

## NEW LIFE CYCLE COMPARISON ANALYSIS DEMONSTRATES ENVIRONMENTAL IMPACT DIFFERENCE BETWEEN REUSABLE THERMAL SHIPPER AND SINGLE-USE CONTAINER

*Reusable Credo Cube® reduces global warming potential by 75 percent and post-consumer waste by 95 percent.*



*The results of a newly completed 2012 Life Cycle Analysis (LCA) research project conducted by Kai Goellner, IE/ME University of Minnesota, concludes that the Credo Cube® shipper imposes less environmental burden in all five impact categories studied. The five-stage “cradle-to-grave” life cycle impact comparison of the Credo Cube® 4-1296 (12 liter) reusable shipper to a similar performance (volumetric capacity/duration) single-use shipper clearly demonstrates that the durable and reusable temperature-controlled container utilizing a closed loop logistics system significantly reduces the carbon footprint of transporting temperature sensitive payloads, especially in high volumes.*



### **Purpose of the LCA study.**

The fast growing pharmaceutical and biological markets serving an aging and growing population have spurred exponential demand for temperature-controlled packaging systems. To preserve and protect these critical payloads, the logistic system must provide strict thermally controlled environments during transport to locations around the globe. Global temperature-controlled transportation systems such as this can significantly increase the environmental footprint of these segments of the healthcare industry.

The challenge for the life sciences industry is that in an era of ever-growing transparency and a need for greater cost containment; sustainability is an important corporate initiative for major healthcare companies that need to protect temperature-sensitive payloads while reducing the environmental impact. MTS initiated this Life Cycle Analysis (LCA) research project with the objective of analyzing temperature-controlled packaging options and to compare their respective impact on the environment.



### **Background.**

There are two commonly accepted temperature sensitive packaging approaches for shipping biological and pharmaceutical payloads, each defined by its insulation type, thermal technology and duration requirements. The more traditional approach is to implement single-use containers employing either extruded polystyrene (EPS) or polyurethane (PUR) and/or water-based gel packs. A more advanced approach, and one that is gaining increasing recognition and acceptance in the life sciences industry, is implementing a reverse logistics system that utilizes durable, reusable and recyclable containers constructed with vacuum insulation panels (VIP) and phase change material (PCM).

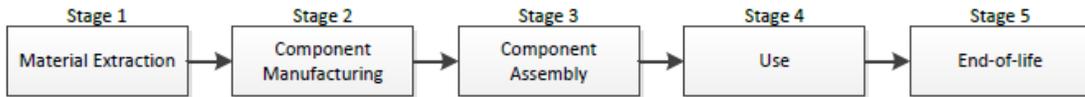
While a variety of packaging LCA comparison studies have been conducted on payload size and encasing materials (coffee, soda, soft goods), MTS' LCA study is the first to focus on thermal performance packaging used in cold chain logistics for the life sciences industry. Although this current research was focused specifically on the pharmaceutical market, it is expected that the methodology and results will apply to similar high-volume markets in the life sciences and cold chain logistics industry.

### **Scope.**

The LCA research project investigated the environmental impact of the Credo Cube® reusable shipper vs. a single-use shipper (with comparable payload volume and performance characteristics) over a two-year period (typical time frame) for a pharmaceutical clinical trial

requiring 30,000 individual shipments within the continental United States. The results of the study represent the cradle-to-grave carbon footprint comparison of the reusable and fully recyclable Credo Cube® 4-1296 (12 liter shipper with VIP/PCM components qualified to maintain a 2–8° C temperature range for 96 hours) with a single-use shipper insulated with either extruded polystyrene or polyurethane and gel packs. The life span of the Credo Cube® is assumed to be two years, although they typically last longer.

