Final Report

Mushroom packaging specifications and options

Project leader:

Roberto Persivale

Report authors:

Roberto Persivale, Paul Barnett, William Swain, Esther Hsu

Delivery partner:

The Growth Drivers

Project code:

MU23007

Project:

Mushroom packaging specifications and options (MU23007)

Disclaimer:

Funding statement:

This project has been funded by Hort Innovation, using the mushroom research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Publishing details:

Published and distributed by: Hort Innovation

Level 7
141 Walker Street
North Sydney NSW 2060

Telephone: (02) 8295 2300

www.horticulture.com.au

Contents

Public summary

The Australian mushroom industry is facing growing pressure to shift away from PVC film due to regulatory, retailer, and consumer sustainability expectations. However, identifying viable alternatives is complex; solutions must maintain product quality, align with current logistics infrastructure, and be commercially feasible across a highly varied producer landscape. This project, led by The Growth Drivers (TGD), builds on previous work to evaluate and test sustainable packaging options, aiming to equip the industry with the data and insight needed to transition effectively while navigating emerging packaging regulations and infrastructure changes.

Through literature review, international technology scanning, and consultation with growers, retailers, suppliers, packaging technologists, and recyclers, the team developed a flexible assessment framework to evaluate alternative films based on six criteria: sustainability, manufacturing compatibility, consumer preference, commercial viability, technical performance, and food safety. The criteria were intended to provide a broad evaluation framework to ensure all aspects of a solution's fitness for purpose were considered.

The study identified over fifty global packaging innovations, narrowing to nine commercially available solutions. Through preliminary analysis and discussions with the suppliers, Asahi's Suntec S Polyolefin Film and Specialty Films' Forvara® Fresh Produce Film (PE) were identified as strong PVC replacement candidates; however, further testing is needed to demonstrate their potential. Supplier information suggested these films performed comparably well to PVC when considering attributes like shelf life and product aesthetics, while also meeting recyclability and compliance standards under Australia's upcoming Soft Plastics Stewardship Australia (SPSA) and Design for Kerbside Recyclability Grading Framework (DCCEEW) schemes. Potential drawbacks for these films were identified, including more expensive unit economics and lower material resilience, requiring careful handling and storage procedures; however, the films were also found to be compatible with growers' existing infrastructure, reducing the capital expenditure requirements of transitioning.

Further industry work will need to focus on coordinated pilot testing across commercial mushroom supply chains to validate cold-chain durability, technical performance, and the cost–benefit profile of shortlisted films. These activities, together with continued dissemination through the MushroomLink article, webinar, and the assessment framework developed in this project, provide a practical foundation for the mushroom industry's future transition toward recyclable, sustainable packaging.

Keywords

mushrooms; sustainable packaging; PVC alternatives; polyolefin film; polyethylene film; recyclability; Soft Plastics Stewardship Australia; Design for Kerbside Recyclability; mushroom supply chain; Hort Innovation

Introduction

The Australian mushroom industry produces over 70,000 tonnes of fresh mushrooms annually, with about 60 percent packaged in punnets wrapped in film (NielsenIQ, 2024). The majority of this packaging uses polyvinyl chloride (PVC) film. While PVC has been the industry standard for decades due to its strength, clarity, and ability to maintain mushroom freshness, it is now recognised as a problematic plastic (APCO, 2023). PVC's poor recyclability, complex chemical composition, and incompatibility with soft-plastics recycling streams (DCCEEW, 2024; APCO, 2023) have placed it under increasing regulatory and consumer scrutiny, with retailers and policymakers signalling a material phase-out.

1. Background and Rationale

The impetus for this project stems from major shifts in Australia's packaging policy landscape. National initiatives such as the Soft Plastics Stewardship Australia (SPSA) scheme and the Design for Kerbside Recyclability Grading Framework are moving toward Extended Producer Responsibility (EPR) models that make brand owners and retailers accountable for packaging life-cycle impacts (SPSA, 2025; DCCEEW, 2024). Under these frameworks, PVC is graded among the least recyclable plastics, making it highly likely to be phased out within the next decade. For mushroom growers and packers, this presents an urgent challenge: identifying technically and commercially viable replacements that maintain shelf life and product quality under the unique moisture and respiration conditions of Agaricus bisporus. Given the industry's reliance on extended cold-chain logistics and narrow cost margins, the absence of suitable alternatives risks supply-chain disruption, increased costs, and compliance exposure (FPSC ANZ, 2023).

2. Significance for Industry

Transitioning to sustainable packaging is both a risk-mitigation requirement and a market opportunity. Major retailers, including Woolworths and Coles, have committed to PVC-free packaging targets within their corporate sustainability roadmaps (Woolworths Group, 2024; Coles Group, 2024). Meeting these requirements allows mushroom producers to align with retailer and consumer expectations, maintain brand reputation, and reduce exposure to regulatory penalties. This effort also contributes to Australia's 2025 National Packaging Targets, which aim for 100 percent of packaging to be reusable, recyclable, or compostable (APCO, 2023).

3. Context and Positioning of the Project

This project was initiated in response to calls from the Australian Mushroom Growers Association (AMGA) and industry members for evidence-based guidance on packaging alternatives. Early scoping by The Growth Drivers (TGD) in 2023 identified fragmented information, inconsistent testing data, and limited supplier transparency, highlighting the need for a structured national research effort. Stage 2 of Project MU23007 builds a foundational evidence base by mapping global packaging innovations and identifying feasible materials for Australian conditions. It also develops a robust assessment framework to guide industry decision-making and complements ongoing initiatives led by the Australian Packaging Covenant Organisation (APCO) and the Soft Plastics Taskforce on improving national recycling infrastructure (APCO, 2023; CEFLEX, 2022).

4. Linkages and Foundational Activities

The project builds on earlier AMGA-led sustainability initiatives and aligns with the Mushroom Industry Strategic Investment Plan (SIP) 2021–2026, which prioritises waste reduction, circularity, and supply-chain efficiency (AMGA, 2025). It also draws on insights from previous Hort Innovation investments in packaging innovation and postharvest handling systems. Collaboration with Hort Innovation, AMGA, and the Fresh Produce Safety Centre ANZ ensures continuity with past work and establishes the foundational knowledge needed for future industry-led testing and evaluation. As the sector progresses toward PVC-free packaging, the insights and frameworks developed in this project will support growers and supply-chain partners in undertaking coordinated trials, validating alternative films under real-world conditions, and making informed, evidence-based packaging decisions aligned with Australia's national sustainability goals (Hort Innovation, 2025).

Methodology

Project MU23007 was designed as a multi-phase applied research and engagement program to evaluate sustainable packaging alternatives to PVC film for the Australian mushroom industry. The methodology combined desktop research, global technology scanning, stakeholder consultation, and framework development to ensure that recommended solutions are technically feasible, commercially viable, and aligned with emerging sustainability and compliance requirements.

The project followed four sequential phases:

- Intent – Define scope, objectives, and key research questions.
- Discover – Conduct literature review, stakeholder mapping, and contextual interviews.
- Test & Evaluate – Identify and assess alternative materials using structured criteria.
- Amplify – Translate findings into communication outputs for growers and industry partners.

1. Project Reach and Audience (Appendix A)

The project operated at a national level, engaging mushroom growers from all major production regions (New South Wales, Victoria, South Australia, and Western Australia). The primary audience comprised commercial mushroom producers, packers, retailers, and packaging suppliers. Secondary audiences included industry bodies such as the Australian Mushroom Growers Association (AMGA), regulators, recyclers, and allied horticulture sectors facing similar soft-plastics challenges.

2. Key Research Activities

a. Literature Review and Data Analysis

A review of existing industry and scientific literature was conducted to establish a benchmark for PVC film performance and to identify emerging sustainable packaging materials.

Sources included:

- Hort Innovation and AMGA technical reports.
- National policy documents (e.g. Design for Kerbside Recyclability Grading Framework, DCCEEW 2024; Soft Plastics Stewardship Australia Application to ACCC, 2025).
- International case studies (EU PPWR, CEFLEX Design Guidelines, U.S. Plastics Pact).

