

## **Final Report**

# **Industry level lifecycle analysis updated to better understand eco-credentials and minimise risks**

**Project leader:**

Jeff Vickers

**Report authors:**

Jeff Vickers, Emily Moore and Haoran Lei

**Delivery partner:**

thinkstep-anz

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Industry level lifecycle analysis updated to better understand eco-credentials and minimise risks (MU22005)

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Level 7  
141 Walker Street  
North Sydney NSW 2060

Telephone: (02) 8295 2300

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## Public summary

Hort Innovation commissioned this project to give the Australian mushroom industry a consistent way to measure and improve its environmental performance. The work included an up-to-date industry-wide Life Cycle Assessment (LCA) and a practical tool for growers to measure their own environmental footprints. An LCA measures the environmental impacts of a product across its full supply chain – from raw materials and energy use through to production, packaging and distribution – to identify where impacts are highest.

This project fills a long-standing gap: growers previously lacked a reliable benchmark or a way to compare their performance with industry averages. The work focuses on key indicators such as carbon footprint, waste, recycling, water use and energy use. The main audience is Australian mushroom growers, particularly Australian Mushroom Growers Association (AMGA) members. Consultants who support growers will also use the results and tools.

### Key activities

thinkstep-anz worked with a pilot group of three major mushroom growers to collect 12 months of on-farm data. The team provided support through calls, online meetings and site visits. The data was used to develop an ISO 14044-compliant LCA model. A program reference group with Hort Innovation and AMGA met regularly to provide directions. An Excel-based benchmarking tool was also developed using publicly available emission factors aligned with national reporting requirements.

### Key outputs

Industry-average LCA: Identifies the main environmental hotspots. Packaging, electricity, fuel use, composting and growing processes, and raw material production contribute most to impacts for greenhouse gas emissions and most of the other environmental indicators. Distribution has only a small influence on greenhouse gas emissions.

Benchmarking tool: Enables growers to calculate their greenhouse gas emissions using simple inputs. Both the LCA and tool will be available on the AMGA member portal, supported by a webinar and an article in early 2026.

### Key outcomes

The project provides the mushroom industry with:

- a trusted environmental benchmark
- a practical method for growers to assess their environmental footprint
- clarity on the main environmental hotspots
- improved understanding of how operational choices influence emissions

It supports the Australian Mushroom Industry's Strategic Investment Plan (2022–2026), particularly improving productivity and maintaining competitiveness.

### Recommendations

The LCA outlines opportunities for improvement, including:

- increasing renewable energy use
- reducing natural gas consumption
- improving production yields where feasible
- reducing packaging and increasing recycled content
- considering whole-of-life impacts when changing materials

Growers are encouraged to use the benchmarking tool to identify their own hotspots and track performance over time. A follow-up LCA in five to ten years would help measure industry progress toward national emissions targets.

## Keywords

Mushrooms; Australian Mushroom Industry; Agriculture; Life Cycle Assessment; LCA

## Introduction

Many Australian industries are facing significant cost pressures while operating in an environment where the Australian Government had committed Australia to net zero greenhouse gas emissions by 2050. To support this target, an interim emissions reduction goal of 43 percent by 2030 is in place. The Australian mushroom industry is particularly affected, largely because it lacked a reliable environmental performance benchmark and a clear way to measure on-farm emissions. Growers were unable to assess the environmental impact of their operations or understand how they were tracking against national emissions targets.

Recognising this gap, Hort Innovation commissioned an LCA study and the development of an emissions calculator tool. The LCA assessed the environmental impacts of mushroom production in Australia and produced an industry-average benchmark for growers to compare their performance against. The results now enable growers to make informed decisions about materials and production processes. With this knowledge, growers can identify hotspots in their supply chain and develop emission reduction targets that align with government expectations.