**Figure 1. Five stages of the cradle-to-grave life cycle analysis.**



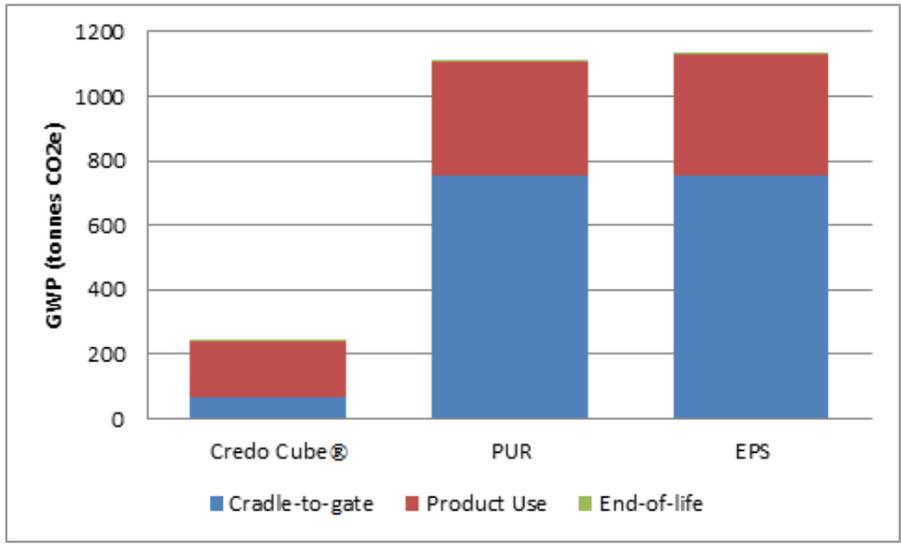
**High Volume = High Environmental Impact.**

The results of the study suggest that pharmaceutical organizations with high volume product shipments should care to consider the overall environmental impact of their packaging and logistical distribution system processes. The research results demonstrate that one of the greatest disadvantages of a single-use logistics system is the emissions generated in the first three phases — material extraction, component manufacturing, component assembly —where 12 times the global warming potential is generated vs. the reusable system. With a closed loop reverse logistics system in place, only 772 Credo® shippers are needed over the two-year period, as compared to 30,000 shippers in a single-use container logistics system. This differential significantly impacts the cradle-to-grave environmental performance with the Credo Cube® generating only 64.9 tonnes emissions in comparison to 752.4 – 754.5 tonnes generated by a single-use shipping container.

**Figure 2. Credo Cube vs Single-Use Extraction, Manufacture and Assembly Environmental Performance**

Credo Cube® 4-1296 packaging	
Component/stage	2 year total (tonnes CO <sub>2</sub> e)
VIPs	31.4
TICs	13.2
PCM	4.1
PP Corrugate	14.8
Encapsulation	1.3
Tape	0.2
<b>Cradle-to-gate total</b>	<b>64.9</b>

Single-use equivalent performance packaging		
Component/stage	2 year total (tonnes CO <sub>2</sub> e)	2 year total (tonnes CO <sub>2</sub> e)
	PUR	EPS
PUR	640.6	---
EPS	---	638.5
Corrugate	34.4	34.4
Gel Bricks	58.9	58.9
Gel Packs	20.5	20.5
<b>Cradle-to-gate total</b>	<b>754.5</b>	<b>752.4</b>



**Two-year carbon footprint comparison.**

**Weight.**

The weight of the shipping container also has significant environmental impact. Although a reusable container requires an additional transportation phase — return of the container for re-use — the phase four (use phase) transportation emissions were still significantly less than those associated with a single-use container. Why? The difference in the container weight. A Credo Cube® weighs in at 9.49 kg as compared to a single-use container that weighs between 17.85 kg and 19.07 kg.