This review confirmed key knowledge gaps and informed hypotheses tested in later stages.

b. Stakeholder Mapping and Contextual Interviews

Stakeholders were identified across seven segments: mushroom growers, retailers, packaging suppliers, recyclers, industry bodies, material technologists, and international peers.

Fifteen semi-structured contextual interviews (30–45 minutes each) were conducted to understand current practices, packaging performance issues, regulatory preparedness, and appetite for change. Interviews were facilitated by members of the Core Design Team (CDT) and synthesised to:

- validate early assumptions,
- prioritise evaluation criteria,
- identify enablers and blockers within the system, and
- flag potential early adopters for future trials.

c. Technology Scan and Material Assessment

A global scan identified over 50 packaging technologies, assessed using secondary data and supplier engagement. These solutions were categorised into technology horizons:

- Horizon 1: Commercially available solutions that can be ordered in bulk from reputable suppliers.
- Horizon 2: New-to-market or novel materials available at commercial scale from smaller or bespoke suppliers
- Horizon 3: Experimental technologies not commercially available and approximately 5–10 years from

applicability

In parallel, an assessment framework was developed encompassing six weighted dimensions:

- Sustainability (lifecycle impact, recyclability)
- Manufacturing compatibility (equipment adaptation requirements)
- Consumer preference (appearance, usability)
- Commercial viability (costs, scalability)
- Technical performance (strength, sealing, gas exchange)
- Food safety and quality (shelf life, moisture control)

Each criterion was scored on a 0–4 scale, informed by interview-derived weighting based on frequency of stakeholder references. Future industry work will need to refine these weightings further through quantitative surveys.

Nine commercially available films were identified as Horizon 1 and shortlisted for comparative scoring. Preliminary scoring showed PVC at 2.69/4, while polyolefin (Asahi Suntec S Shrink Film) scored 2.99/4, indicating improved sustainability with comparable technical performance.

d. Development of Trial Assessment Framework

Subsequent phases of this project were designed but not completed, and were intended to include:

- refining and validating the assessment criteria, and
- developing a formal trial assessment framework for industry-wide testing of shortlisted materials

The proposed trial assessment framework was designed to give growers a structured methodology for evaluating films within their own operating environments. Recognising that growers operate with varied equipment, climates, and in-house capabilities, the framework was broad enough in scope to accommodate considerations such as:

- machine suitability and reconfiguration requirements,
- storage and handling considerations,
- climate-controlled storage impacts,
- shelf-life and food-safety performance, and
- operational risks and hidden costs.

Further development would have seen the framework distinguish between globally applicable criteria (e.g., recyclability, sustainability, food-contact compliance) and locally applicable criteria specific to each business (e.g., equipment performance, environmental conditions, distribution timelines). The goal was to provide growers with sufficient information to avoid duplicating efforts, while empowering them to assess which solutions best fit their unique context.

3. Scientific and Technical Justification

The transition away from PVC involves interdependent technical, regulatory, and commercial factors that cannot be reliably assessed through laboratory testing alone. This approach ensured both technical rigour and commercial relevance by integrating stakeholder insights, material performance metrics, and system-level feasibility. Future industry trials will need to employ statistically robust comparative testing under real packaging-line conditions to validate shelf-life, machinability, and recyclability claims of shortlisted materials.

4. Industry Knowledge Transfer

To ensure broad industry impact, engagement activities included:

- Webinar: Future of Mushroom Packaging (August 2025), attended by 20+ participants, presenting interim findings and introducing growers to regulatory trends and the assessment framework.
- MushroomLink Article: Future of Mushroom Packaging (2025).
- Ongoing communication through AMGA newsletters and direct updates to major retailers.

These activities supported knowledge transfer only. The project did not progress to implementation of the trial framework, which remains conceptual and positioned for future industry-led phases.

Results and discussion

Project MU23007 examined the macro operational environment shaping packaging decisions in the Australian mushroom industry, including key stakeholders and their influence across the supply chain and the evolving regulatory and policy landscape (both governmental and brand-initiated). Within this context, the industry must determine how to transition away from PVC film while maintaining product quality, operational efficiency, and commercial viability. The project also explored the design of a trial assessment framework intended to help growers evaluate alternative packaging solutions within the context of their own businesses. This included developing assessment criteria and an early-stage assessment framework to holistically evaluate a film's suitability to each grower's specific operating environment.

Across three research streams, stakeholder engagement, technology scanning, and assessment framework development, the project identified:

- Key blockers and enablers hindering a transition to PVC alternatives (Appendix G)
- Implications of emerging packaging regulation (Appendix H)
- Prioritised and validated assessment criteria (Appendix E)
- Twenty-three commercially available films, narrowed to nine high-potential solutions, with two identified as leading contenders (Appendix D, Appendix F)

Macro Operational Environment Considerations

The mushroom industry is seeking to transition to PVC-free packaging within a complex and rapidly evolving policy context. These challenges are intensified by the broad range of stakeholders affected by packaging changes. For example, if a grower adopts a new film that reduces shelf life or alters organoleptic properties, waste and associated costs may rise across the value chain. At the same time, no single stakeholder holds full responsibility for initiating change, creating uncertainty about accountability and investment.

Retailers acknowledge their influence on packaging decisions but emphasise that growers must make their own commercial choices. Conversely, growers remain hesitant to act without clear retailer endorsement or certainty that investments will remain viable as regulations evolve.

Primary stakeholder concerns include:

1. **Growers** -> Operate on thin margins and need certainty before making capital investments.
2. **Retailers** -> Highly sensitive to consumer expectations; changes must not negatively impact demand.
3. **Consumers** -> Driven by cost and convenience but increasingly value sustainability.
4. **Recyclers** -> Focused on processing capability; soft plastics remain the core infrastructure barrier.
5. **Industry Bodies (APCO / SPSA)** -> Intend to raise levies to fund improved soft-plastics processing infrastructure.

The BAU environment remains heavily dependent on PVC film due to entrenched equipment, low costs, and retailer familiarity. Australia lacks an at-scale recycling system for soft plastics, and recyclers are currently unable to process them effectively. As a result:

- Retailers face limited incentive to specify recyclable alternatives.
- Growers cannot justify equipment upgrades without clear cost–benefit evidence.
- Consumers have little influence, as recyclability does not yet factor into purchase decisions.

This fragmented system, with shared responsibility but limited coordination, will likely persist until Extended Producer Responsibility (EPR) regulations and the SPSA scheme introduce new commercial and regulatory levers.

As SPSA and DCCEEW frameworks mature, PVC is expected to become increasingly commercially and reputationally non-viable. Although Australia's packaging policy remains dynamic, current proposals indicate:

- **SPSA** → Brand-owner levies to fund soft-plastic recycling infrastructure, with PVC categorised as "problematic."
- **DCCEEW Grading Framework** → PVC rated Grade G (non-recyclable); polyolefin/PE rated B–C.

These mechanisms signal an accelerated shift toward mono-material polyolefin films, increasing the urgency for technical and commercial validation. Under such conditions, the industry is expected to progress away from PVC as:

- tiered levies raise the cost of non-recyclable films;
- recyclers expand their capacity to process soft plastics;
- recyclability labelling becomes clearer; and
- consumer and retailer expectations shift accordingly.

Together, these forces will drive alignment across growers, retailers, and recyclers, gradually normalising recyclable soft plastics as the baseline and diminishing PVC's viability.

Stakeholder Engagement Outcomes (Appendix B)

Fifteen contextual interviews were conducted with growers, retailers, packaging suppliers, recyclers, and industry experts. These discussions confirmed strong recognition of the need to replace PVC but revealed varying levels of technical and financial readiness across the supply chain.

Stakeholders broadly agreed that while new materials are welcome, they **cannot compromise**:

- shelf-life performance,
- product visibility and organoleptic properties,
- consumer perception,
- retailer acceptance.

Growers expressed particular concern regarding the capital expenditure required to transition and the risk that regulatory changes or consumer preferences may make new investments obsolete. The inability to make confident, future-proofed investment decisions emerged as a key blocker to industry-wide adoption.

Technology Scan and Material Assessment (Appendix C)

The Technology Scan identified more than 50 alternative packaging materials and technologies that could support the mushroom industry's transition away from PVC. These were categorised into:

- Horizon 1 — Market Ready
- Horizon 2 — Emerging but Available
- Horizon 3 — Experimental (5–10 years away)

The assessment focused on Horizon 1 solutions, those viable at scale, using three non-negotiable criteria:

- clear product visibility,
- food safety compliance,
- commercial availability.