The emissions calculator was developed alongside the LCA and allows growers to enter their own on-farm inputs to calculate the environmental impacts of their operations. The tool is hosted on the AMGA website and delivered in Microsoft Excel to maximise accessibility. Any updates or maintenance of the tool could be captured by a future research project but are not included within this body of work.

The project contributes to Outcome 2 of the Australian Mushroom Industry's Strategic Investment Plan (2022–2026): improving industry productivity to maintain competitiveness and secure supply. This will be supported through the optimisation of production processes informed by the LCA recommendations.

## Methodology

Upon formal agreement to commence the project, the thinkstep-anz project team met with the project group comprising of representatives from Hort Innovation and a small group of Australian mushroom growers. This project kick-off meeting confirmed key project milestones, listed the environmental indicators to be included in the study, mapped out the pilot study process and listed the intended deliverables of the project.

The pilot group was then established with three mushroom growers with varying size and location across Australia. While there was initial interest expressed by a larger number of growers, they were unable to commit to the pilot study. The three growers collectively have nearly 30% market share, helping to provide defensible results from the LCA.

A data collection template was prepared by the thinkstep-anz team and was distributed to the pilot group. This template requested information regarding on-farm inputs for a period of 12 months of production. To support the pilot group in collecting data, the thinkstep-anz team made themselves available via phone calls and online meetings via Microsoft Teams. Some on-site visits were also conducted to further aid the data collection process.

Once the primary data was gathered from the pilot group, the thinkstep-anz team reviewed the data. There were a few instances where the team returned to the growers with requests for more data, or for clarification of the data provided, to fill some data gaps. The reviewed data was then used to build a LCA model for the mushroom industry. The study follows ISO 14044, the international standard for LCA, and was carried out by LCA practitioners. Please refer to the LCA background report for a more detailed methodology.

The results from the completed LCA model were reviewed iteratively by the thinkstep-anz team until the results were ready to be finalised. These results are summarised in the results and discussion section (see page 8).

Once the LCA model was complete, the thinkstep-anz team developed the benchmarking tool in Microsoft Excel. The tool was created using publicly available emission factors, rather than the commercial emission factors used in the main LCA study. This was done to ensure alignment with Australia's National Greenhouse and Energy Reporting Scheme and to avoid data licence fees so that all mushroom growers could use the tool. However, the use of these public emission factors means the tool is only capable of calculating carbon footprint, rather than any other environmental indicator such as water or eutrophication. These other indicators were calculated in the LCA report using commercial emission factors.

Halfway through the project, a program reference group was established. This group was comprised of the R&D manager from Hort Innovation, two members of AMGA and two members from the thinkstep-anz team (Project Leader and Project Administrator). The purpose of this group was to ensure that the direction of the project remained aligned with the industry expectations. The group met every six weeks during the project lifetime to provide feedback on interim deliverables, review project progress and raise ideas and concerns which helped further shape the project outcomes. On top of this, weekly updates were provided to Hort Innovation via e-mail and the milestone reports submitted with each interim deliverable provided Hort Innovation with clarity on progress.

The final LCA report and benchmarking tool will be hosted on the AMGA online portal. This portal is only accessible to AMGA members, rather than the broader public. To provide more information around these tools, a webinar and an article will be circulated on the AMGA online portal in Q2 2026. AMGA members are likely to be Australian mushroom growers and consultants.

## Results and discussion

The results of the LCA study are presented in the background report which will be made available to Hort Innovation and AMGA members. The study found that the main contributors to the carbon footprint of mushrooms were:

- Packaging of finished mushrooms, particularly cardboard and PET.
- Operational emissions during the composting and growing processes.
- Electricity and fuel consumption during mushroom growing.
- Production of raw materials, particularly compost.

The results of this LCA can be used as a valuable input to future research into the environmental impact of the Australian mushroom industry. The process used for the study is standardised and repeatable, which will be useful if the study is to be repeated in the near future to assess the industry's progress towards the Australian Government's 2050 emission reduction targets.

