Designing a Sustainable Packaging Program

Results and Recommendations

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Project Overview

The Case for Sustainable Packaging

Though packaging serves many purposes, the main function of EMC’s packaging is to protect products during transportation, including transportation of raw materials from suppliers, transportation of inventory and finished goods between EMC facilities, and transportation of EMC products to customers.

Many companies that produce packaged goods consider packaging sustainability as part of broader sustainability initiatives. Packaging can be viewed as “an icon of consumption,”¹ and is often considered waste by customers. Unlike internal business practices that are targets for sustainability initiatives, packaging is very visible to the customer and thus represents an opportunity to either impress or disappoint. As customers increasingly focus on sustainability, packaging will become a visible way to communicate the company’s sustainability efforts.

Optimal sustainable packaging balances product protection with environmental impact of packaging production, use, and disposal. When designing packaging, it is important to consider both the impact of the packaging itself and the impact of any product losses due to under-packaging, as the impact of product losses due to under-packaging can outweigh the impact of reduced packaging because “products generally represent far greater resources and have a much higher value

![Diagram of optimal packaging balance]

Figure 1. Optimal packaging minimizes the total impact of both the packaging itself and product losses due to under-packaging. Source: “A Global Language for Packaging and Sustainability,” Global Packaging Project.

than the packaging used to protect them.”\textsuperscript{2} (See Figure 1.) The Global Packaging Project clarifies that “well-designed packaging will meet the requirements of the product while minimizing the economic, social, and environmental impact of both the product and its package.”\textsuperscript{3}

**Project Motivation**

In recent years, EMC has started to consider environmental impact when designing packaging. Initiatives have focused on reducing package weight, increasing reusability, and using more environmentally sustainable materials. Sustainable packaging improvements have been implemented in an ad-hoc manner, often thanks to the motivation of a few key employees.

EMC wants to create a formal packaging program that brings sustainability into the design process. This project seeks to help EMC understand the state of its current packaging process, compare that process to industry best practices, and develop recommendations to improve EMC’s approach to environmental packaging sustainability. This report provides recommended program objectives, key performance indicators and metrics, and a high-level plan for implementation.

This project addresses the following questions for EMC:

1. What are the industry best practices for sustainable packaging?
2. What is the current state of EMC’s packaging program?
3. What are the gaps between best practices and EMC’s packaging program?
4. What should EMC’s sustainable packaging program look like and what are some steps to get there?

**Industry Best Practices**

**Sustainable Packaging Initiatives**

We identified two industry groups that have developed guidance for companies seeking to improve packaging sustainability – the Sustainable Packaging Coalition and the Global Packaging Project.

**Sustainable Packaging Coalition**

The Sustainable Packaging Coalition (SPC), founded by non-profit sustainability institute GreenBlue, is an industry group that supports sustainable packaging initiatives by conducting research, sharing best

\textsuperscript{2} “A Global Language for Packaging and Sustainability.” *Global Packaging Project*, 2009.

\textsuperscript{3} “A Global Language for Packaging and Sustainability.” *Global Packaging Project*, 2009.
practices, and advocating for environmentally-friendly packaging. SPC’s criteria-based definition of sustainable packaging considers not only environmental impact from the full lifecycle perspective, but also the economic and social impact of packaging choices.

According to SPC, “Sustainable packaging:

A. Is beneficial, safe, and healthy for individuals and communities throughout its life cycle;
B. Meets market criteria for performance and cost;
C. Is sourced, manufactured, transported, and recycled using renewable energy;
D. Optimizes the use of renewable or recycled source materials;
E. Is manufactured using clean production technologies and best practices;
F. Is made from materials healthy in all probable end-of-life scenarios;
G. Is physically designed to optimize materials and energy;
H. Is effectively recovered and utilized in biological and/or industrial closed loop cycles.”

SPC considers its definition to be a set of goals towards which companies can strive and provides detailed information on best practices and metrics that companies can use to assess their packaging efforts against the SPC definition. 57 sustainable packaging indicators span material use, water use, energy use, material health, clean production and transport, cost and performance, community impact, and worker impact. 5

SPC has developed design guidelines that support its definition of sustainable packaging and consider the full lifecycle. These guidelines offer strategies that companies can use to develop their own sustainable packaging programs. (See Figure 2.)