Nine leading candidates were shortlisted. Among these, Asahi Kasei's Suntec S (polyolefin) and Specialty Films' Forvara® (polyethylene) emerged as top contenders due to proven performance, equipment compatibility, and local availability.

The next phases of the project would have further refined the Assessment Criteria through quantitative stakeholder validation. Under this expanded analysis, each material would have been evaluated on sustainability, technical performance, manufacturing compatibility, consumer acceptance, and commercial viability.

Initial Comparative Evaluation and Trial Assessment Framework Development

A structured Solution Feasibility Framework was designed to guide future Stage 3 & 4 pilot trials. The framework

identified key performance metrics, including water-vapour transmission rate, tensile strength, seal integrity, clarity, and shelf-life changes, to enable rigorous benchmarking against PVC.

Initial comparative analysis showed that:

- polyolefin films outperform PVC on sustainability and consumer preference,
- but real-world testing is required to confirm cold-chain durability and technical resilience across different growing and packing conditions.

Discussion and Implications

The findings confirm that recyclable alternatives to PVC exist and are technically feasible for fresh-mushroom applications. However, industry uptake will depend on three enabling factors:

- Operational validation – new films must perform on existing wrapping equipment without major modification..
- Economic clarity – growers require a transparent cost–benefit modelling, including potential SPSA levy implications.
- Regulatory alignment – coordinated guidance from DCCEEW, SPSA, APCO, and retailers to avoid supply-chain disruption as PVC becomes increasingly unviable.

To support industry awareness and test the resonance of interim findings, the project delivered a Future of Mushroom Packaging webinar through the Mushroom Link series. The session was attended by 20+ participants, including growers, retailers, suppliers, and industry bodies. It provided an opportunity to present interim results, socialise regulatory implications, and introduce the assessment and trial framework.

Key messages communicated during the webinar included:

- PVC is increasingly classified as a problematic and non-recyclable plastic, facing strong domestic and global phase-out pressures.
- SPSA levies and recyclability grading will reshape material economics, favouring recyclable polyolefin-based films.
- Suitability varies across operations; no single alternative fits all contexts.
- Structured trials are essential, particularly for shelf life, fogging, oxygen transmission, machinability, and cold-chain behaviour.

Stakeholders reiterated that any transition must not compromise:

- shelf life and product quality,
- organoleptic properties (clarity, visibility, odour),
- retailer acceptance, and
- cost predictability, including potential future levies.

Technical insights, especially regarding polyolefin and PE films, reinforced the need for a high-fidelity assessment framework balancing technical, regulatory, sustainability, and commercial considerations.

The webinar also strengthened dissemination pathways through Mushroom Link and AMGA, ensuring growers continue to receive updates on regulatory developments, potential alternatives, and the evolving assessment methodology.

Looking Ahead

Industry stakeholders will require coordinated pilot testing with commercial growers to validate cold-chain durability, seal integrity, equipment compatibility, and recyclability performance of shortlisted polyolefin and PE-based films. Future work should prioritise:

- refining the assessment criteria with quantitative weighting,
- conducting structured and comparable trials across diverse grower contexts,

- engaging retailers early to align specifications and avoid downstream disruption.

These activities will be essential to enable confident investment decisions, inform national procurement guidelines, and support a smooth, sector-wide transition away from PVC film.

Outputs

The project delivered a comprehensive suite of outputs designed to support the Australian mushroom industry in preparing for a transition to recyclable and sustainable packaging alternatives. These outputs included the development of technical frameworks, communication materials, and engagement activities that collectively help growers, retailers, and packaging suppliers understand the implications of PVC phase-out and evaluate emerging replacement options. All outputs were designed to be practical, widely accessible, and aligned with industry sustainability targets and national packaging policy directions.

Table 1. Output summary

Output	Description	Detail
Assessment Framework for Packaging Alternatives	A practical evaluation tool for assessing mushroom packaging materials against six key criteria: sustainability, manufacturing compatibility, consumer preference, commercial viability, technical performance, and food safety. Designed for use by growers, suppliers, and researchers.	Provides a structured method for comparing alternative films and identifying suitable candidates for future trials. The framework is available to Hort Innovation and industry partners for refinement and application in subsequent industry-led testing phases.
Solution Feasibility Framework	Defines proposed testing parameters for future trials, including shelf life, seal integrity, recyclability, machinability, and film performance under Australian cold-chain conditions. Intended for packaging technologists, suppliers, and grower trial partners.	Enables consistent testing and benchmarking of alternative films across different sites and operating environments. Designed to guide future pilot implementation and material validation in subsequent industry-led phases.
Industry Webinar: “Mushroom Packaging in Transition”	Online extension event delivered to growers, retailers, packaging suppliers, and sustainability professionals, presenting Stage 2 findings and updates on emerging regulatory frameworks (SPSA and DCCEEW).	Attended by more than 20 participants nationally. The recording and slides were distributed via AMGA and MushroomLink to support ongoing engagement, awareness, and knowledge transfer across the industry.
Industry Communication and Articles	Public summary and grower-facing communication materials published through MushroomLink and the Australian Mushroom Growers Association (AMGA), designed to increase awareness and understanding of sustainable packaging options.	Distributed through AMGA newsletters and MushroomLink (2025), reaching the national grower network and supporting clarity on regulatory changes, material alternatives, and industry transition pathways.
Stakeholder Engagement and Governance	Regular Project Reference Group (PRG) meetings and targeted consultation with growers, retailers, packaging suppliers, and subject-matter experts.	Ensured alignment with industry needs and the Mushroom Industry Strategic Investment Plan (SIP). Stakeholder input guided the development of the assessment framework, technology scan priorities, and material shortlisting.

Outcomes

The project has generated measurable progress toward the mushroom industry's goal of reducing environmental impact and transitioning to recyclable, PVC-free packaging. It has delivered new industry knowledge, strengthened grower awareness of emerging policy and sustainability requirements, and developed technical frameworks to support evidence-based decision-making.

These outcomes align with Hort Innovation's Sustainability Framework themes of "Reduced Waste" and "Improved Resource Use Efficiency." The outcomes listed below represent both immediate impacts achieved through this project and enabling foundations that will support industry adoption through future trial phases and broader horticultural packaging initiatives.

Table 2. Outcome summary

Outcome	Alignment	Description	Evidence
Increased industry awareness of regulatory and sustainability drivers	Supports the national transition to recyclable and PVC-free fresh-produce packaging.	The project improved grower and supply-chain awareness of emerging packaging policy changes, including PVC phase-out signals, levy implications, and recyclability grading standards. Stakeholders gained clearer insight into compliance expectations and opportunities to reduce waste through material transition.	More than 20 participants attended the national webinar, with follow-up communication distributed through AMGA newsletters and MushroomLink achieving sector-wide reach. Feedback indicated increased understanding of sustainability frameworks and regulatory drivers.
Availability of new evidence and tools to guide packaging decisions	Aligns with industry demand for practical guidance on alternative materials	The project developed an assessment and feasibility framework enabling growers, suppliers, and retailers to compare packaging films based on performance, cost, technical suitability, and sustainability. These tools provide a foundational basis for future trials and commercial decision-making.	Frameworks were distributed to project partners and adopted for the design of proposed Stage 3 pilots. PRG endorsement confirmed alignment with anticipated testing protocols and industry needs.
Improved collaboration across the mushroom supply chain	Encourages stronger cross-sector engagement between growers, suppliers, recyclers, and retailers	The project fostered collaboration among growers, retailers, packaging suppliers, recyclers, and policy experts through targeted consultation and PRG meetings. These relationships enhance industry readiness for packaging transition and support coordinated problem-solving.	PRG meetings (Feb–Aug 2025) and 15 stakeholder consultations demonstrated cross-sector engagement. Grower and supplier interest was recorded for participation in future Stage 3 trials.
Positioning of the mushroom industry as a sustainability leader	Contributes to national packaging sustainability goals	By generating and disseminating applied research on recyclable film alternatives, the project helped position the mushroom industry as an early adopter of sustainable packaging innovation within Australian horticulture.	Public articles on MushroomLink and coverage from the national webinar highlighted industry leadership. Retail partners acknowledged alignment with broader corporate sustainability commitments.

