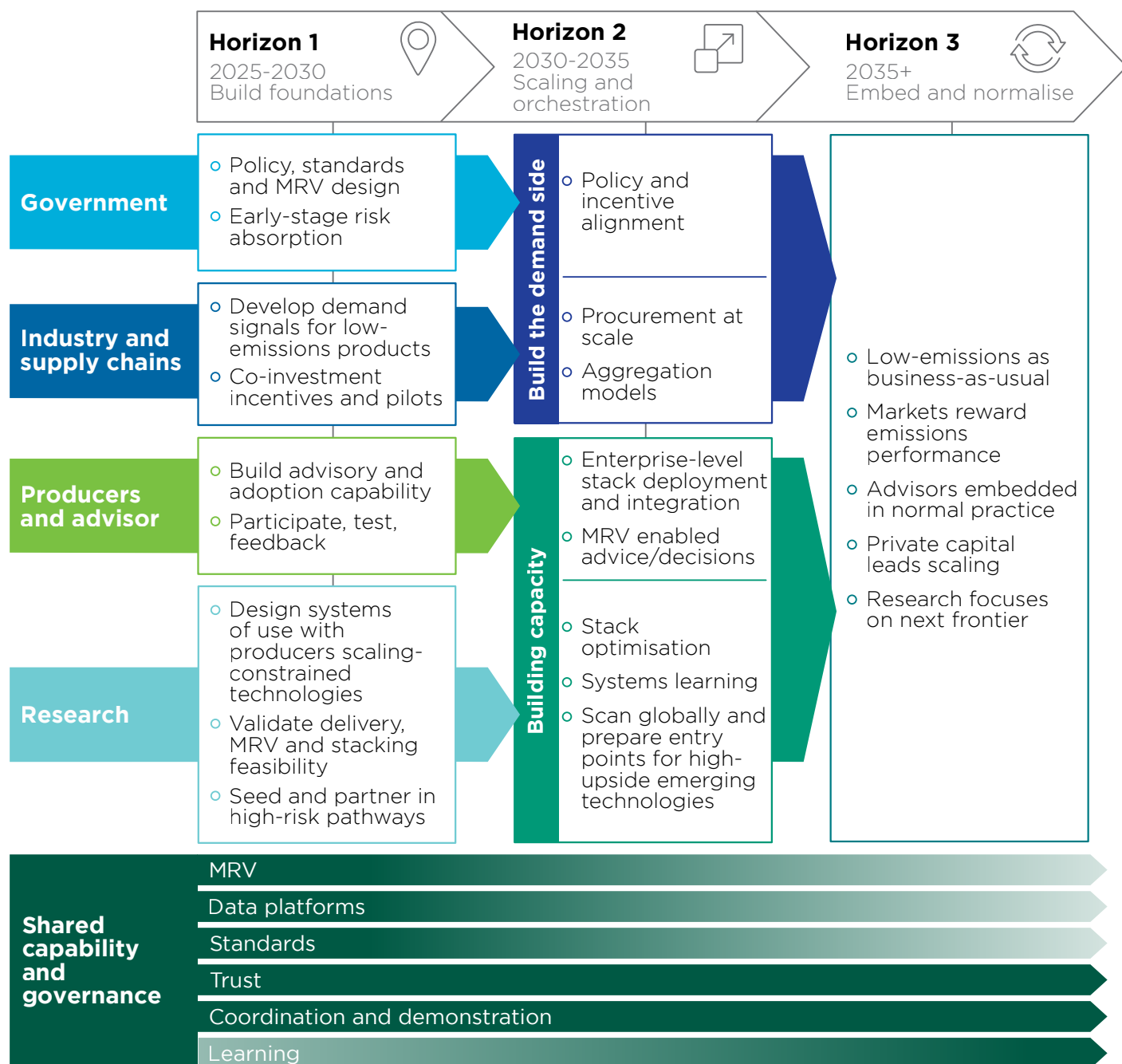
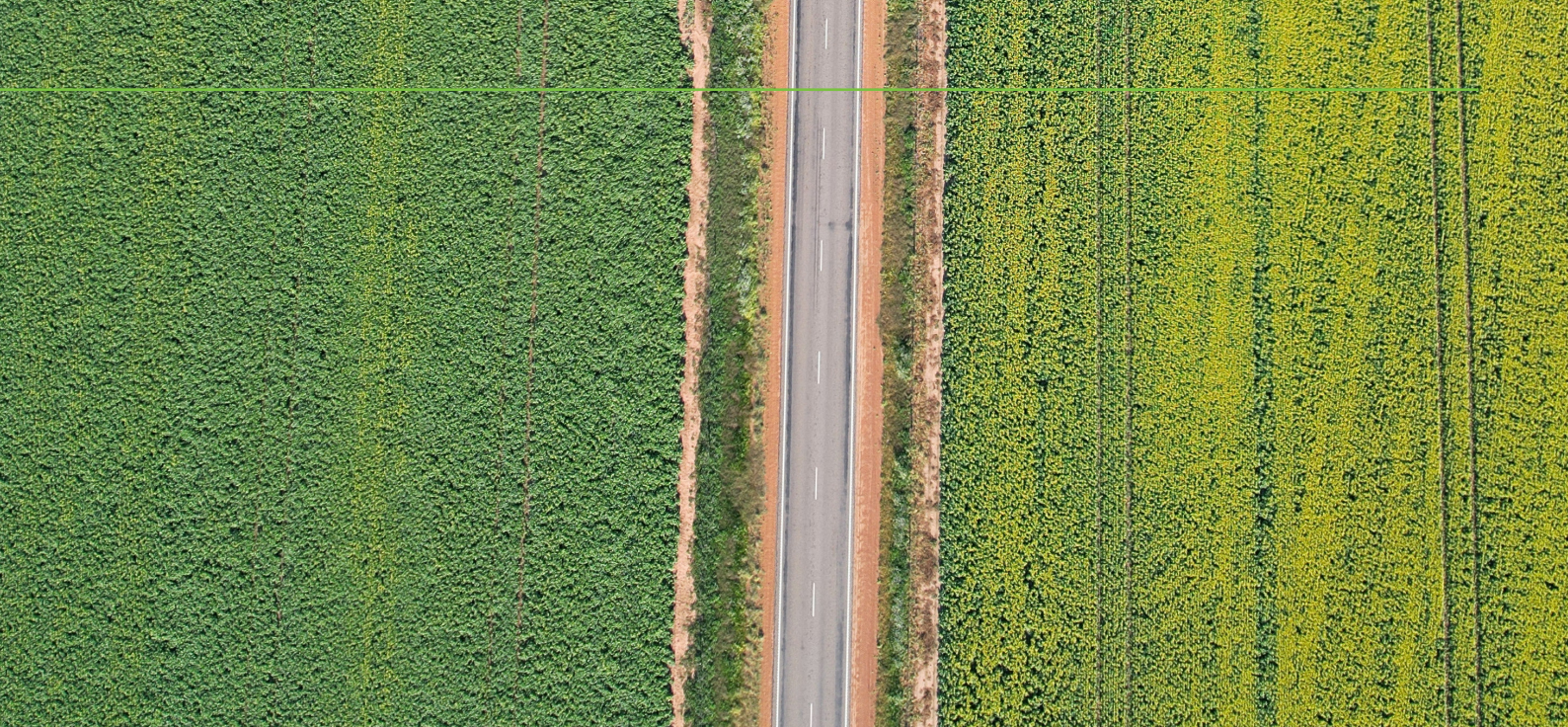