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4 “Definition of Sustainable Packaging.” Sustainable Packaging Coalition, October 2009.
Global Packaging Project
Global Packaging Project (GPP), an initiative of the Global CEO forum, aims to coordinate sustainable packaging initiatives throughout the supply chain by creating a standard language for companies to use when considering package sustainability. A common language enables clearer and more informed communication across the supply chain regarding packaging sustainability, reduces costs due to established data expectations, and improves decision-making based on robust metrics.

Based on initial work done by SPC and several other groups, the GPP developed a packaging sustainability measurement framework that includes definitions, indicators, metrics, and usage guidelines. Though the framework is in pilot testing, GPP encourages companies to utilize this framework and hopes that it will become standard practice across the supply chain.

GPP believes that “to positively contribute to the sustainability of a product, packaging should increasingly be:

- Designed holistically with the product in order to optimize overall environmental performance
- Made from responsibly sourced materials
- Able to meet the market criteria for performance and cost
- Manufactured using clean production technologies
- Efficiently recoverable after use
- Sourced, manufactured, transported, and recycled using renewable energy.”

The GPP framework includes 52 indicators that address environmental, economic, and social aspects of sustainability. For each indicator, GPP provides a detailed definition and guidance for what to measure and example metrics to use.

Considering the Full Lifecycle of Packaging
Both the GPP and SPC definitions are based on an analysis of the full lifecycle of packaging, from

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sourcing of the raw materials to disposal of the packaging at the end of its life. This “cradle-to-cradle” approach suggests an understanding of the dire consequences of waste. “Each material in a product is designed to be safe and effective, as well as to provide quality resources for subsequent generations of products.”

Choices made during the packaging design, impact each step of the process, from sourcing of raw materials to freight to end-of-life, so it is important for packaging designers to understand how to optimize the impact of packaging across its entire lifecycle. (See Figure 3.)

**Process for Designing a Sustainable Packaging Program**

SPC and GPP provide useful guidance on the process for designing a sustainable packaging program. The development of the program for EMC will be outlined later in this report according to the guidelines below.

<table>
<thead>
<tr>
<th>1</th>
<th><strong>Clearly Define Program Objectives:</strong> Clear goals will provide a useful framing for the program that will inform program scope, influence choice of metrics, and enable success tracking.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Define Scope:</strong> Scope should clearly identify what is within the project’s purview, distinguish between decisions the company controls directly and decisions controlled by third parties, and define clear start and end points for analysis (i.e. gate-to-gate or cradle-to-gate).</td>
</tr>
<tr>
<td>3</td>
<td><strong>Identify Areas of Focus:</strong> Companies must consider the high-level focal points of their sustainable packaging program, for instance “water” or “energy” or “labor.” These focus areas should align with the company’s broader corporate sustainability goals.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Select Appropriate Indicators:</strong> Companies must identify appropriate indicators and metrics to track progress toward articulated goals. An indicator acts as a proxy that allows companies to measure movement toward a goal. An indicator can often be expressed by several different metrics.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Select Appropriate Metrics:</strong> Metrics should offer a reasonable balance between specificity and flexibility in order to be both meaningful and feasible. A metric is a specific measurement that can be used to express an indicator. Metrics are usually objective, quantitative, and measured in identifiable units.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Establish a Baseline:</strong> The company must collect initial data (often a full year’s worth) to establish a baseline level of performance on each metric. The baseline provides a starting point against which subsequent data can be compared.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Set Concrete Goals:</strong> Based on baseline data, companies should set concrete targets for each metric. Goals should be SMART - specific, measurable, attainable, relevant, and time-bounded.</td>
</tr>
</tbody>
</table>

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Example Sustainable Packaging Programs

In recent years, metrics within the packaging industry have started to stabilize. Research on several companies considered leaders in sustainable packaging suggests that the approach, Key Performance Indicators (KPIs), and metrics that companies use to assess and guide packaging sustainability are quite similar across a wide range of industries. The metrics and KPIs used to assess packaging sustainability at three companies are described below.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Scorecard Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse gas emissions</td>
<td>15%</td>
</tr>
<tr>
<td>Material value</td>
<td>15%</td>
</tr>
<tr>
<td>Product to package ratio</td>
<td>15%</td>
</tr>
<tr>
<td>Cube utilization</td>
<td>15%</td>
</tr>
<tr>
<td>Transportation</td>
<td>10%</td>
</tr>
<tr>
<td>Recycled content</td>
<td>10%</td>
</tr>
<tr>
<td>Recovery value</td>
<td>10%</td>
</tr>
<tr>
<td>Renewable energy</td>
<td>5%</td>
</tr>
<tr>
<td>Innovation</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Wal-Mart**

