

Executive Summary

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Internship Host: Revino Inc. (Newberg, Oregon)

Single-use beverage packaging remains a significant contributor to material waste streams and greenhouse gas emissions in the United States, with glass packaging representing a particularly energy-intensive material when treated as disposable. Although glass is often perceived as environmentally preferable due to its recyclability, the production and remelting of virgin and recycled glass require high-temperature furnaces and substantial energy inputs.

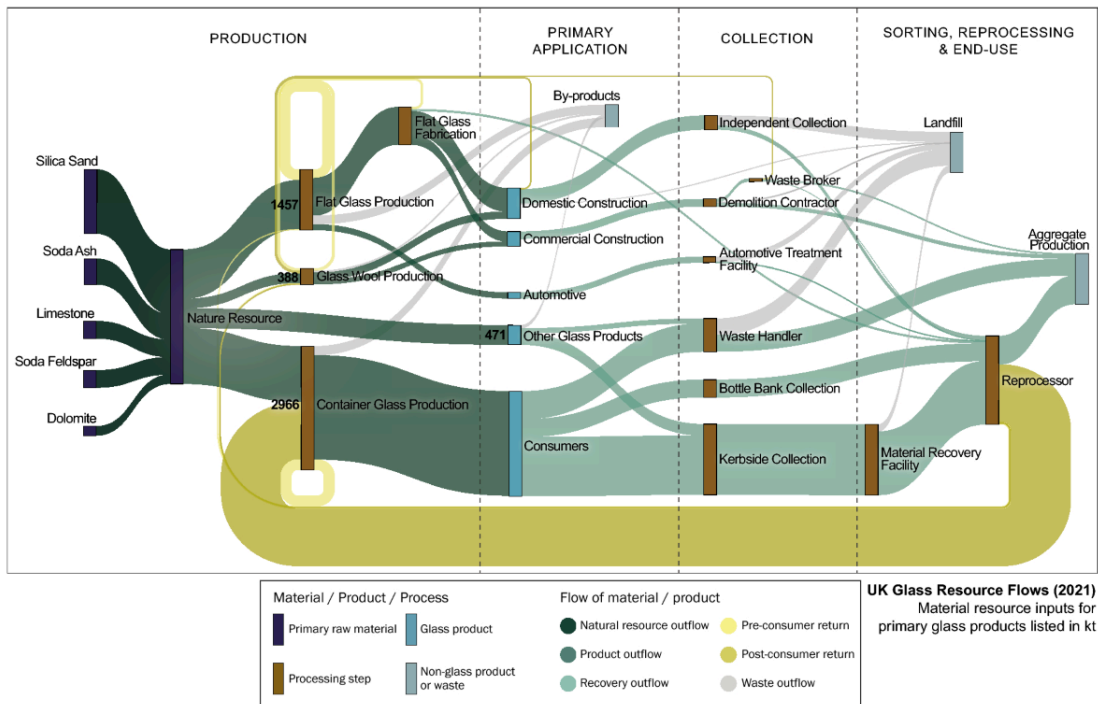


Figure 1: Energy Flow in Virgin Glass Manufacturing (°C and % energy by stage)

Estimates indicate that 75–85% of the total energy demand in glass manufacturing occurs during the melting phase, resulting in a considerable carbon footprint even within well-established recycling systems (European Container Glass Federation [FEVE], 2021; U.S. Environmental Protection Agency [EPA], 2023).

In response to these limitations, reuse-based systems have re-emerged as a higher-order circular economy strategy, particularly for beverage packaging. Refillable glass bottles retain the embodied energy of the container across multiple use cycles, offering significant reductions in energy demand, greenhouse gas emissions, and raw material extraction when reuse thresholds are met (WRAP, 2021; Franklin Associates, 2020). The successful implementation of reuse systems depends on both market participation and technically sound, environmentally safe washing infrastructure, particularly within regulatory frameworks governing wastewater discharge, chemical handling, and worker safety.

This Professional Science Master's (PSM) internship project evaluated the technical, environmental, and business foundations of a refillable glass bottle system in Oregon's beverage industry. Conducted in partnership with Revino Inc., a reuse-focused start-up based in Newberg, Oregon, the project addressed two integrated objectives: (1) development of a targeted beverage partner outreach and acquisition strategy, and (2) a pre-operational evaluation of bottle-washing chemicals, safety practices, and regulatory considerations to support environmentally responsible facility start-up.



Figure 2: Revino INC. Official Logo

Circular Economy Context and Rationale

The project was grounded in circular economy theory, which prioritizes material retention, waste prevention, and system-level efficiency over end-of-life management alone (Ellen MacArthur Foundation, 2019).