**Figure 3. Component materials and weights per Credo Cube® container.**

Component	Weight (kg)	Material(s)
Vacuum insulated panels (VIP)	2.90	Carbon silica, carbon black, metalized PET film, LLDPE film, PVC film, PU adhesive
Thermal isolation chamber (TIC)	1.70	HDPE
Phase change media (PCM)	3.87	Paraffin wax blend
Outer corrugate	0.93	Polypropylene (PP)
Tape	0.09	Polypropylene (PP)
<b>Total</b>	<b>9.49</b>	

**Figure 4. Component materials and weights per single-use container.**

Component	Weight (kg)	Material(s)
Insulation*	4.84/6.06	PUR/EPS
Gel packs	8.92	Water, CMC, LDPE
Gel bricks	2.95	Water, phenolic foam, LDPE
Corrugate	1.14	Cardboard
<b>Total</b>	<b>17.85/19.07</b>	PUR model/EPS model

\* - Equivalent performance insulation, two materials analyzed independently

Due to the weight differential, the Credo Cube® has significantly better environmental performance than a single use container. The inference would be that less weight not only provides this emissions advantage but also provides a financial advantage with lower transport cost as a results of less shipping weight.

**Figure 5. Credo Cube® vs. Single-use Container Use Performance**

Transport to Indianapolis	0.9	Transport to Indianapolis	66.0	70.5
Refrigeration	2.2	Refrigeration	10.9	10.9
Transportation	171.0	Transportation	276.6	295.1
<b>Use total</b>	<b>174.0</b>	<b>Use total</b>	<b>353.5</b>	<b>376.5</b>

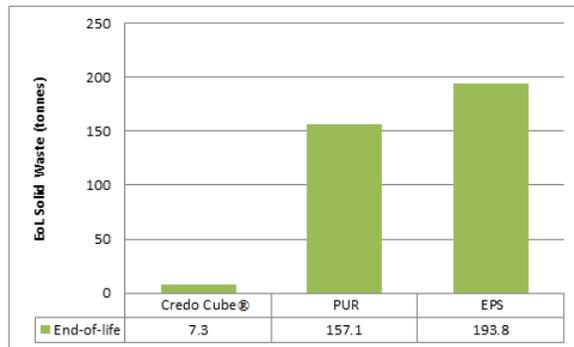
### Single-use Containers Have Several Recycling Hurdles

In order to lessen the environmental impact of the single-use logistics approach, organizations would need to create & implement a PUR and EPS recycling program - an infrastructure that does not currently exist in the continental U.S. This remains a major barrier — clinical sites with the ability to recycle these materials locally are far and few between. Furthermore, users of single-use thermal containers are generally only aware of a fraction of the total volume of single-use containers employed and thus are not fully cognitive of the waste generated by the high volume utilized. This is considered an impediment to initiating recycling programs within the organization.

In comparison, recycling the components of a reusable container is integrated into a comprehensive reverse logistics system where the recycling process is simply another step in the overall logistics plan. While the tonnes of CO<sub>2</sub> generated by a cold chain reverse logistics system is 2.0, that of a single-use logistics system ranges between 3.6 – 3.9 tonnes.

In addition, while the Credo Cube® container life span generates 7.3 tonnes of waste, a single-use container generates between 157.1 – 193.8 tonnes of waste. That is a significant difference in terms of carbon footprint and environmental impact.

**Figure 6. Comparison of post-consumer solid waste at end-of-life.**



**Reverse logistics has a lesser environmental impact.**

Ultimately, the full study demonstrates the extent to which a reverse logistics system is environmentally superior to a single-use logistics system. The Credo Cube® reusable thermal protection container with a reverse logistics system outperforms a comparable single-use container logistics system and significantly reduces the environmental impact of transporting thermal protected payloads. The study determined that the global warming break-even point between the reusable and single-use container occurred after just nine shipments. For organizations sustaining large volumes of temperature-sensitive shipments, a reverse logistics system is preferable.

Bottom line: Over a two-year course of 30,000 shipments, an organization that implements reusable (772 containers vs. 30,000) temperature-controlled containers utilizing recyclable VIP insulation and PCM technology in a reverse logistics system can reduce global warming potential by 75 percent and post-consumer waste by 95 percent.

To learn more about Minnesota Thermal Science and the complete line of Credo Cube® reusable packaging technology solutions, visit: <http://www.mnthermalscience.com/products>.