Figure 2. Sequenced, coordinated action across government, industry, producers and research builds the capability that enables scalable emissions reduction. H3 items are end-state goals, reflecting the limited value of defining actions over decadal timeframes. NB: Many actions allocated to one entity in Horizon 1 would be undertaken as partnerships. They are ascribed by the likely lead.



4 Conclusion

This report suggests that prioritising investment in Scope 1 emissions reduction in Australian agriculture will require deliberate targeting and sequencing of investment to ensure emissions reduction can be accelerated over time—but it does so with important caveats:

- 1)** Estimates of feasible abatement remain uncertain, particularly for emerging technologies and in highly variable farming systems. Data on adoptability, costs and returns at scale are limited, and national-level analysis masks regional and enterprise specific dynamics.
- 2)** The analysis does not attempt to predict future policy or market settings; it instead examines how different goals and incentives would interact with existing capabilities and constraints.
- 3)** The report focuses on emissions-reduction technologies, and should be interpreted alongside complementary work on sequestration, land-use change and Scope 2 and 3 emissions for agriculture, as well as how these connect with and complement economy-wide net-zero transition pathways.

There are clear next steps to sustain the work started in here, and to scale low-emissions agriculture solutions more widely. Firstly, this work can be extended to other industries such as forestry and fisheries; maintaining and updating the sector technology assessments that are the foundation of this report. Second, to develop and scale solutions, key actions include strengthening a national MRV spine that supports stacking, learning and credible claims; investing in regional demonstration and advisory capability; and improving coordination across research, policy, finance and supply chains. Importantly, these are not one-off tasks, nor are their benefits confined to emissions reductions alone; they will strengthen the absorptive capacity and robustness of Australia's agricultural innovation system at large, supporting competitiveness, profitability and sustainability.

This work shows that accelerating agricultural emissions reduction requires the development of technologies alongside strengthening of systems that allow options to scale credibly and equitably. The primary risks ahead are not scientific failure, though technologies will fail, but mis-sequencing, over-confidence in early abatement, and under investment in shared infrastructure such as MRV, advisory capacity and coordination. Addressing these risks deliberately will ensure that agriculture can contribute appropriately to Australia's long-term emissions goals.