## Outputs

**Table 1. Output summary**

Output	Description	Detail
Data collection with a select group of mushroom growers, develop the LCA model and preliminary results	Data collection complete, with LCA model and preliminary results generated.	The output will be made available on the AMGA online portal. This will only be accessed by AMGA members who are predominantly mushroom growers or consultants. AMGA members will be made aware of this output via an article and a webinar which will be circulated in the first half of 2026.
Development of a Microsoft Excel tool for growers to calculate their own specific environmental footprint	A simple tool which enables growers to understand their own environmental footprint (focus on carbon indicators).	The output will be made available on the AMGA online portal. This will only be accessed by AMGA members who are predominantly mushroom growers or consultants. AMGA members will be made aware of this output via an article and a webinar which will be circulated in the first half of 2026.

## Outcomes

**Table 2. Outcome summary**

Outcome	Alignment to fund outcome, strategy and KPI	Description	Evidence
Development of trusted sustainability credentials for the mushroom grower industry and increased industry sustainability	Australian Mushroom industry's Strategic Investment Plan (2022-2026) – Outcome 2	A significant share of the growers is aware of their product sustainability by the end of the project	Three major growers (~30% market share collectively) have used the carbon tool and have results for their products. The MushroomLink article and webinar will create further awareness.
Raise awareness of what the industry is doing and achieving within environmental sustainability	Australian Mushroom industry's Strategic Investment Plan (2022-2026) – Outcome 2	Number of growers indicating the tool assists in increasing their knowledge in assessing their product's environmental impact	MushroomLink article and webinar, survey of growers who have used the preliminary carbon tool, presentation at AMGA Conference 2024
Measuring the industry's carbon footprint, waste generation, materials recycling, water usage, energy usage and overall environmental management and developing industry-average results	Australian Mushroom industry's Strategic Investment Plan (2022-2026) – Outcome 2	The mushroom industry is well-informed on its environmental performance, including strengths and gaps in data  Clarity on steps required to strengthen performance without compromising productivity or profitability  Stakeholders are provided with an understanding of how well the industry performs	MushroomLink article and webinar which explain the LCA study and the calculator to growers

## Monitoring and evaluation

Table 3. Key Evaluation Questions

Key Evaluation Question	Project performance	Continuous improvement opportunities
<p>To what extent has the project achieved its expected outcomes?</p> <p>To what extent has the project increased the adoption of the sustainable industry best practice guidelines?</p> <p>To what extent has the project improved knowledge and awareness of growers’ insights on sustainability?</p> <p>To what extent has the project increased the percentage of produce meeting minimum/optimum sustainable requirements?</p> <p>Has the project developed a new sustainable benchmarking tool that is now available for industry uptake?</p>	<p>The pilot group of mushroom growers, which represent a significant proportion of total production, have improved upon their knowledge and awareness of sustainability through their contributions to this project. The data collection process highlighted how operational decisions influence the emissions footprint of the resulting yield.</p> <p>A new sustainable benchmarking tool has been developed through this project. The tool will be made available for industry uptake via the AMGA online portal.</p> <p>It is too early to determine if the project has increased the percentage of produce meeting sustainability requirements. Once the tool has been adopted by mushroom growers, they can compare their results against the industry average shown in the LCA report to see how they are tracking.</p>	<p>There should be an opportunity for growers to provide feedback on the benchmarking tool. The feedback could be incorporated into future versions of the tool, to keep the tool relevant and useful for industry.</p> <p>If possible, AMGA could provide website analytics to show how many of their members are accessing the LCA study and the benchmarking tool. This will help us understand the uptake within industry and how successfully this project aim has been met.</p>
<p>How relevant was the project to the needs of intended beneficiaries?</p> <p>To what extent has the project met the needs of mushroom industry levy payers?</p> <p>How relevant was the project to the needs of the growers/association/industry to produce sustainable products?</p>	<p>The project has provided mushroom industry levy payers with a reliable sustainability benchmark through the LCA report, and a means of comparing their individual performance against the industry benchmark through the tool. This will help them track their progress against the Australian Government’s emission reductions targets and will enable them to report their emissions if this becomes required.</p>	<p>As above, there should be an opportunity for growers to provide feedback on the benchmarking tool which could then inform any future updates to the tool.</p>