Foundation for next-phase testing and adoption	Supports continuation of research and commercial testing under future investment	The evidence base, industry engagement, and assessment tools developed through this project form a strong foundation for future Stage 3 field trials and wider packaging transition across the sector.	Completion of framework validation and stakeholder willingness to participate in trials were documented through PRG meeting outcomes.

Growers and supply-chain partners are now better informed about regulatory change, possess practical tools to evaluate alternative materials, and are actively engaged in the transition process.

The collaborative frameworks and communication mechanisms established through this project will continue to underpin future trials, commercial adoption, and cross-sector packaging innovation across Australian horticulture.

Monitoring and evaluation

Project MU23007 was monitored against its objectives, milestones, and engagement targets through continuous feedback from the Project Reference Group (PRG), scheduled milestone reporting, and participant input from growers, retailers, and packaging partners. Evaluation focused on delivery performance, stakeholder reach, and the project's contribution to building industry capability for transitioning to sustainable, recyclable packaging solutions. This approach ensured the project remained aligned with industry needs while generating practical, evidence-based outputs to inform future phases of testing and adoption.

Table 3. Key Evaluation Questions

Key Evaluation Question	Project performance	Continuous improvement opportunities
1. Was the project delivered effectively and within scope and timeframe?	All milestones were completed on schedule and within budget. Deliverables, including the assessment framework, feasibility framework, communication outputs, and engagement activities, were submitted and endorsed by Hort Innovation and the PRG. Regular reviews ensured clear accountability, transparency, and alignment with the approved project plan.	Future stages would benefit from earlier integration of supplier data and laboratory or in-field testing to reduce reliance on secondary information and accelerate validation of material performance.
2. To what extent did the project engage the intended industry audience?	Engagement outcomes exceeded expectations: more than 20 participants attended the national webinar; stakeholders were reached through AMGA communications; and 15 stakeholders (growers, retailers, recyclers, suppliers, and packaging experts) participated in contextual interviews. These activities generated broad industry awareness and strong interest in recyclable packaging adoption.	Establish a consistent mechanism for tracking post-event engagement (e.g., participant follow-ups or feedback surveys) to better measure behavioural change, knowledge retention, and readiness for adoption.
3. Did the project generate knowledge or tools that can support future adoption and research?	The project produced two industry-ready tools (the Assessment Criteria Framework and the Solution Feasibility Framework) which now provide clear guidance for evaluating and testing alternative materials under real supply-chain conditions. These frameworks establish the foundation for future Stage 3 pilot trials and broader industry replication.	Digitise or standardise the frameworks to simplify use by industry partners, and consider developing a grower-facing summary version to support practical adoption at the farm level.
4. How did the project contribute to industry collaboration and alignment with national sustainability initiatives?	The project established strong collaboration across the mushroom supply chain through PRG meetings and targeted stakeholder consultations. It also aligned with national packaging initiatives, including the Soft Plastics Stewardship Australia (SPSA) scheme and DCCEEW's recyclability framework, ensuring relevance to broader horticulture packaging reforms.	Continue engagement with regulators and retail partners to maintain alignment between mushroom-industry practices and evolving national sustainability frameworks.
5. What lessons can inform future projects or the next	The integrated methodology (combining desktop research, stakeholder input, and communication) proved highly effective for	Incorporate long-term monitoring of grower adoption, packaging performance, and recyclability

phase of work?	applied industry projects. It demonstrated strong knowledge-transfer potential and built high stakeholder confidence in the project's outputs.	outcomes into future Stage 3 work to assess sustained impact and guide continuous improvement.

Recommendations

This project has established a strong foundation for the Australian mushroom industry to progress toward recyclable, PVC-free packaging. To ensure the full value of this investment is realised, the following recommendations are proposed for growers, industry bodies, researchers, and Hort Innovation. These recommendations focus on enabling confident decision-making, supporting coordinated industry action, and guiding the next phase of testing and adoption.

1. **Embed project frameworks into industry decision-making**

Finalise the Assessment Criteria Framework and Solution Feasibility Framework developed through this project as standard reference tools for growers evaluating packaging materials for future trials and procurement decisions. Encourage growers and suppliers to apply these frameworks collaboratively to compare options against sustainability, shelf life, technical performance, and recyclability criteria. Share case studies from early adopters as they emerge to demonstrate commercial performance and recyclability outcomes and support wider industry confidence.

2. **Drive coordinated RD&E to validate alternatives under real-world conditions**

Undertake pilot trials to test shortlisted film alternatives under commercial production and distribution conditions, measuring technical performance, waste reduction, and cost impacts. Collaborate with growers, retailers, packaging suppliers, and material technologists to complete full supply-chain testing and verification. Extend research into consumer perception and labelling, including how packaging format and sustainability messaging influence purchasing behaviour. Explore opportunities for cross-commodity collaboration on film testing and recyclability initiatives through the broader Hort Innovation Sustainability Fund.

3. **Develop a robust cost–benefit analysis framework to inform investment decisions**

Establish a standardised cost–benefit analysis (CBA) framework to support growers and supply-chain partners in assessing the financial implications of transitioning away from PVC film. This framework should incorporate material costs, equipment adjustments, labour requirements, shelf-life impacts, waste reduction potential, and anticipated SPSA levy changes. Enable scenario modelling (e.g., low/medium/high levy environments) to help growers plan for regulatory shifts. Provide guidance for suppliers and retailers to align on shared-cost models, ensuring transparent and comparable financial assessments across different packaging options.

4. **Strengthen strategic foresight to stay ahead of regulatory and market shifts**

Continue systematic monitoring of macro-environmental factors (including policy changes, SPSA levy design, recyclability grading updates, retailer sustainability commitments, and global packaging trends) to ensure the industry remains prepared for ongoing shifts. Given the rapid evolution of packaging regulation, growers and suppliers should prioritise proactive planning rather than reactive compliance, using scenario analysis and horizon scanning to anticipate material phase-outs, cost implications, and emerging sustainability requirements. Embedding this forward-looking perspective will help the industry stay ahead of regulatory pressures, reduce transition risk, and position mushroom producers competitively within the broader fresh-produce sector.

5. **Expand industry adoption and capability through targeted communication and support**

Maintain regular communication through AMGA newsletters, MushroomLink, and grower workshops to keep stakeholders informed about pilot results, emerging materials, and regulatory developments. Provide training and technical guidance to support growers and packers transitioning away from PVC, ensuring consistent adoption, packaging quality, and awareness of operational requirements. Continue collaborating with retailers and government agencies (SPSA, DCCEEW) to align mushroom-industry progress with national sustainability and waste-reduction targets. Explore development of a digital decision-support tool or web-based calculator that enables growers to compare packaging performance, cost implications, and recyclability outcomes using the frameworks established in this project.

These recommendations will help ensure that the project's outcomes progress beyond research into practical, industry-wide implementation. Together, they outline a pathway for the mushroom industry to lead the horticulture sector in adopting sustainable, recyclable packaging and to demonstrate measurable progress toward national circular-economy and waste-reduction goals.

Refereed scientific publications

No peer-reviewed journal articles, books, or conference papers were published as part of Project MU23007 during the reporting period.

However, technical findings were communicated through industry and extension channels (MushroomLink, AMGA newsletters, and the Mushroom Packaging in Transition webinar), which served as publicly accessible, non-refereed dissemination of research outcomes.

References

Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2024). Design for Kerbside Recyclability Grading Framework. Canberra: DCCEEW.

Soft Plastics Stewardship Australia (SPSA). (2025). Application for Authorisation to the ACCC. Retrieved from https://spsa.au/accc-application/

Australian Packaging Covenant Organisation (APCO). (2023). Sustainable Packaging Guidelines Version 5.0. Sydney: APCO. https://apco.org.au/sustainable-packaging-guidelines

European Commission. (2023). Packaging and Packaging Waste Regulation (PPWR) Proposal. Brussels: EU Publications Office.

CEFLEX. (2022). Designing for a Circular Economy: Flexible Packaging Guidelines. Brussels: CEFLEX.