Appendix 1

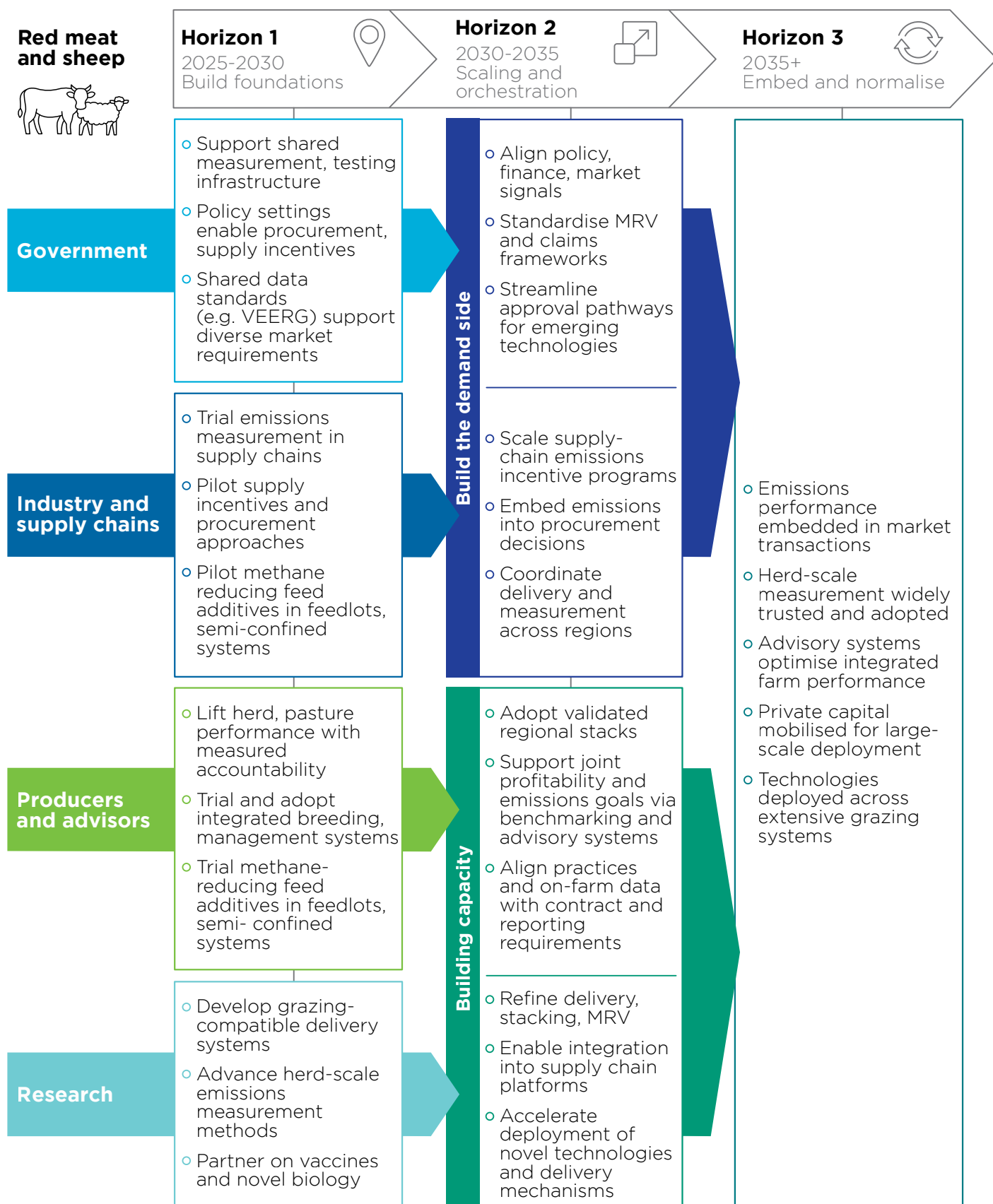


Figure A1. Sequenced, coordinated action across government, industry, producers and research builds the capability that enables scalable emissions reduction in the red meat and sheep sub-sector.