Wal-Mart has announced an inspirational goal to be “packaging neutral” globally by 2025, which means through recycling, reusing, or composting, it will recover as much material as was used in packaging that flows through its stores. A shorter-term goal is to reduce total packaging by five percent from 2008 to 2013. To achieve its objectives, Wal-Mart has developed a packaging scorecard that allows the retailer’s suppliers to make more environmentally-friendly packaging decisions. The scorecard evaluates packaging based on several metrics that together provide a comprehensive picture of packaging sustainability.

**Dell**

Dell has a clear target of improving packaging sustainability while reducing packaging costs. Dell focuses on three distinct angles of packaging – cube, content, and curb – and identifies clear targets for each.

<table>
<thead>
<tr>
<th>Area of Focus</th>
<th>Key Questions</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube</td>
<td>How big is the box? Could it be smaller?</td>
<td>Reduce packaging volume by 10%</td>
</tr>
<tr>
<td>Content</td>
<td>What materials are used in the packaging? Can it be made using more sustainable materials?</td>
<td>Increase amount of recycled content to 40%</td>
</tr>
<tr>
<td>Curb</td>
<td>Is the package easily recycled at curbside?</td>
<td>Increase amount of material in packaging that is curbside recyclable to 75%</td>
</tr>
</tbody>
</table>

**UPS**

As a leader in logistics, UPS does a lot of research on sustainable packaging. Because it combines packaging and transportation, UPS measures its packaging impact more holistically than other
companies. UPS considers five sustainable packaging focal topics that address core functionality, transportation, and overall environmental effect.

<table>
<thead>
<tr>
<th>Area of Focus</th>
<th>Key Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging Material</td>
<td>● Reduced amount of packaging material used (cost, weight, and volume)</td>
</tr>
<tr>
<td></td>
<td>● Reusability of materials</td>
</tr>
<tr>
<td></td>
<td>● Recycled content</td>
</tr>
<tr>
<td></td>
<td>● Recovery value</td>
</tr>
<tr>
<td></td>
<td>● Biodegradability of packaging materials</td>
</tr>
<tr>
<td>Cube</td>
<td>● Cube of package relative to contents</td>
</tr>
<tr>
<td>Damage Prevention</td>
<td>● Validation testing to prevent damage, including shock, vibration, compression, and atmospheric hazards</td>
</tr>
<tr>
<td>Transportation Mode</td>
<td>● Type of transportation to move the product, including over the road, air, and ship</td>
</tr>
<tr>
<td>Total Carbon Footprint</td>
<td>● Carbon footprint generated throughout the lifecycle of the packaged product movement</td>
</tr>
</tbody>
</table>

**Similarities in Sustainable Packaging Programs**
There are striking similarities between the three examples presented. First, all three companies have clearly articulated goals. Second, they all consider the full packaging lifecycle. Third, they have defined metrics and KPIs to measure performance consistently. Fourth, they have selected similar indicators such as packaging material content, packaging to product utilization ratio, and overall impact on the environment. Our recommendations will also include these attributes.

**Current State of EMC’s Packaging Process**

**Understanding EMC’s Packaging Process**
To gain a thorough understanding of how packaging decisions are made at EMC, we spent a full day touring EMC’s Franklin facility and meeting with employees. In addition, several employees from other EMC offices were interviewed via phone. A full list of the employees interviewed is below.

<table>
<thead>
<tr>
<th>Employee</th>
<th>Title and Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathrin Winkler</td>
<td>Vice President and Chief Sustainability Officer</td>
</tr>
<tr>
<td>Mike Kerouac</td>
<td>Senior Vice President of Global Product Operations and Chief Procurement Officer</td>
</tr>
<tr>
<td>Laura Nelson</td>
<td>Consulting Packaging Engineer, EMC Product Design</td>
</tr>
<tr>
<td>Lisa Brady</td>
<td>Director, Global Product Operations Sustainability</td>
</tr>
<tr>
<td>Todd McBride</td>
<td>Director of Franklin Program Office</td>
</tr>
<tr>
<td>Alyssa Caddle</td>
<td>Senior Program Manager, Propel Team</td>
</tr>
<tr>
<td>Tim Fasolt</td>
<td>Senior Manager, Quality Assurance</td>
</tr>
<tr>
<td>Bill Ramsay</td>
<td>Senior Program Manager for Sustainability Cork GPO</td>
</tr>
</tbody>
</table>
Through the interviews, we learned that EMC packaging falls into three categories: outbound, internal, and inbound. Outbound, internal, and inbound packaging differ significantly in the way packaging decisions are made and how much control EMC has over the decisions.