Fresh Produce Safety Centre ANZ. (2023). Postharvest Packaging and Food Safety Guidelines for Fresh Produce. Sydney: FPSC.

Woolworths Group. (2024). Sustainability Plan 2025: Plastic and Packaging Commitments. Sydney: Woolworths Group.

Coles Group. (2024). Sustainability Strategy and Packaging Roadmap. Melbourne: Coles Group.

Empauer Pty Ltd. (2025). Mushroom Packaging Alternatives Report – Technical Evaluation for AMGA. Melbourne: Empauer.

Australian Mushroom Growers Association (AMGA). (2025). MushroomLink: Future of Mushroom Packaging. Retrieved from https://www.mushroomlink.com.au/resources-1/future-of-mushroom-packaging

NielsenIQ. (2024). *Mushrooms Comprehensive Review 2024* [Report]. Hort Innovation. Retrieved from https://www.harvesttohome.net.au/static/comprehensive-reviews/Mushrooms%20comp%20review_P10_Dashboard%20version.pdf

The Growth Drivers (2025). Internal project documents and supplemental materials (Google Drive Repository, accessed 2025)

Acknowledgements

The Growth Drivers (TGD) acknowledges the support and collaboration of Hort Innovation, the Australian Mushroom Growers Association (AMGA), and the Fresh Produce Safety Centre ANZ in the delivery of this project.

Special thanks to members of the Project Reference Group (PRG) for their technical input, review, and guidance throughout the project, including representatives from mushroom growers, packaging suppliers, recyclers, retailers, and sustainability specialists.

The project also thanks participating growers and industry partners for sharing insights and contributing to the collective effort toward a more sustainable mushroom packaging future.

Appendices

Appendix A: Stakeholder list

Stakeholder Category	Stakeholder	Role
Project Team	Will Swain	Design & Research Lead
	Helen Millicer	Policy Expert
	Paul Barnett	Project Director
	Roberto Persivale	Project Lead
	Michael Grima	Packaging Expert
Industry Body	Australian Mushroom Growers Association (AMGA)	Peak industry body representing mushroom growers
Supporting Organisations / Collaborators	Empauer	Sustainability & packaging advisory
	Earthodic	Circular materials and sustainability specialist
	Anthesis	Sustainability & packaging consulting partner
	Planet Ark	Circular economy and packaging transition partner
Government / Regulatory	DCCEEW	Federal packaging and recycling policy authority
	APCO (Australian Packaging Covenant Organisation)	Packaging and recyclability standards & compliance
	SPSA (Soft Plastics Stewardship Australia)	Soft plastics stewardship and recycling scheme leader
Retail Sector Referenced	Woolworths	Retailer adopting PVC-free packaging policy
	Coles	Retailer transitioning to recyclable soft-plastics
International Benchmark	EU PPWR (EU Packaging and Packaging Waste Regulation)	Global regulatory benchmark influencing PVC phase-out

Appendix B: Stakeholder Insights Table

Theme	Key Insights	Implications for Industry
Regulatory awareness	Stakeholders understood the coming PVC phase-out but lacked clarity on SPSA levy design and DCCEEW recyclability grading.	Industry needs practical compliance guidance and communication materials.
Packaging performance	Growers emphasised visibility, seal integrity, and shelf life; suppliers prioritised recyclability and cost.	Replacement films must achieve performance parity with PVC at competitive price points.
Operational compatibility	Equipment calibration and film tension were major concerns.	Machine-compatibility trials are required before full adoption.
Consumer perception	Retailers reported increasing demand for “PVC-free” labelling.	Early adopters can leverage sustainability branding.

Appendix C: Tech Scan with Initial Filter Criteria

Only Horizon 1 (top 23) solutions were assessed against the initial filter criteria.

Solution Scan							
#	Company	Product	Material	Is it a Stretch / Shrink Film Wrap?	Has it been tested with mushrooms?	Is it readily available?	Do they have an Australian presence?
1	Asahi Kasei / Perfect Automation	Suntec S Film	Polyolefin Film (POF)	✅	✅	✅	✅
2	Specialty Polyfilms	Forvara® & Wrapit® Films	Polyethylene	✅	✅	✅	✅
3	Grounded Packaging	Recyclable bio-based laminate	Sugarflex™	✅	❓	✅	✅
4		Recyclable mono-material laminate	Low Density Polyethylene	✅	❓	✅	✅
5	Intertape Polymer Group (IPG)	ExlfilmPlus® PCR	Multi-layered clear polyolefin film	✅	❓	✅	❓
6		ExlfilmPlus® 365	Polyolefin film	✅	❓	✅	❓
7		Exlfilm® 307	Plastics (proprietary withheld)	✅	❓	✅	❓
8		ExlfilmPlus® Global Performance Lite (GPL) Shrink Film	Polyolefin film	✅	❓	✅	❓
9		ExlfilmPlus® Global Performance (GPS) Shrink Film	Polyolefin film	✅	❓	✅	❓
10		SuperFLEX® Genesys® Ultra PLUS	Low Density Polyethylene	✅	❓	✅	❓
11		SuperFlex® Genesys®	Low Density Polyethylene	✅	❓	✅	❓
12	The Griff Network	Bi-Axially Oriented Polypropylene (BOPP) Film	Polypropylene	❌	✅	✅	✅
13	StePac	StePac - Xgo	Plastics (proprietary withheld)	❌	✅	✅	❌
14		StePac - Xflow	Plastics (proprietary withheld)	❌	✅	✅	❌

15		StePac - Xtend	Plastics (proprietary withheld)	✗	?	☑	✗
16	Grounded Packaging	Recyclable bio-based thermoforming film	Sugarflex™ or Re:Mono™ Sugarcane	✗	?	☑	☑
17		Recyclable post-consumer recycled (PCR) thermoforming film	Plastics (proprietary withheld)	✗	?	☑	☑
18		Recyclable ocean-bound rPET thermoforming film	Recycled PET (Polyethylene Terephthalate)	✗	?	☑	☑
19		Compostable laminate	Plantcell™	✗	?	☑	☑
20	The Griff Network	Oriented Polypropylene (OPP) Film	Polypropylene	☑	?	☑	✗
21		Polyethylene Terephthalate (PET) Film	Polyethylene Terephthalate	☑	?	☑	✗
22		High-Density Polyethylene Film (HDPE)	Polyethylene	☑	?	☑	✗
23		Medium Density Polyethylene (MDPE)	Polyethylene	☑	?	☑	✗
24	Notpla		Seaweed-based	FALSE	FALSE	FALSE	FALSE
25	Evoware		Seaweed-based	FALSE	FALSE	FALSE	FALSE
26	CJ Biomaterials	PHACT™ CA1270P / PHACTTM MA1250P-A	Polyhydroxyalkanoates (PHA)	FALSE	FALSE	FALSE	FALSE
27	TotalEnergies Corbion	Luminy® PLA	Polylactic acid (PLA)	FALSE	FALSE	FALSE	FALSE
28	Mitsubishi chemical group	BioPBS™	Polybutylene succinate (PBS)	FALSE	FALSE	FALSE	FALSE
29	Sichuan Biochem-ZX Research Co.,Ltd	PCL-50T / PCL-80T	Polycaprolactone (PCL)	FALSE	FALSE	FALSE	FALSE
30	Evonik	PVOH films	Polyvinyl alcohol (PVOH)	FALSE	FALSE	FALSE	FALSE
31	NatureWorks LLC	Ingeo™	Polylactic acid (PLA)	FALSE	FALSE	FALSE	FALSE

