Clean Earth Bot

A Bootstrapped Circular Robotics Platform for Livestock Waste-to-Nutrient Management

COLETEK PTY LTD

1 Executive Summary

Clean Earth Bot (CEB) is a bootstrapped Australian robotics initiative by COLETEK PTY LTD. It is being developed as a circular-economy system that links autonomous ground robotics with on-site anaerobic digestion to address manure management, paddock hygiene, nutrient reuse, labour burden, and broader environmental pressures across livestock settings.

The initial commercial beachhead is the equine sector. This is a strategically strong starting point because horse facilities experience acute manure management pain, place high value on animal welfare and presentation, and often operate in relatively structured outdoor environments that are suitable for early robotic deployment. From this entry point, the same platform vision can expand into broader livestock and paddock-management applications.

Importantly, Clean Earth Bot is still in active proof-of-concept and heavy R&D rather than full commercial rollout. COLETEK has used its long-standing mobile robot platform, Scotty, to demonstrate the core manure-to-fertiliser workflow, gather feedback from end-users and stakeholders, and de-risk the next-stage product architecture. This honest maturity position strengthens the case study: the project is not presented as a finished mass-market robot, but as a technically credible and evidence-informed Australian robotics venture with clear impact potential.

Clean Earth Bot is also a strong example of founder-market fit. Sandra Cole identified the problem from lived equine experience and ongoing horse care, while Luke Cole brought the robotics, autonomy, embedded-systems, and product-development capability required to turn that problem into a credible technology pathway. The result is a system-level solution, not a single-purpose machine.

Figure 1: Clean Earth Bot circular workflow: manure harvesting, on-site digestion, and controlled nutrient return.

2 Innovation and Creativity

Clean Earth Bot is innovative because it treats manure management as a circular robotics system rather than a single-purpose clean-up tool. The concept links autonomous collection, transport, on-site anaerobic digestion, and controlled nutrient reuse into one workflow. In practical terms, the same base platform also supports adjacent paddock-maintenance tasks such as mowing, material transport, and arena upkeep, increasing the utility of the robot rather than creating a one-task machine.

The originality is also commercial, not just technical. COLETEK has deliberately chosen the equine sector as the first entry point because it combines clear pain points, strong animal-welfare expectations, relatively structured operating environments, and customers who already invest heavily in care and infrastructure. This creates a realistic early-adopter market for a technology that can later expand into broader livestock settings.

The project is founder-led in an unusually strong way. Sandra Cole identified the problem from lived equine experience and day-to-day manure management realities; Luke Cole translated that into a robotics, autonomy, and systems-integration pathway. That coupling of end-user insight with deep technical execution is central to the project's originality.

3 Impact and Effectiveness

Clean Earth Bot targets a real operational problem with measurable consequences. At horse facilities, manure accumulation drives labour, disposal cost, fly pressure, paddock fouling, reduced usable grazing area, and animal-health risk. A typical 1,000-pound horse produces around 50 pounds of manure per day, making waste handling a persistent burden even before bedding is considered.[1]

The broader livestock context reinforces why this matters. This problem set also aligns with active veterinary parasitology research in Australia: the University of Melbourne lists Professor Abdul Jabbar's public research areas as including novel diagnostics for horse parasites and anthelmintic resistance in parasites of Australian Thoroughbred horses.[2, 3]

Internal parasites impose losses on Australian livestock industries running to hundreds of millions of dollars annually. For sheep specifically, current MLA/ParaBoss workshop materials cite approximately $655 million in annual losses from internal parasites, including both prevention and production losses.[4]

Australia's dependence on conventional fertiliser is also economically material. Australia imported about US$3.63 billion of fertilisers in 2025, and ABARES reports that fertiliser accounted for around 20% of total cash costs on specialist cropping farms in 2022–23.[5, 6]

For equine biosecurity specifically, contemporary parasite guidance warns that non-composted horse manure should not be spread onto horse-grazed pastures because it increases parasite contamination and transmission.[7] This makes the core Clean Earth Bot proposition strategically strong: frequent manure removal, controlled on-site processing, and safer nutrient reuse rather than unmanaged accumulation or raw redistribution.

The concept also aligns with broader environmental needs. Official Australian sources note that agriculture contributed 17.9% of national greenhouse gas emissions in 2021–22, and that nitrous oxide emissions totalled 16.7 Mt CO_2-e in that year.[8] CSIRO and the Bureau of Meteorology further report increasing heat extremes and declining cool-season rainfall across much of southern and eastern Australia, likely increasing time spent in drought.[9] NSW DPI notes that soil organic matter improves soil structure and moisture-holding capacity, while Queensland's State of the Environment reporting identifies land-based runoff as the most significant contributor to reduced water quality for the Great Barrier Reef.[10, 11]

Published digestate research also supports the broader circular-economy logic: anaerobic digestion can substantially reduce viable pathogens, and digestate use can increase earthworm abundance over the longer term when managed appropriately, although short-term ammonia toxicity requires care.[12, 13]

Because the project remains in proof-of-concept, COLETEK is careful not to overstate realised savings. The current evidence supports a strong problem-solution fit, early demonstration of the circular workflow, and a credible pathway toward measurable operational, economic, and environmental outcomes as field trials expand.