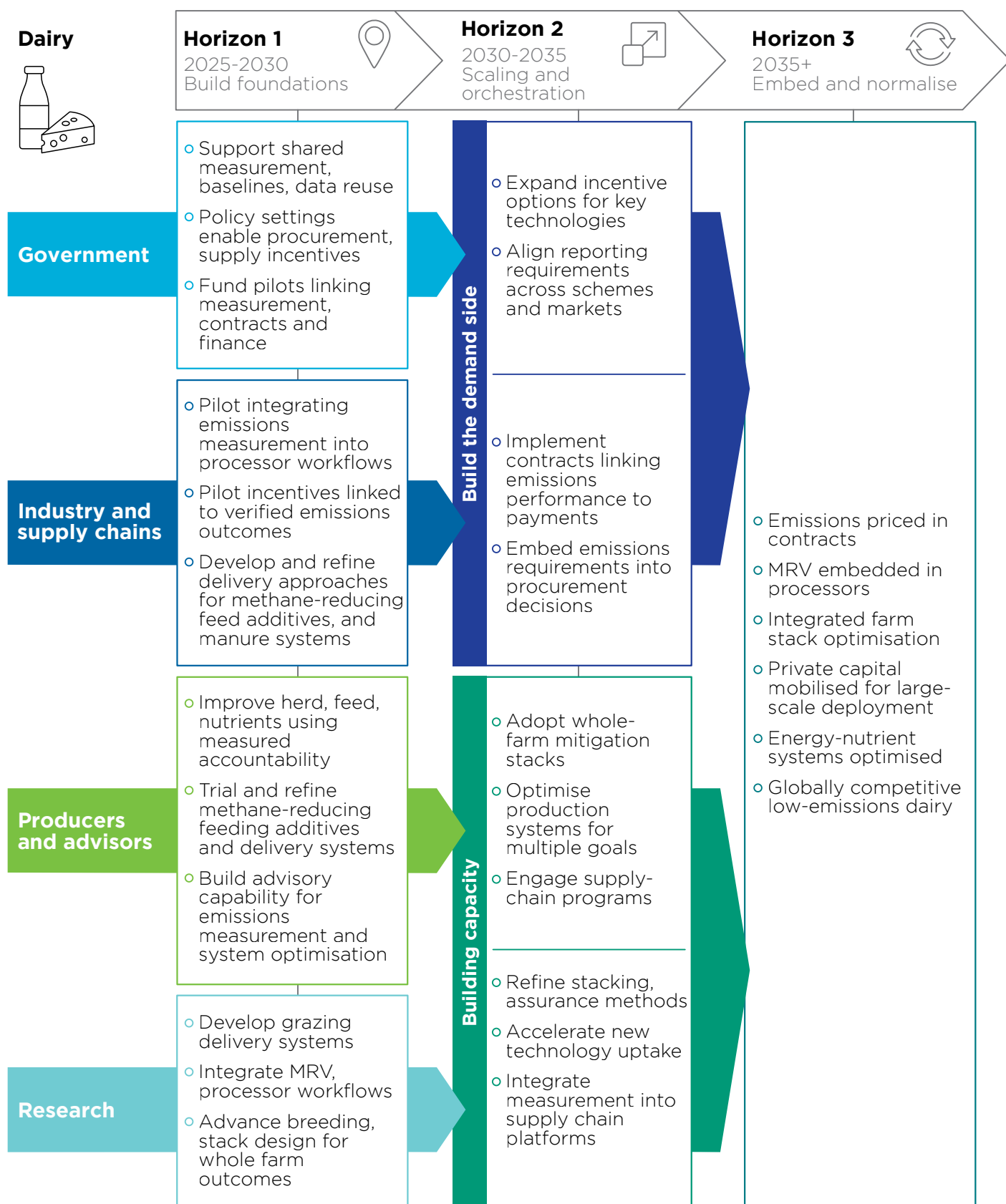


Figure A2. Sequenced, coordinated action across government, industry, producers and research builds the capability that enables scalable emissions reduction in the dairy sub-sector.