32	OMORI	Barrier Density Film (BDF)	Polyolefin	FALSE	FALSE	FALSE	FALSE
33	Scanfill	Scanfill	Ethylene-Vinyl Alcohol Copolymer (EVOH)	FALSE	FALSE	FALSE	FALSE
34				FALSE	FALSE	FALSE	FALSE
35				FALSE	FALSE	FALSE	FALSE
36	Xampla	Morro™ Soluble Film	Polyvinyl alcohol (PVOH)	FALSE	FALSE	FALSE	FALSE
37	PLANTIC™	Thermoplastic Starch film	Thermoplastic Starch (TPS)	FALSE	FALSE	FALSE	FALSE
38	Avantium	Releaf® Film	Polyethylene Furanoate (PEF)	FALSE	FALSE	FALSE	FALSE
39	WikiFoods	WikiCell	Natural Polymers / Nutritive Ions (e.g., Calcium) / Microscopic Food Particles	FALSE	FALSE	FALSE	FALSE
40	RWDC Industries	Solon® PHA	Polyhydroxyalkanoate (PHA)	FALSE	FALSE	FALSE	FALSE
41	BASF	Soil-biodegradable mulch films	BASF's ecoflex® (PBAT)	FALSE	FALSE	FALSE	FALSE
42	Futamura	NatureFlex™ cellulose films	Cellulose	FALSE	FALSE	FALSE	FALSE
43	TIPA	TIPA's Compostable Net Packaging	Cellulose	FALSE	FALSE	FALSE	FALSE
44				FALSE	FALSE	FALSE	FALSE
45	REDYSIGN	Smart flexible film	lignocellulosic micro- and nanofibres (LCMNF)	FALSE	FALSE	FALSE	FALSE
46	(research status)	Protein-Based Films	Gluten/Soy Proteins/Zein/Casein/ Whey/Gelatin	FALSE	FALSE	FALSE	FALSE
47	(research status)	Chitosan-based films	Chitosan + Acid (usually Acetic) + Plasticizer	FALSE	FALSE	FALSE	FALSE
48	(research status)	Nanocellulose Composite Films	Nanocellulose	FALSE	FALSE	FALSE	FALSE
49	(research status)	PVP-CMC hydrogel film	Hydrogels	FALSE	FALSE	FALSE	FALSE
50	(research status)	Bioplastic film	Spider web-reinforced chitosan/starch biopolymer	FALSE	FALSE	FALSE	FALSE
51	(research status)	PHB film	PHB, poly(3-	FALSE	FALSE	FALSE	FALSE

			hydroxybutyrate)				

Figure 1. [Assessment Criteria 2.0]

At this stage, the assessment criteria were preliminary. Further refinement and weighting validation were planned for subsequent quantitative grower surveys.

Key Criteria	**Weights** Criteria weights based on stakeholder feedback.	**Overall Score**	**A (+4)** Exceeds standards or performs outstandingly	**B (+3)** Meets all standards or performs excellently	**C (+2)** Meets most standards or performs well	**D (+1)** Meets minimum standards or performs basic required function	**F (+0)** Doesn't meet standards or can't perform required function
		2.69					
Food Safety & Quality	**Overall Weight: 15%**	2.94					
Water Vapour Transmission Rate (WVTR)	25%	1.02	4				
Gas permeability (O_2 and CO_2 exchange rates) AKA: Oxygen Transmission Rate (OTR)	16%	0.31			2		
Temperature stability during storage & transport	16%	0.31			2		
Chemical inertness	10%	0.29		3			
Both volume and size	10%	0.29		3			
Microbial barrier properties	8%	0.24		3			
Use-by and best-before dates	8%	0.24		3			
Anti-microbial properties (if applicable)	8%	0.24		3			
Sustainability	**Overall Weight: 20%**	0.93					
Recyclability in existing streams *	26%	0.00					0
Recycled material source (if applicable)	13%	0.00					0
End-of-life disposal impact *	13%	0.00					0
Water usage (in production)	11%	0.22			2		
Energy consumption (in production)	10%	0.19			2		
Emissions Intensity	8%	0.24		3			
Certified compostability *	7%	0.00					0
Renewable resource content	7%	0.07				1	
Transportation efficiency (weight to volume ratio)	7%	0.20		3			
Manufacture	**Overall Weight: 20%**	3.69					
Equipment compatibility with existing lines	15%	0.59	4				

Line speed capability	15%	0.59	4				
Shelf life of packaging material	15%	0.59	4				
Material availability (procurement)	12%	0.48	4				
Labeling	8%	0.24		3			
Sealing/closing mechanism reliability	8%	0.24		3			
Storage space requirements	8%	0.24		3			
Processing temperature requirements	7%	0.20		3			
Lead time requirements (procurement)	7%	0.27	4				
Supplier diversity options (procurement)	7%	0.27	4				

Consumer	**Overall Weight: 15%**	1.59					
Visual appeal (Colour) (organoleptic property)	13%	0.39		3			
Clear sustainability messaging	11%	0.00					0
Educational content space	11%	0.00					0
Odour (of pkging) (organoleptic property)	11%	0.34		3			
Resealability options	10%	0.10				1	
Product use convenience features (ie. wash in pack)	10%	0.10				1	
Ease of opening	8%	0.08				1	
Storage convenience	8%	0.25		3			
Portion control features	8%	0.16			2		
Premium/quality perception (organoleptic property)	8%	0.16			2		

Commercial Viability	**Overall Weight: 15%**	3.82					
Shelf life of contents	24%	0.96	4				
Equipment / CapEx Requirements	19%	0.74	4				
Input cost per unit (raw material + likely PE labeling)	15%	0.60	4				
Packing efficiency	13%	0.53	4				
Production cost	12%	0.46	4				
Transportation cost	12%	0.35		3			
Minimum order quantities	6%	0.19		3			

Technical Performance	**Overall Weight: 15%**	3.45					
Shelf life impact	16%	0.64	4				
Elongation (Stretch)	9%	0.36	4				
Puncture resistance	9%	0.36	4				
Humidity resistance	9%	0.36	4				

Tear strength	9%	0.36	4				
Substrate Compatibility	9%	0.27		3			
Tensile strength	8%	0.31	4				
Impact resistance	8%	0.23		3			
Stacking strength	8%	0.08				1	
Temperature tolerance range	8%	0.23		3			
UV Resistance	8%	0.23		3			

Appendix F. TOP 2 Contenders & High Potential Solutions

Top 2 Contenders

perfect automation

Suntec S Shrink Film
Material - Polyolefin
Supplier - Perfect Automation
Manufacturer - Asahi Kasei

Description
Asahi's polyolefin film, previously successful in Japan's mushroom market, is now set to transform Australian packaging practices. Known for its ability to preserve natural colours and flavours, Suntec Film offers high anti-fogging properties and superior transparency, crucial for product presentation.

Asahi Suntec film demonstrates excellent performance, appearance, and durability. It functions as a shrink film but has enough stretch to work with Omori machines without requiring significant modifications. Additionally, it offers improved presentation and shelf appeal compared to PVC.

It boasts "exceptional puncture and tear resistance", ensuring reliable performance on high-speed tray stretch wrappers like those from Omori, Perfect Automation's partner in this initiative.

Specialty Polyfilms

Forvara® Fresh Produce Film
Material - Polyethylene (PE)
Supplier - Specialty Films
Manufacturer - Specialty Films

Description
Forvara® Fresh Produce Film is manufactured through a specially engineered combination of select food-grade polyethylene (PE) polymers and process innovation to create a product free from any taste or odour. Our Non-PVC, Polyethylene films are known for their soft feel and are an eco-friendly alternative to conventional PVC-based fresh produce films.

Forvara® Fresh Produce Film is a specialized film with different attributes covering customized requirements to meet market expectations, specifically for the produce industry.

High Potential Solutions

GROUNDED

Recyclable mono-material laminate

Material - Low Density Polyethylene
Supplier - Grounded Packaging
Manufacturer - Grounded Packaging

Description
Grounded's recyclable PE laminate is a mono-material and can be recycled in either dedicated PE stream or soft plastics collections. It has similar performance and barrier properties to traditional plastics that are not recyclable and is suitable for use across a number of different industries.

Recyclable bio-based laminate

Material - *Sugarflex™ (proprietary withheld)*
Supplier - Grounded Packaging
Manufacturer - Grounded Packaging

Description
Grounded's recyclable Sugarflex™ laminate is carbon negative and made from sugarcane. It is a fully recyclable mono-material and has similar functional characteristics to traditional plastics. It is available in high and low barrier and is suitable for use across a number of different industry applications.

ipg intertape polymer group

ExlfilmPlus® PCR (Post Consumer Recycled)

Material - Multi-layered clear polyolefin film
Supplier - Intertape Polymer Group
Manufacturer - Intertape Polymer Group

Description
ExlfilmPlus® PCR represents a groundbreaking advancement in shrink film sustainability. This multi-layered clear polyolefin film incorporates post-consumer recycled content. Its versatility allows it to excel on all sealing systems and tunnels. Whether you're packaging club store multi-packs or food products, ExlfilmPlus PCR is the ideal choice for environmentally conscious customers seeking a circular and sustainable shrink packaging solution.