4 Scalability and Adaptability

Clean Earth Bot is being developed as a modular platform rather than a single-purpose machine. The near-term application is manure collection and transport in equine settings, but the underlying platform logic is broader: autonomous outdoor navigation, payload handling, attachment integration, and repeatable paddock operations.

The long-term scale context is substantial. FAO-based figures place the global cattle herd at about 1.6 billion head and the global sheep flock at about 1.3 billion head, while United Nations reporting citing FAO 2023 data puts the global horse population at around 60.8 million. This does not mean all of those animals represent an immediate addressable market for Clean Earth Bot, but it does show that the underlying waste, biosecurity, and nutrient-recovery problem exists at very large scale across multiple livestock sectors.[14, 15]

That makes the system adaptable in two ways. First, it can expand across functions within the same customer environment, including manure collection, material transport, mowing, and arena or paddock maintenance. Second, it can expand across livestock sectors as the attachments, autonomy stack, and economics mature. COLETEK's equine-first strategy is therefore not a limitation; it is a deliberate beachhead market that offers strong pain points, high welfare expectations, and relatively structured environments for early robotic deployment.

This staged rollout reduces risk. It allows the team to validate workflow, safety, user interaction, and return-on-labour in one segment before extending the same platform into cattle, sheep, and broader livestock applications. In this sense, Clean Earth Bot is best understood as a scalable paddock-management robotics platform built around a strong initial use case.

5 Collaboration and Teamwork

Clean Earth Bot is the product of strong founder collaboration. Sandra Cole brought the original end-user insight from lived equine experience and day-to-day horse care, while Luke Cole brought the robotics, autonomy, and systems-engineering capability required to convert that insight into a credible technology pathway. That combination of customer pull and technical execution has shaped both the product concept and the market-entry strategy.

The project has also been developed in dialogue with a broader ecosystem. Sandra Cole was publicly listed in Climate Salad's 2023 Queensland Women in Climate Tech cohort, where Clean Earth Bot was described as a climate technology solution for converting animal waste into nutrient-rich organic fertiliser[16]. Sandra also participated in InnovationAus' *Industry Papers* circular economy and sustainability event in Brisbane, placing the venture within wider discussions around circular economy, sustainability, and industrial transition.[17, 18]

Beyond the product itself, COLETEK is using the venture as a platform for capability building through mentoring, STEM engagement, and contributions to discussion around robotics productivity and skills pipelines. This matters because successful robotics ventures do not only build machines; they also help build the workforce and ecosystem needed to sustain the sector.

These ecosystem links have also translated into visible public engagement and external recognition.

Clean Earth Bot has also begun attracting public interest and recognition beyond COLETEK's immediate network. Sue Keay publicly described the project as "such a great initiative" and said she looked forward to seeing CEB in action, providing visible support from within Australia's robotics ecosystem.[19]

The project has also been presented internationally. At the 7th Annual HorseTech Conference in Del Mar, California, held on the eve of the Breeders' Cup, Luke Cole was profiled as presenting the Clean Earth Bot system as next-generation paddock automation that collects and recycles manure into fertiliser, reinforcing the relevance of the concept to high-value equine settings.[20, 21]

More recently, Sandra Cole publicly noted being invited to Google Sydney HQ for a tour and round-table discussion, and stated that those conversations helped sharpen the direction and funding pathways for Clean Earth Bot. This is best understood not as product validation by Google, but as evidence that the venture is engaging constructively with broader AI, innovation, and industry communities.[22]

6 Technical Excellence

Clean Earth Bot draws on multidisciplinary engineering rather than a narrow point solution. The technical challenge is not simply autonomous driving; it is reliable operation in outdoor animal environments while integrating navigation, safety, payload handling, manure collection, transfer to on-site anaerobic digestion, and controlled redistribution of liquid fertiliser. That systems-level architecture is where the technical depth of the project lies.

COLETEK is approaching this in a pragmatic way. Instead of claiming a finished commercial robot before the hardest field problems are solved, the team has used its existing Scotty mobile robot platform to demonstrate the manure-to-fertiliser workflow and gather feedback while de-risking the next-stage product architecture. This is good engineering practice: validate the workflow, user interaction, operating environment, and attachment requirements before locking into a dedicated production platform.