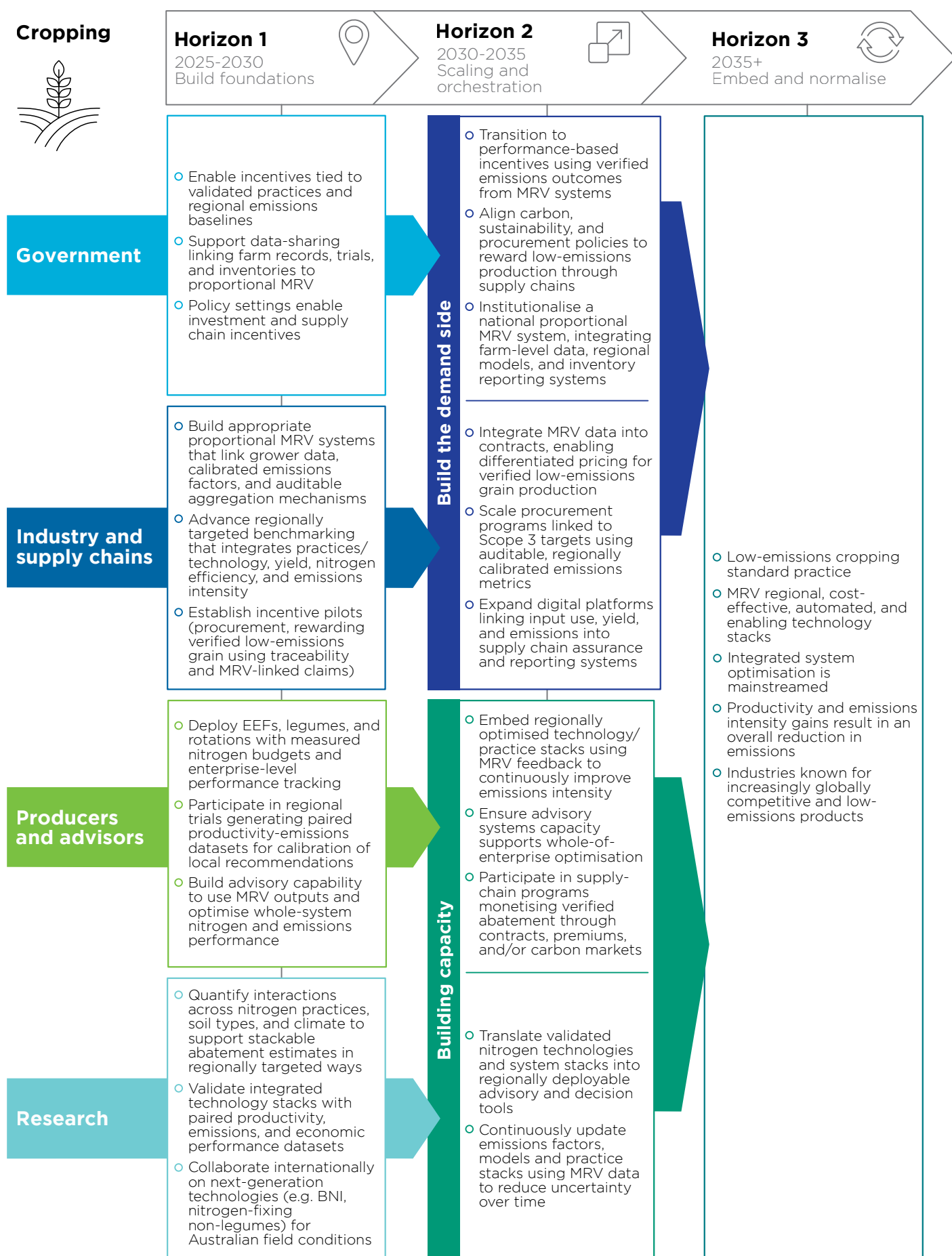


Figure A3. Sequenced, coordinated action across government, industry, producers and research builds the capability that enables scalable emissions reduction in the cropping sub-sector.

