

Appendix B: STA operational method used in this report

STEP 1: Gather resources: Using a research search engine or a variety of these as well as web searches, collect recent papers, reports and web resources into reference software as PDFs. Prioritise recent scientific, government and industry reports. Initially, take a broad sweep (meta-analyses, sectoral and government scoping studies, etc.) to be used in step #2) . Then, for each industry and technology focus, develop a relatively comprehensive resource library.

STEP 2: Develop technology list. For each sub-sector use different AI and tools, team review and wider networks to develop a preliminary technology list. Lump narrowly specified technologies into coherent categories that can be assessed together as much as possible.

STEP 3: Validate and gain wider perspectives using stakeholder workshops (See Appendix D)

STEP 4: First pass technology assessment process using AI assistance

4.1. Using Co-Pilot (research) first provide this prompt:

I would like to provide several documents and then get you to draw on these to assist with a technology assessment. I will load all the documents first, then provide detailed definitions of the criteria for the assessment, and then present a series of queries. Read and refer to all the papers as relevant for each of the subsequent queries. Here is the first set of documents

4.2. load publicly available documents as PDFs in groups (i.e. three at a time) including no more than 20 documents. NB: the queries are best run separately by loading only documents relevant to the specific technologies.

4.3. Now, here are the criteria definitions for all the subsequent queries. Remember these and use them in assessments of relevant criteria:

“Breadth of Application: Level of application with reasonable financial incentives in place

Low = Applicable only in limited sections of the sub-sector (<20%) and not applicable to all enterprise types .

Medium = generally applicable across enterprise types but limited by delivery logistics or regional suitability.

High = Broadly applicable across enterprises (>80%).

Co-benefit Potential

Low = Minimal or no additional benefits beyond emissions reduction; may even carry risks to productivity.

Medium = Offers some productivity, feed efficiency, or animal health improvements though realisation of benefits may be very context specific.

High = Delivers substantial co-benefits such as improved milk yield, feed conversion, soil health, reduced fertiliser use, or resilience to climate variability in almost all instances of application.

Barriers and Knowledge Gaps

Low = Well-understood with minimal regulatory, technical, or adoption barriers; widely validated and accepted.

Medium = Some uncertainties in efficacy, delivery, or safety; moderate regulatory or logistical challenges; further trials needed.

APPENDIX B: Priorities for Low Emissions Agricultural Solutions Investment

High = Significant scientific, regulatory, or practical barriers; limited field validation; major knowledge gaps in long-term impacts or scalability.

Stacking Potential

Low = Limited ability to combine with other mitigation strategies; may conflict with other interventions or offer minimal additive effects.

Medium = Can be integrated with some other technologies or practices; moderate synergy potential.

High = Strong compatibility with multiple strategies (e.g., feed additives, breeding, pasture management); proven additive or synergistic effects.

Enabling Potential

Low = Does not facilitate or unlock other mitigation strategies, standalone intervention.

Medium = Supports or complements other practices (e.g., pasture improvement, nitrogen management); may reduce reliance on inputs.

High = Acts as a platform or enabler for broader system transformation (e.g., infrastructure, carbon accounting, breeding programs); catalyses adoption of other technologies.

Definition of Technology Readiness Level (TRL)

TRL 1 – Basic principles observed and reported: Initial research with theoretical or experimental studies.

TRL 2 – Concept or application formulated: Practical identification based on initial observations.

TRL 3 – Experimental proof of concept: Laboratory studies to validate the concept.

TRL 4 – Component validation in the lab: Initial testing of components or systems.

TRL 5 – Component validation in a relevant environment: Prototyping in near-real environments.

TRL 6 – System demonstration in a relevant environment: Functional demonstration under realistic conditions.

TRL 7 – System demonstration in an operational environment: Prototyping in real-world settings.

TRL 8 – System fully qualified: Fully tested and qualified technology.

TRL 9 – System proven and operational: Fully mature technology ready for deployment.

Definition of Commercial Readiness Level (CRL)

CRL 1 – Conceptual Idea: Identification of a market opportunity.

CRL 2 – Preliminary Proposal: Initial studies on commercial feasibility.

CRL 3 – Exploratory Business Model: Early definition of commercialization strategy.

CRL 4 – Initial Commercial Strategy: Developing partnerships and conducting market analysis.

CRL 5 – Small-Scale Commercial Implementation: Early sales or pilot demonstrations.

CRL 6 – Limited-Scale Commercialization: Initial market penetration.

CRL 7 – Expanded Commercial Scale: Broader market integration of the product.”

APPENDIX B: Priorities for Low Emissions Agricultural Solutions Investment

4.4. Run the query as follows, replacing the technology each time and cutting and pasting the output into a word document (asking for the output as a document provides incomplete data at the time of writing). Repeat this step for each technology, checking output as you go.

“Now here is the query: You are assisting with a DAFF-supported project investigating abatement opportunities in Australian agriculture. Provide an output based on analysis of all pdfs and websites provided. The output should be presented with a heading for each approach under which there is a sub-heading for each criterion.

Use the following prompt structure exactly, based on the provided framework and the criteria already provided, to assess: “Approaches to reducing scope 1 emissions from **INDUSTRY NAME**.

Approaches can be practices or technologies, or a combination of both. They are referred to from herein as technologies.

I will ask you to do this one technology at a time to produce a short report on each starting with a description and then providing a concise, 50-80 word summary for each of the criteria below.