<p>How well have intended beneficiaries been engaged in the project?</p> <p>To what extent were the target engagement levels of mushroom industry levy payers achieved?</p> <p>Have regular project updates been provided through linkage with the industry communication project?</p>	<p>The pilot group of mushroom growers were involved since the start of the project. This group consists of three major growers, which makes up a significant share of total production. The pilot group was engaged through emails, phone calls and site visits throughout all stages of the project, particularly during data collection phase.</p> <p>Regular project updates have been made to Hort Innovation through weekly email updates and program reference group (PRG) meetings every six weeks.</p>	<p>As stated above, feedback from the industry relating to their use of the LCA report and tool could be collated and actioned.</p>
<p>To what extent were engagement processes appropriate to the target audience/s of the project?</p> <p>Did the project engage with industry levy payers through their preferred learning style?</p> <p>To what extent were engagement processes successful to target the mushroom growers, association and industry of the project?</p>	<p>Most of the engagement was conducted virtually (over the phone, through email and online meetings). We recognised that site visits were necessary to help growers fill out the data collection template effectively.</p> <p>Engagement with the mushroom industry (AMGA) was conducted purely virtually, primarily through emails and PRG meetings every six weeks. Actions and minutes were circulated after each meeting, which helped to keep all parties accountable for project responsibilities. This frequent engagement with the industry body ensured that the project outcomes were always aligned with expectations from industry.</p>	<p>Industry levy payers will continue to be engaged through the article and webinar to be posted on the AMGA portal via MushroomLink.</p>
<p>What efforts did the project make to improve efficiency?</p> <p>How does the developed sustainability benchmark tool help individual growers to benchmark their sustainability impact over the industry-average impacts?</p>	<p>As thinkstep-anz were developing a similar benchmarking tool for other horticulture sectors, efficiencies were made as the structure of the tool was already in place.</p> <p>The benchmark tool has been designed so that mushroom growers can provide simple inputs to return powerful outputs. AMGA have provided feedback on a draft of the tool, and this feedback has been incorporated into the final version.</p>	<p>AMGA could provide ongoing support for use of the tool, while also using this to gauge the level of uptake by members.</p>

## Recommendations

The LCA report ends with several recommendations for the Australian mushroom industry to follow so that they may collectively reduce emissions. These recommendations are summarised below.

- Increase use of renewable electricity, such as on-site solar and purchased renewable energy certificates (RECs)
- Reduce use of natural gas
- Improve production yields (wherever feasible)
- Reduce use of packaging and/or consider alternative packaging materials
- Increase recycled content in packaging
- Consider the whole life cycle when making changes, to avoid shifting environmental impacts from one stage to another.

In addition to adopting these recommendations, we propose that mushroom growers use the benchmarking tool to calculate their on-farm emissions. Using this information, growers can understand their own environmental hotspots and can develop plans to improve their performance over time. These hotspots could also be the focus of future research into resources efficiencies and cost savings. The environmental performance of individual growers can also be compared with the industry average to see their progress towards the Australian Government's emission reduction targets.

Another future research project could involve an updated LCA in 5 to 10 years. This update could be based on the results generated by mushroom growers who have used the benchmarking tool, rather than starting from scratch with a pilot group, which would significantly reduce the time required for data collection. The two industry-average benchmarks could then be compared to quantify the progress made against emissions reduction targets.

We recommend that the AMGA continue to promote the LCA report and the benchmarking tool to their members and to monitor their uptake over time.

## Refereed scientific publications

None to report.

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## **Intellectual property**

Restrictions to the IP raised during the project apply. More details contained in the IP register.

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