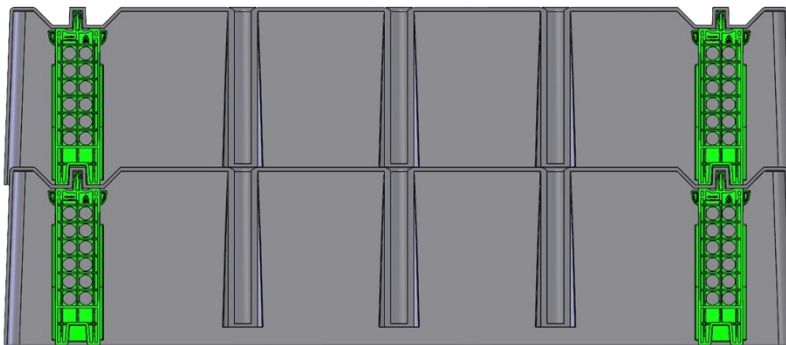


VanStack™ Case Study

Column-Reinforced Thermoformed Packaging for High-Demand Supply Chains

Executive Summary

VanStack is a fully patented packaging architecture developed by Vantage Plastics and its family of companies. Robotically inserted stacking columns, molded from the same high-molecular-weight polyethylene (HMW-PE) resin as the tray, lock into place while a single 0.200-inch sheet is still molten. The columns carry vertical loads, which allows the shell to run roughly forty percent thinner than conventional trays and still post a forty-plus-percent strength gain. Because every ounce of material is polyethylene, the entire unit grinds together at end-of-life with no disassembly, no fasteners, and no adhesives, keeping recycling labor near zero and satisfying modern Extended Producer Responsibility (EPR) requirements. Comparative testing on a North American engine program documented a 28 percent rise in unit-load density, a 42 percent reduction in starting sheet gauge, and a 45 percent boost in static load capacity when VanStack replaced the incumbent design. These gains trimmed annual freight runs by one-third, decreased Scope 3 carbon, and produced a favorable Life Cycle Analysis (LSA) outcome, all of which strengthens the organization's overall Environmental Social Governance (ESG) profile.



VanStack Thermoformed
Trays and Inserts



VanStack Injection Molded
Stacking Column Insert

The **VANTAGE** Family of Companies



1 Engineering Challenge: Breaking the Weight-vs-Capacity Deadlock

Automotive powertrain, suspension and structural parts routinely travel hundreds, sometimes thousands, of miles between stamping plants, machining centers, and final assembly lines. Historically, shippers had to accept one of two compromises:

- Steel flip-racks weighed between 90-120 pounds empty. A benchmark rack carried only twenty-four parts yet consumed an entire pallet footprint. Keeping a mid-volume engine line supplied demanded more than 300 outbound tractor-trailers per year, while 60 percent of manual picks exceeded OSHA's 35-pound ergonomic limit, forcing lift-assist devices that slowed takt time.
- Thick-wall thermoformed trays eliminated the mixed-material problem but typically ran at 0.345-inch gauge or thicker. They still delivered only four parts per layer, drove resin consumption north of budget, and left scant tolerance for automated pick-and-place tooling.

Both approaches under-performed against modern ESG scorecards. Heavy tare weights inflated diesel consumption, low cube utilization wasted trailer space, and multi-material constructions complicated EPR take-back schemes. The market needed a mono-material container that could:

1. Raise part density without sacrificing protection,
2. Drop tare weight below 30 pounds to erase lift-assist bottlenecks, and
3. Close the recycling loop with zero tear-down labor.

2 Technical Solution: Redirecting the Load Path

Finite-element analysis revealed that when compressive forces route through discrete columns instead of the thermoformed shell, buckling concerns vanish even at half-thickness skins. VanStack operationalizes that insight through three integrated steps:

1. **Load-path redesign.** Weight passes straight through the encapsulated columns, not the tray walls, eliminating bending stress and allowing a thinner skin.
2. **In-mold assembly.** Columns drop into guide rails in the aluminum tool; the hot sheet flows through engineered openings and fuses into a mechanical lock—nothing is drilled, riveted or glued.
3. **Polymer parity.** Both columns and skin are HMW-PE, so reclaimers grind the entire tray in one pass, fulfilling EPR mandates and eliminating contamination risk.

The result is a rigid spaceframe that self-registers layer-to-layer, enhancing both manual loading speed and robotic repeatability.

3 Materials & Processing: Simple, Scalable, Single-Stream

- **Tray skin** – Black HMW-PE sheet, 0.200 inch starting gauge, thermoformed on temperature-controlled aluminum tooling.
- **Stacking columns** – Green HMW-PE inserts for quick visual QC, molded in a four-cavity family tool and placed robotically before forming.
- **Cycle integration** – Sheet heating, column placement and vacuum forming run in one automated sequence; trimming and stacking mirror a standard tray workflow, so scaling requires no additional capital.

The one-shot process aligns with Industry 4.0 automation goals and has been validated on forming beds from 60x 80 inches up to 96x120 inches.

4 Performance Validation: Numbers That Move the Dial

Metric (Ford engine program)	Legacy Design	VanStack	Delta
Parts per layer	4	5	+1 part
Parts per unit-load	24	30	+28 %
Starting sheet gauge	0.345 in	0.200 in	–42 %
Static load capacity	1.00×	1.45×	+45 %
Raw material per tray	100 %	87–95 %	5–13 % less
Annual trailer count	100	67	–33 %
Annual freight spend	—	≈ \$2 million saved	

These data confirm that VanStack unlocks more capacity with fewer pounds of resin, raising EBIT while checking critical ESG boxes.

5 Sustainability Impact: ESG, EPR and LSA Alignment

- Scope 3 carbon cuts. One-third fewer truck runs translate directly into diesel and CO₂ reductions, improving ESG disclosures.
- EPR readiness. Single-polymer construction lets brand owners retrieve and recycle trays under state-level EPR programs without paying for manual separation.
- Life Cycle Analysis advantage. Internal cradle-to-gate modeling shows that the resin saved and the freight avoided outweigh the modest energy used to mold the columns, delivering a double-digit drop in global-warming potential over a five-year tray life.
- Closed-loop reality. Columns and skin melt at the same temperature, so processors grind and re-extrude without yield loss or cross-contamination.

6 Operational & Financial Benefits

- **Ergonomics.** Finished trays weigh under 30 pounds, clearing the 35-pound OSHA guideline and eliminating lift-assist slow-downs.
- **Pick-and-place speed.** Male-female geometry on each column head self-aligns layers in seconds; robots hit ± 0.060 -inch repeatability even on high-mix lines.
- **Fleet efficiency.** Higher density and lighter tare shrink tray inventories, reduce warehouse rent, and free working capital for core production assets.
- **Warranty risk mitigation.** With no bolts or rivets to shake loose, VanStack removes a common source of foreign-object damage claims.

Conclusion

VanStack resolves the long-standing trade-off between strength, weight, and recyclability in industrial packaging. By channeling compressive loads through integrated polyethylene columns, the system delivers quantifiable gains in density, ergonomics, total landed cost, and ESG performance while meeting EPR mandates and driving positive LSA metrics. Engineering teams under pressure to reduce carbon, cut freight, and streamline recycling can deploy VanStack with confidence, backed by Vantage Plastics' patented know-how and turnkey design-to-launch services.

Interested in quantifying the impact on your supply chain? Contact the Vantage Plastics engineering group for a technical review today.