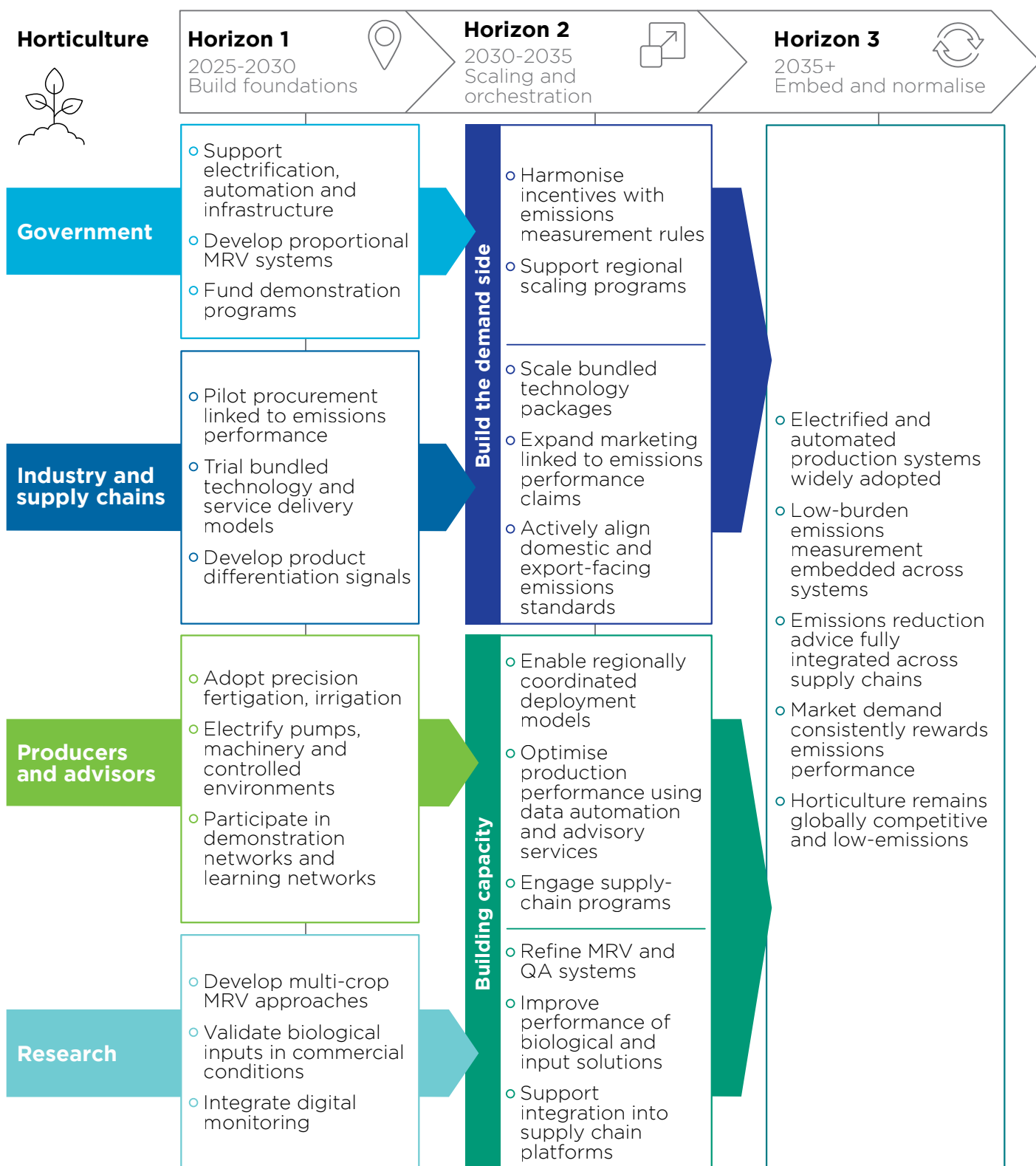


Figure A4. Sequenced, coordinated action across government, industry, producers and research builds the capability that enables scalable emissions reduction in the horticulture sub-sector.