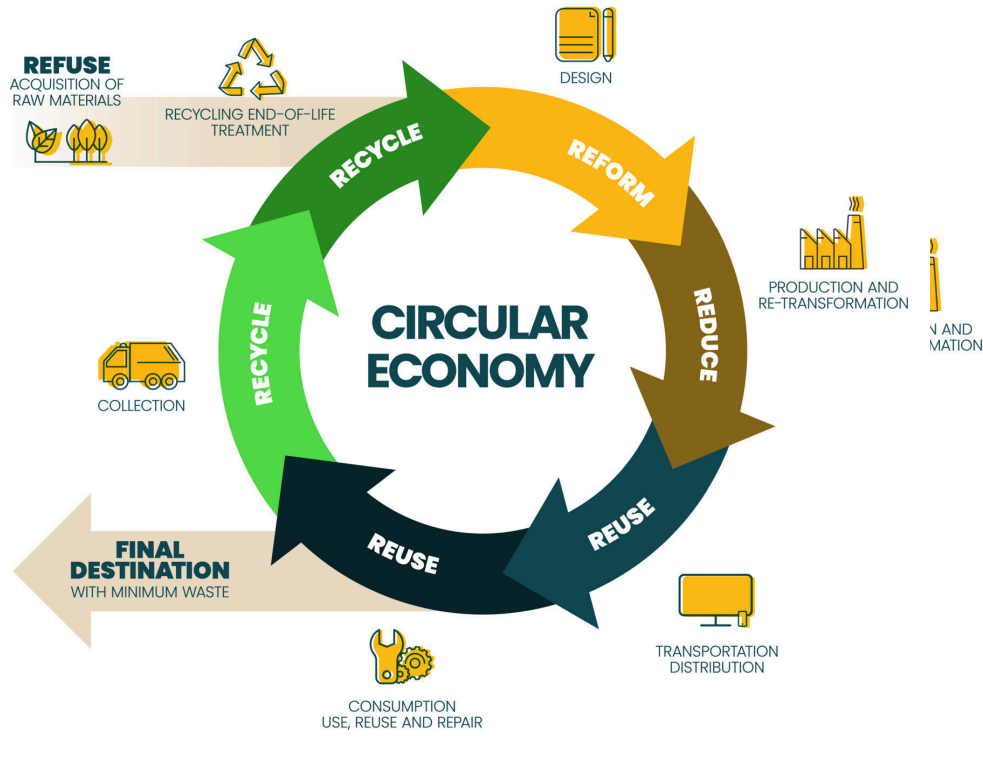


Figure 3. Circular economy infographic. Adapted from City of Adelaide (n.d.)

Within this framework, reuse occupies a higher tier than recycling because it preserves product form and avoids repeated energy-intensive remanufacturing. Comparative life cycle assessments consistently demonstrate that refillable glass systems outperform single-use glass when bottles achieve sufficient reuse cycles and transport distances are optimized (Franklin Associates, 2020; WRAP, 2021).

In the U.S., refillable glass infrastructure remains underdeveloped relative to European systems, where standardized bottle formats, deposit schemes, and centralized washing facilities support high reuse rates (FEVE, 2021). Revino's model seeks to

address this infrastructure gap within Oregon’s regional beverage market by offering standardized bottles, reverse logistics, and centralized washing services to small and mid-sized producers.



Figure 4 Circular economy at Revino visual. Adapted from <https://www.revinocontainers.com/returns/>

Project 1: Beverage Partner Outreach and Market Analysis

The first project component focused on evaluating market readiness and adoption barriers among Oregon beverage producers. A total of 93 potential partners were identified across wineries, cideries, kombucha producers, and craft beverage manufacturers. Of these, 81 producers were contacted directly, resulting in three completed surveys and six in-depth follow-up discussions.

Outreach findings indicated that while sustainability values were widely shared, adoption decisions were shaped by operational constraints, branding considerations, and perceived consumer expectations. These results align with broader research identifying social, economic, and logistical barriers as key determinants of reuse

adoption in beverage systems (Ellen MacArthur Foundation, 2019; WRAP, 2021). Three producers were identified as early adopters interested in pilot participation, providing Revino with a realistic entry point for phased system implementation.

This analysis informed a refined outreach strategy that emphasized incremental adoption, clear communication of environmental benefits, and alignment with producer capacity—demonstrating how applied market research can directly support circular economy infrastructure development.

Project 2: Bottle-Washing Chemicals, Pollution Prevention, and Compliance

The second project component addressed the technical and environmental integrity of refillable glass operations. While reuse systems reduce upstream impacts, improper chemical selection or wastewater management can undermine environmental benefits if not carefully designed (EPA, 2023). Accordingly, this project evaluated bottle-washing practices through the lens of pollution prevention (P2), which emphasizes source reduction, safer chemical substitution, and risk minimization before treatment or disposal (EPA, 2023).

Key activities included:

- Review of original equipment manufacturer (OEM) recommendations for industrial bottle washers
- Analysis of Safety Data Sheets (SDSs) for caustic detergents and sanitizing agents
- Comparative evaluation of environmentally preferable cleaning alternatives
- Assessment of regulatory oversight from Oregon DEQ, OSHA, and local wastewater authorities

Given that Revino's facility was not yet operational, all findings were framed as pre-operational best-practice guidance rather than performance-based observations. Pollution Prevention tables and draft Standard Operating Procedures (SOPs) were developed to support safer chemical handling, appropriate storage, worker training, and wastewater considerations consistent with regulatory expectations.

This proactive approach reflects established best practices in environmental management, where early design decisions significantly influence long-term environmental and compliance outcomes (EPA, 2023).

Integrated Outcomes and Professional Significance

Together, the outreach and technical components demonstrate the importance of integrating business strategy with environmental science in emerging sustainability ventures. Reuse systems cannot succeed through technical optimization alone; they require market participation, regulatory alignment, and operational transparency.

The PSM framework enabled this integration by combining scientific analysis, professional communication, and applied problem-solving. The project illustrates how environmental science graduates can contribute meaningfully to circular economy transitions by addressing both human and technical dimensions of sustainability challenges.

Conclusion

This internship underscores the role of applied graduate education in advancing real-world environmental solutions. By supporting Revino's transition from concept to operational readiness, the project demonstrates how reuse-based systems can be implemented responsibly when grounded in circular economy theory, pollution prevention principles, and regulatory awareness. The outcomes provide a replicable framework for evaluating refillable glass systems in regional markets and highlight the

value of interdisciplinary training offered by the Professional Science Master's in Environmental Sciences at Oregon State University.

References

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