The engineering quality is also strengthened by founder background and product-development context. Luke Cole brings long-standing experience across autonomous systems, mobile robotics, computer vision, electronics, and commercial product development, while Sandra Cole contributes deep equine-domain knowledge and the end-user perspective that defined the product need in the first place.

Luke Cole's broader technical standing has also been publicly recognised by Alex Zelinsky AO FAA, who described him as "an outstanding young Australian and entrepreneur whom he had the privilege to mentor".[23]

The project's technical merit is also reinforced by the fact that it sits inside a coherent systems view. Clean Earth Bot is not framed as a gadget or one-off paddock helper. It is being developed as a practical robotics layer inside a wider manure-to-fertiliser circular workflow that connects animal health, biosecurity, paddock condition, nutrient reuse, and operational efficiency.

Within the wider Clean Earth Bot system, anaerobic digestion is the processing layer that converts collected organic waste into two useful outputs: biogas and digestate. Biogas can be used directly for heat and electricity or upgraded to biomethane, while digestate can be managed as a nutrient-rich fertiliser. Published work has also shown that horse dung can be used as a feedstock in solid-phase biogas digestion systems, which is directly relevant to Clean Earth Bot's equine-first deployment logic.[24] This matters because Clean Earth Bot is not only automating manure collection; it is linking that collection step to a circular on-site energy and nutrient-recovery pathway.

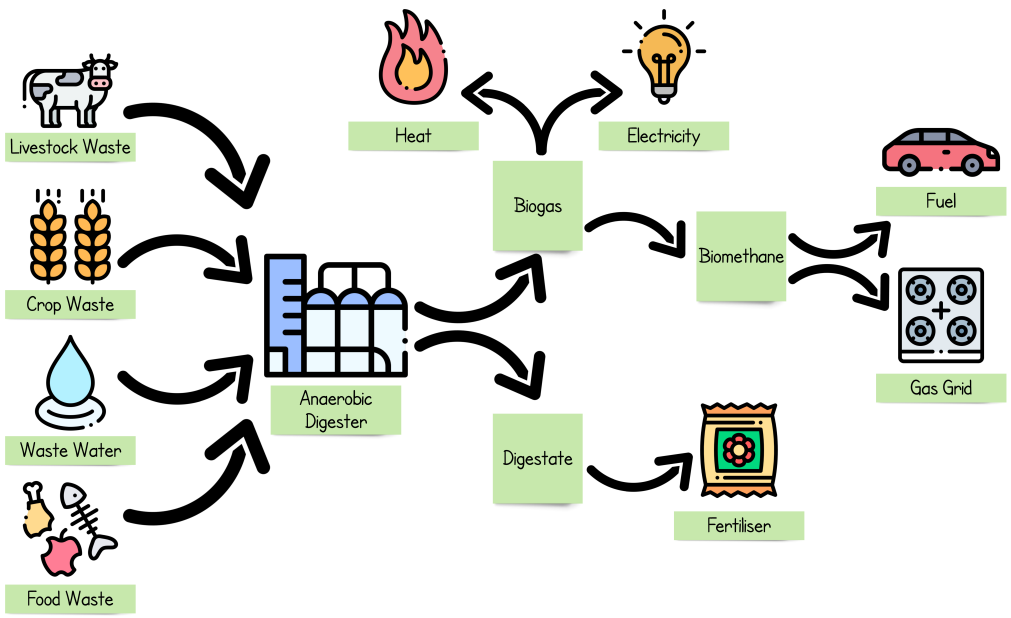

Figure 2: Anaerobic digestion layer relevant to Clean Earth Bot: organic waste streams enter the digester, producing biogas for heat, electricity, or biomethane, and digestate for fertiliser.

This digestion layer strengthens the technical architecture of the project by turning waste handling into a controllable processing workflow rather than a mere disposal task. In Clean Earth Bot, the robot is therefore not the entire solution by itself; it is the autonomous collection and logistics layer within a broader waste-to-nutrient and waste-to-energy system.

7 Current Development Status

Clean Earth Bot is currently at proof-of-concept stage rather than full commercial deployment. COLETEK has used its existing Scotty mobile robot platform to demonstrate the core manure-to-fertiliser workflow, gather stakeholder feedback, and de-risk the next-stage architecture. This is a deliberate engineering approach: validate the problem, workflow, and subsystem logic first, then progress toward a more dedicated production platform and field-trial program.

This current maturity position is a strength rather than a weakness. It keeps the case study technically honest, clearly distinguishes what has already been demonstrated from what is still being developed, and shows that the project is being advanced through staged validation rather than over-claiming premature commercial readiness.

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