The first technology to assess is:

Technology NAME

Use the following criteria the technologies against:

1. Annual Abatement Potential (Technical) Definition: Abatement potential (ABpot) should be the % of the emissions from the target thing that the technology can potentially abate. This might be an average hectare of a crop, the average emissions coming from diesel use in an average pump, or the rumen of a single sheep or dairy cow. Rationale: a measure of the proportion of total emissions that could be abated provides insight into the potential effectiveness of the technology, but lacks insight into feasibility. Ranking method: The maximum theoretical abatement achievable based on biophysical and technical parameters.

2. The feasible abatement is the product of: 1) the total emissions from that thing at a national scale per year (E_t) in MT CO₂ e / Yr, 2) ABpot (see above), 3) Application domain (APdom) what proportion of things (piggeries, Ha, sheep, cows, or whatever) can this technology be applied to, and 4) estimate the % of things that might be considered the maximum extent of adoption (ADpot). Provide all of these quantities, sources and explain the assumptions made. Rationale: provides an estimate of the feasible annual emissions abatement that the technology could deliver at the maximum extent of adoption. Ranking: MT CO₂ e / Yr

$$AB_{feas} = AB_{pot} \times E_t \times AP_{dom} \times AD_{pot}$$

3. Breadth of Application Definition: The extent to which a solution can be applied across Australian farm enterprises. Rationale: Broader applicability enhances the potential impact of a solution at scale. This criterion highlights integration feasibility and the level of engagement required across sectors. Ranking method: ranking high, medium, low

4. Co-Benefit Potential Definition: The potential for a solution to deliver additional benefits (economic, social, environmental, cultural). Rationale: Technologies that generate co-benefits are more likely to be adopted and can drive systemic improvements. Evaluation must also consider negative externalities and trade-offs. Ranking method: ranking high, medium, low

5. Barriers and Knowledge Gaps Definition: Evaluation of obstacles across financial, scientific, policy, regulatory, supply chain, and market dimensions. Rationale: Identifies why technologies may fail to scale and where interventions are needed. This informs policy, investment, and research focus, and helps determine the role of government and other stakeholders in bridging the “valley of death.” Ranking method: ranking high, medium, low

APPENDIX B: Priorities for Low Emissions Agricultural Solutions Investment

6. Stacking Potential Definition: The ability of a solution to combine synergistically with others for enhanced outcomes. Rationale: Supports bundling of technologies to maximise emissions reductions and cost-effectiveness. Ranking method: ranking high, medium, low

7. Technology Readiness Level (TRL) Definition: A scale (1–9) assessing the maturity of a technology. Rationale: Helps gauge development risk, time to deployment, and suitable investor types. Informs how technologies can be sequenced within an investment portfolio. Ranking: on scale of 1 to 9

8. Commercial Readiness Level (CRL) Definition: A scale (1–6) assessing commercial viability and scalability. Rationale: Highlights the readiness of a solution for market uptake and identifies gaps where public investment might be warranted. Can point to system blockages and what sort of support mechanisms can assist the entire sector. Ranking: on scale of 1 to 6

9. Enabling Potential Definition: The capacity to facilitate or accelerate other abatement solutions (e.g., through advisory systems, accounting frameworks). Why it matters: Recognises system-level innovations (e.g., accounting frameworks, advisory systems) that support the scaling of other technologies; recognises that sometimes it is technology suites rather than individual technologies alone that create adoption potential and value creation Ranking method: ranking high, medium, low

10. Estimated cost range: Definition: The current average cost (and variability in this) of application of this technology on-farm. This will usually be in \$/Ha/year or similar. Why it matters: Provides insight into the financial viability of a technology for on-farm adoption. Assumptions applied. Details the assumptions on which costs are estimated.

11. Estimate benefits: Definition: The current average financial return of application of this technology on-farm. This will usually be in \$/head/day, or \$/Ha/year or similar. Rationale: Provides insight into the financial viability of a technology for on-farm adoption.

12. Level of investment: in research and development and commercialisation in the technology. Record investment that has occurred in scale starting at \$0-100000, 100000 – 5000000, then in steps of \$1000000. For each of those technologies, list the investments and grants that you can find and classify as 1. research and development, 2. commercialisation, 2. Industry scaling. In addition to defining Australian investments, create a section for global investments.

For each and every criteria include : 1. Justification; 2. Evidence: and references used for each claim (format = author, date, pg.). Include page numbers where possible. Provide a list of full citations at the end in Harvard style.

If there are gaps or relevant information is unavailable, state gaps, uncertainties or unknowns clearly and concisely.

If information from the sources included to address any criteria is not available for any technology, draw on credible internet sources. Include citations for all sources that have been used. Preference peer-reviewed sources where these can be accessed. If a source is identified but cannot be accessed in full, say so.”

STEP 5: Validation and checking. This is the time-consuming part. Each claim that is made in the TA output needs to be checked against the relevant literature and mistakes corrected. Papers behind firewalls need to be checked against AI-assimilated data, manually. AI-generated output should provide page numbers, which help to find and check claims, but whole documents or sections will usually need to be scanned or read to ensure the validity of claims and context. Check also for plagiarism, inaccuracies, simplifications and claims taken out of context. Work through the sectoral assessment to improve the accuracy. Ensure claims are well referenced and assumptions are clear.