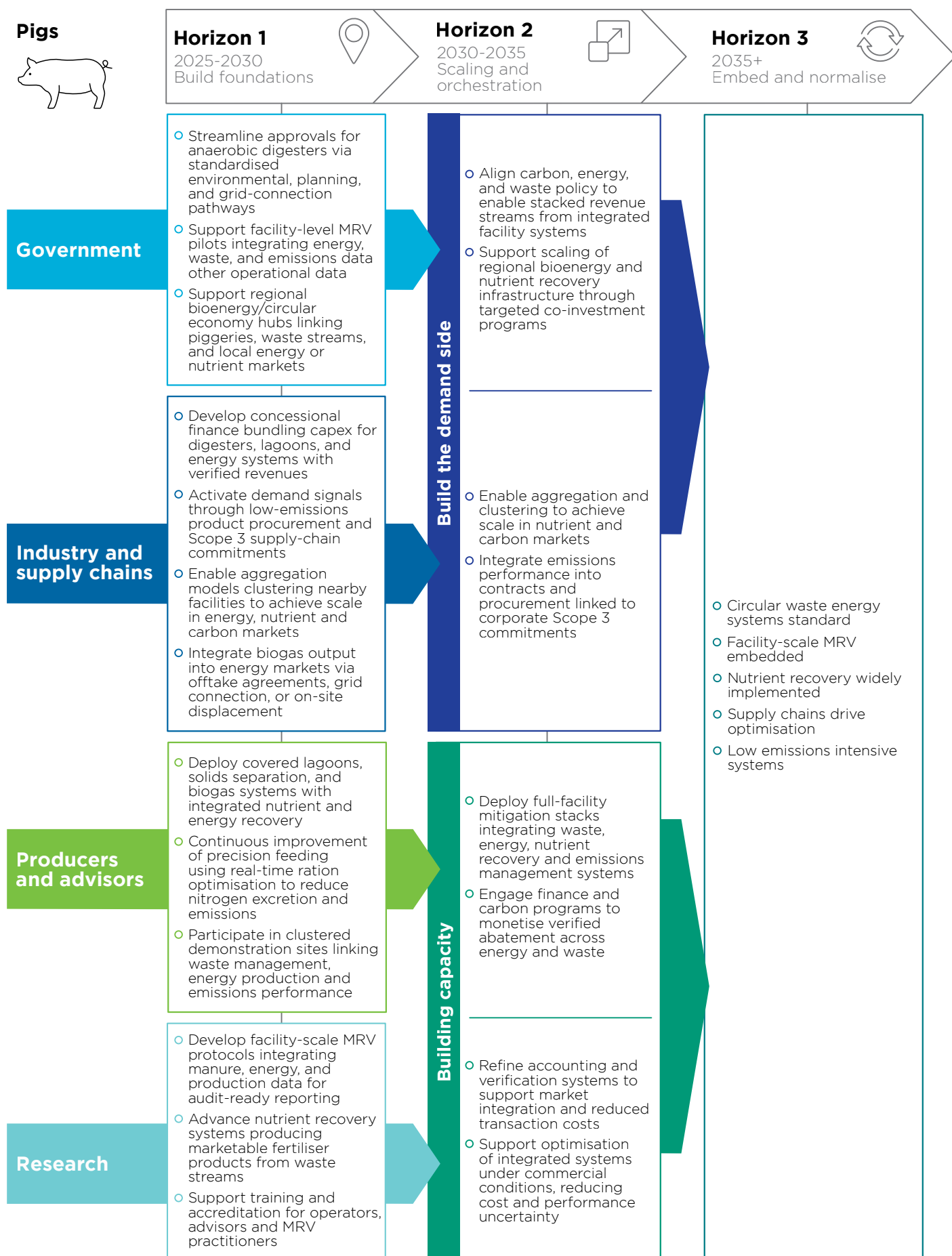


Figure A5. Sequenced, coordinated action across government, industry, producers and research builds the capability that enables scalable emissions reduction in the pigs sub-sector.