ExlfilmPlus® Global Performance (GPS) Shrink Film

Material - Polyolefin film
Supplier - Intertape Polymer Group
Manufacturer - Intertape Polymer Group

Description
ExlfilmPlus® GPS high performance crosslinked polyolefin shrink film is a multilayered film that is versatile enough to perform on all sealing systems and shrink tunnels. The premium resin formulation provides our strongest seals ever.

ExlfilmPlus® 365

Material - Polyolefin film
Supplier - Intertape Polymer Group
Manufacturer - Intertape Polymer Group

Description
ExlfilmPlus® 365 is a high performance crosslinked polyolefin shrink film. This multilayered film is versatile enough to perform on all sealing systems and shrink tunnels.

ExlfilmPlus® Global Performance Lite (GPL) Shrink Film

Material - Polyolefin film
Supplier - Intertape Polymer Group
Manufacturer - Intertape Polymer Group

Description
ExlfilmPlus® GPL is IPG's newest high performance crosslinked polyolefin shrink film. GPL is a thin gauge, high yield film offering customers superior machinability, clarity and cost savings. The high slip ensures easier material handling, collating and package insertion.

Exlfilm® 307

Material - *Plastics (proprietary withheld)*
Supplier - Intertape Polymer Group
Manufacturer - Intertape Polymer Group

Description
Exlfilm® 307 is a fast-sealing shrink film that allows for short dwell times that maximize production and increase plant efficiency. Your product is protected from the rigors of high-speed packaging and shipping by consistently strong seals and exceptional tensile strength. The high slip ensures easier material handling, collating and package insertion.

Appendix D: Preliminary Comparative Material Assessment - PVC Report & Polyolefin Report

Overall Score

2.69 / 4

PVC Performs outstandingly in its unit economics, technical performance, food safety & quality characteristics, justifying its wide spread use across the industry, however it performs terribly from a sustainability perspective. Its inability to be recycled in existing waste streams due to the harmful chemicals it offgases during processing means its use is being phased out for other alternatives.

Main Strengths

1. High performing packaging material well suited to mushrooms.
2. Cheap unit economics.

Main Weaknesses

1. Unsuitable for recycling.
2. Highly unsustainable material.

Horizon Level - 1

PVC is industry standard and highly available.

Key Criteria	Weights Criteria weights based on stakeholder feedback.	Overall Score	A (+4) Exceeds standards or performs outstandingly	B (+3) Meets all standards or performs excellently	C (+2) Meets most standards or performs well	D (+1) Meets minimum standards or performs basic required function	F (+0) Doesn't meet standards or can't perform required function
		2.69					
Food Safety & Quality	**Overall Weight: 15%**	2.94					
Water Vapour Transmission Rate (WVTR)	25%	1.02	4				
Gas permeability (O_2 and CO_2 exchange rates) AKA: Oxygen Transmission Rate (OTR)	16%	0.31			2		
Temperature stability during storage & transport	16%	0.31			2		
Chemical inertness	10%	0.29		3			
Both volume and size	10%	0.29		3			
Microbial barrier properties	8%	0.24		3			
Use-by and best-before dates	8%	0.24		3			
Anti-microbial properties (if applicable)	8%	0.24		3			
Sustainability	**Overall Weight: 20%**	0.93					
Recyclability in existing streams *	26%	0.00					0
Recycled material source (if applicable)	13%	0.00					0
End-of-life disposal impact *	13%	0.00					0
Water usage (in production)	11%	0.22			2		
Energy consumption (in production)	10%	0.19			2		
Emissions Intensity	8%	0.24		3			
~~Biodegradability~~ / Certified compostability *	7%	0.00					0
Renewable resource content	7%	0.07				1	
Transportation efficiency (weight to volume ratio)	7%	0.20		3			
Manufacture	**Overall Weight: 20%**	3.69					
Equipment compatibility with existing lines	15%	0.59	4				
Line speed capability	15%	0.59	4				
Shelf life of packaging material	15%	0.59	4				
Material availability (procurement)	12%	0.48	4				
Labeling	8%	0.24		3			
Sealing/closing mechanism reliability	8%	0.24		3			
Storage space requirements	8%	0.24		3			
Processing temperature requirements	7%	0.20		3			
Lead time requirements (procurement)	7%	0.27	4				
Supplier diversity options (procurement)	7%	0.27	4				

Consumer	Overall Weight: 15%	1.59					
Visual appeal (Colour) (organoleptic property)	13%	0.39		3			
Clear sustainability messaging	11%	0.00					0
Educational content space	11%	0.00					0
Odour (of pkging) (organoleptic property)	11%	0.34		3			
Resealability options	10%	0.10				1	
Product use convenience features (ie. wash in pack)	10%	0.10				1	
Ease of opening	8%	0.08				1	
Storage convenience	8%	0.25		3			
Portion control features	8%	0.16			2		
Premium/quality perception (organoleptic property)	8%	0.16			2		

Commercial Viability	Overall Weight: 15%	3.82					
Shelf life of contents	24%	0.96	4				
Equipment / CapEx Requirements	19%	0.74	4				
Input cost per unit (raw material + likely PE labeling)	15%	0.60	4				
Packing efficiency	13%	0.53	4				
Production cost	12%	0.46	4				
Transportation cost	12%	0.35		3			
Minimum order quantities	6%	0.19		3			

Technical Performance	Overall Weight: 15%	3.45					
Shelf life impact	16%	0.64	4				
Elongation (Stretch)	9%	0.36	4				
Puncture resistance	9%	0.36	4				
Humidity resistance	9%	0.36	4				
Tear strength	9%	0.36	4				
Substrate Compatibility	9%	0.27		3			
Tensile strength	8%	0.31	4				
Impact resistance	8%	0.23		3			
Stacking strength	8%	0.08				1	
Temperature tolerance range	8%	0.23		3			

Overall Score

2.99 / 4

Polyolefin stretch film ranks highly in all criteria, matching PVC in technical performance and food safety and quality characteristics. While it is more expensive than PVC film, it can be recycled, offering a sustainable alternative to PVC. Additionally it is compatible with existing overwrapping equipment, decreasing implementation costs and CAPEX requirements.

Main Strengths

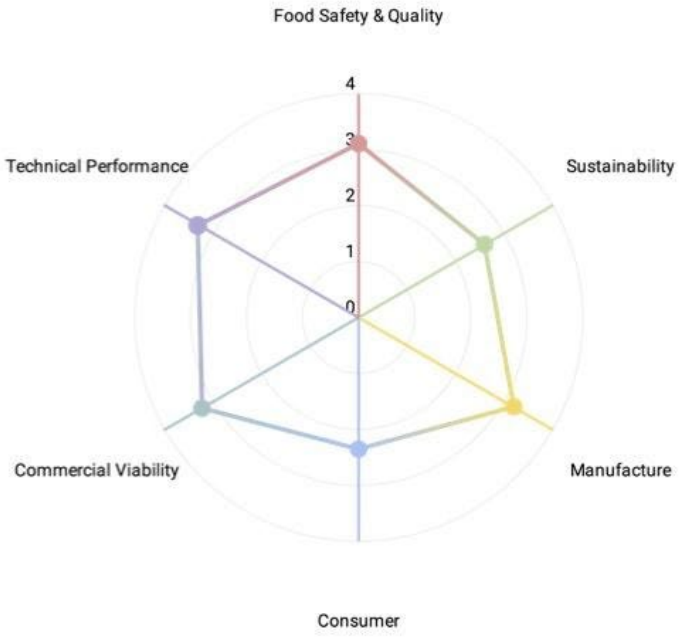
1. Recyclable film.
2. Equal to PVC in all performance related criteria.
3. Compatible with existing equipment.

Main Weaknesses

1. More expensive.
2. Not as robust as PVC film, requiring careful storage to retain properties.

Horizon Level - 1

Polyolefin film is widely available, and is used in markets internationally.



Key Criteria	Weights Criteria weights based on stakeholder feedback.	Overall Score	A (+4) Exceeds standards or performs outstandingly	B (+3) Meets all standards or performs excellently	C (+2) Meets most standards or performs well	D (+1) Meets minimum standards or performs basic required function	F (+0) Doesn't meet standards or can't perform required function
		2.99					
Food Safety & Quality	**Overall Weight: 15%**	3.10					
Water Vapour Transmission Rate (WVTR)	25%	1.02	4				
Gas permeability (O_2 and CO_2 exchange rates) AKA: Oxygen Transmission Rate (OTR)	16%	0.47		3			
Temperature stability during storage & transport	16%	0.31			2		
Chemical inertness	10%	0.29		3			
Both volume and size	10%	0.29		3			
Microbial barrier properties	8%	0.24		3			
Use-by and best-before dates	8%	0.24		3			
Anti-microbial properties (if applicable)	8%	0.24		3			
Sustainability	**Overall Weight: 20%**	2.61					
Recyclability in existing streams *	26%	0.78		3			
Recycled material source (if applicable)	13%	0.38		3			
End-of-life disposal impact *	13%	0.38		3			
Water usage (in production)	11%	0.22			2		
Energy consumption (in production)	10%	0.19			2		
Emissions Intensity	8%	0.33	4				
Certified compostability *	7%	0.00					0
Renewable resource content	7%	0.13			2		
Transportation efficiency (weight to volume ratio)	7%	0.20		3			
Manufacture	**Overall Weight: 20%**	3.19					
Equipment compatibility with existing lines	15%	0.59	4				
Line speed capability	15%	0.59	4				
Shelf life of packaging material	15%	0.59	4				
Material availability (procurement)	12%	0.24			2		
Labeling	8%	0.24		3			
Sealing/closing mechanism reliability	8%	0.24		3			
Storage space requirements	8%	0.24		3			
Processing temperature requirements	7%	0.20		3			
Lead time requirements (procurement)	7%	0.20		3			
Supplier diversity options (procurement)	7%	0.07				1	

Consumer	**Overall Weight: 15%**	2.34					
Visual appeal (Colour) (organoleptic property)	13%	0.52	4				
Clear sustainability messaging	11%	0.34		3			
Educational content space	11%	0.00					0
Odour (of pkging) (organoleptic property)	11%	0.46	4				
Resealability options	10%	0.10				1	
Product use convenience features (ie. wash in pack)	10%	0.10				1	
Ease of opening	8%	0.08				1	
Storage convenience	8%	0.25		3			
Portion control features	8%	0.16			2		
Premium/quality perception (organoleptic property)	8%	0.33	4				

Commercial Viability	**Overall Weight: 15%**	3.22					
Shelf life of contents	24%	0.96	4				
Equipment / CapEx Requirements	19%	0.56		3			
Input cost per unit (raw material + likely PE labeling)	15%	0.30			2		
Packing efficiency	13%	0.53	4				
Production cost	12%	0.35		3			
Transportation cost	12%	0.35		3			
Minimum order quantities	6%	0.19		3			

Technical Performance	**Overall Weight: 15%**	3.54					
Shelf life impact	16%	0.64	4				
Elongation (Stretch)	9%	0.36	4				
Puncture resistance	9%	0.36	4				
Humidity resistance	9%	0.36	4				
Tear strength	9%	0.36	4				
Substrate Compatibility	9%	0.36	4				
Tensile strength	8%	0.31	4				
Impact resistance	8%	0.31	4				
Stacking strength	8%	0.08				1	
Temperature tolerance range	8%	0.15			2		
UV Resistance	8%	0.23		3			

Appendix G. Key blockers limiting the adoption of PVC Film alternatives

Stakeholders	2025 (Current) Business as usual.	2026 (Interim) First levy comes in.	2027 onwards (New Future State) PVC phase out & expanded levies.
Recyclers	❌ Recyclers can't currently collect soft plastics at scale via in-store collection or kerbside with limited to low end markets.	❌ Design for Kerbside Recyclability Grading Framework (aka EPR) Scheme and Soft Plastics Stewardship Australia (SPSA) Scheme Implementation. Soft plastics recycling is largely unavailable to consumers.	✅ Soft Plastics Stewardship Australia Scheme Expansion. Soft plastics recycling is increasingly accessible to consumers. Increases in kerbside soft plastic collection results in higher collection volumes encouraging further investment into soft plastics recycling and end market avenues.
Consumers	❌ Can't make purchasing decisions based on recyclability / sustainability.	❌ SPSA Scheme only available to a smaller number of consumers (c.500 drop off points, c.120,000 households) ⚠️ SPSA Scheme initially a return to store program, providing limited conscious consumers with an option to recycle soft plastics.	✅ Purchasing decisions can be made on sustainability and recyclability.
Retailers	❌ Have limited commercial incentives to proactively transition to PVC alternatives while the sustainability benefits can't be marketed toward consumers.	⚠️ Design for Kerbside Recyclability Grading Framework scheme still considers soft plastics as unrecyclable, however PVC alternatives may be able to be marketed as "recyclable" under the SPSA in-store collection scheme. ⚠️ SPSA Scheme levy implemented at $160/tonne for all soft plastics while tiered EPR levy favors non PVC films. SPSA scheme objective to phase out problematic plastics will prompt consideration to move to PVC alternatives.	✅ Mandated EPR Grading Scheme implemented, grading soft plastics on their recyclability. ✅ PVC alternatives can be marketed as recyclable at kerbside. ✅ SPSA Scheme levy increasing YoY: FY27 - $200 /tonne FY28 - $240-$270 /tonne FY29 - $380-$420 /tonne
Growers	❌ Will avoid proactively transitioning to a PVC film alternative until the economic impacts / cost benefit analysis of continued PVC use vs an alternative can be more accurately assessed.	⚠️ SPSA scheme & tiered EPR Levies implementation will indicate a shift in industry requirements to find PVC film alternative. ⚠️ Clearer cost benefit analysis will derisk transitioning enough for proactive growers to transition to PVC alternative.	✅ Combined public soft plastic recycling availability with increased levies will create significant pressure on growers to adopt PVC alternatives. ✅ Reduced mandated EPR levy grading for mono-polymer materials (E to B) will economically incentivise transition. ✅ Regulatory pressure to phase out problematic and unnecessary plastics will create additional pressure to adopt PVC alternatives.

Appendix H. Regulatory Landscape

Regulatory Landscape

Australia is shifting toward an Extended Producer Responsibility (EPR) model, echoing European reforms and placing greater accountability on those who put packaging on the market.

Sustainable Packaging Solutions Australia (SPSA) Scheme

SPSA is a new not-for-profit industry body aiming to lead the transition toward a coordinated, national approach for soft plastics recovery. In late March 2025, SPSA lodged an application with the ACCC seeking authorisation to activate its long-anticipated scheme, which would enable competing businesses to collaborate on setting minimum recyclability standards, phasing out problematic packaging, and funding critical recycling infrastructure. The SPSA proposal introduces a tiered levy structure applied as a flat fee across all soft plastics, with planned increases over time.

Design for Kerbside Recyclability Grading

The Design for Kerbside Recyclability Grading Framework (EPR), released by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) in December 2024, introduces a national A–G grading system (plus an ALT category) to assess how packaging performs in Australia's kerbside recycling system. Soft plastics are currently graded in the lower bands (E–G or ALT) due to limited collection, processing, and end-market viability. PVC is especially impacted, with no scalable kerbside recycling pathway and strong signals it will be phased out under future regulatory settings.

The framework is intended as a living document and is currently under industry consultation throughout 2025. This flexibility gives industry a clear pathway to design packaging that is both future-proof and aligned with emerging national standards for recyclability and circularity.

SPSA soft plastic product stewardship scheme overview

SPSA's levy is aiming to raise $500 million over an 8 year period to fund the infrastructure and operations needed to build a national soft plastics stewardship scheme.

Source: SPSA, Application for Authorisation, Lodged with ACCC, March 2025

Grades & Recyclability

As recycling infrastructure and markets evolve and collection capacity increases, materials like polyolefin soft plastics, currently unrecyclable, are likely to be reclassified into higher grades, reducing compliance costs under upcoming EPR schemes.

Source: DCCEW, Design for Kerbside Recyclability Grading Framework, December 2024