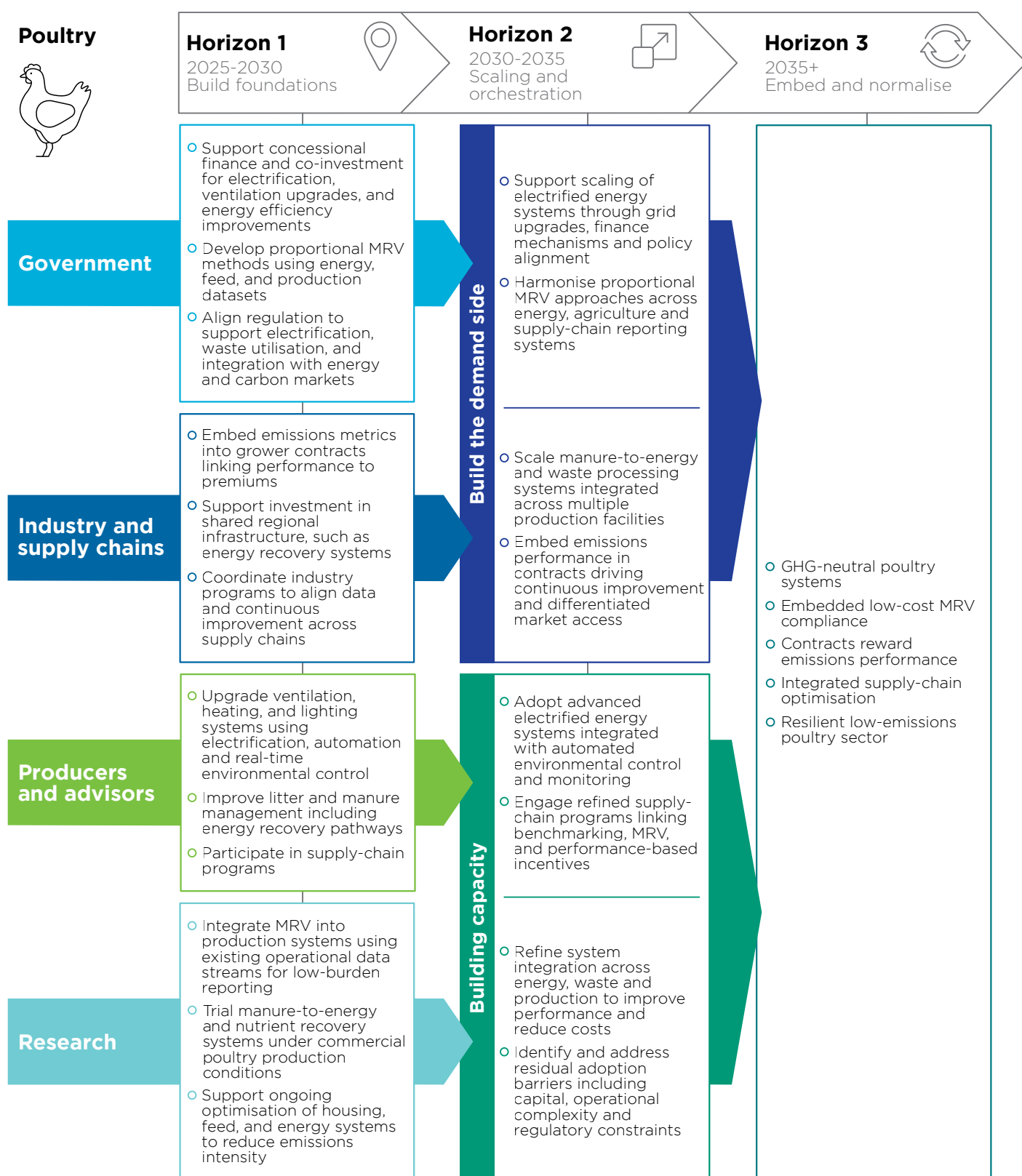


Figure A6. Sequenced, coordinated action across government, industry, producers and research builds the capability that enables scalable emissions reduction in the poultry sub-sector.