**Outbound and Internal Packaging**

EMC uses outbound packaging to deliver its products to customers, while internal packaging is used for transit within and between EMC facilities. Outbound packaging must meet stringent resiliency and protective standards to ensure that both packaging and contents arrive to the customer in pristine condition.

EMC sources most of its packaging from two suppliers with which it has close relationships. The design process is a collaboration between EMC packaging engineers, such as Laura Nelson, and these suppliers, with input from other EMC groups like Hardware QA, Process Engineering, and Global Advanced Manufacturing Engineering. Laura typically works with the suppliers to create a mock-up design based on the customer specification (“spec”), product requirements, and input from EMC teams. The mock-up is then tested to ensure durability under a variety of extreme circumstances.

Speed is critical in the package design process. When possible, the packaging suppliers will offer standardized solutions that shorten the lead time. However, packaging design is generally a customized process based on the product spec. Best practices are communicated organically across packaging engineers but no standardized procedures exist to guide engineers on sustainable packaging solutions.

EMC shares a single common supply chain globally, and responsibility for packaging, including design, testing, and data collection, occurs almost exclusively in the United States. To meet the high standards of customers in Asia, who view packaging as a representation of the product and thus expect perfection, EMC designs packaging to meet strict aesthetic requirements even after withstanding long-haul travel. These “overpackaged” solutions are implemented throughout the supply chain regardless of delivery.
location. EMC believes that customers in some regions, like Northern European, would be amenable to more sustainable or reused packaging, but these customers still receive the “Asian-standard” packaging.

**Inbound Packaging**
Inbound packaging is used for materials and products that EMC purchases from external suppliers. These items range from raw materials used in production processes to IT components that are incorporated into EMC products or shipped directly to other customers (where EMC acts as a middleman). EMC has very little control over inbound packaging. In cases where EMC acts as a middleman, the product usually remains in the original supplier packaging and is sent outbound to the end customer without being unpacked.

EMC maintains a standard spec, “the 501 spec,” that contains requirements for inbound packaging, but is currently light on sustainability-related criteria. While EMC has control over its spec, it has little control over inbound packaging beyond the spec. Upon placing an order with a supplier, EMC communicates the spec requirements for packaging. The supplier then submits a packaging plan in accordance with the spec to EMC’s Supply-Based Management-Technical (SBM-T) team. The team sometimes passes the packaging plan to EMC packaging engineers for feedback. Alternatively, a few core suppliers may forward the packaging plan directly to the packaging engineers. When packaging engineers receive the plan, there is an opportunity to suggest improvements, but this does not happen regularly, and most improvements are focused on operational efficiency.

**Prior Sustainability-Related Efforts**
In 2009-2010, Alyssa Caddle, whose primary responsibility is toxicity compliance, was assigned an ad-hoc project with Laura Nelson to analyze how EMC could further its packaging sustainability efforts and understand the packaging sustainability programs of competitor companies. Alyssa identified three areas of focus that have guided EMC’s packaging improvements to date:

- Ratio of package weight to product weight
- Use of recycled materials
Tracking of returned packaging

Within each area of focus, EMC selected a few key objectives. (See Figure 4.) Ultimately, Alyssa encountered data collection challenges that prevented her from completing a comprehensive benchmarking analysis.

EMC started by publicizing the sustainable packaging choices that the company has been making for years, like the fact that EMC packaging has always been free of PVC and polystyrene. Additionally, EMC sources wood and corrugated cardboard from only mills that have been certified sustainable, and minimizes the use of pesticides to treat wood by following ISPM 15 standards.

Laura Nelson has made incremental improvements to the design of select packaging over the last two years, and these improvements have translated to long-run savings for EMC. Though improvements have been ad hoc rather than driven by a formal corporate initiative, the impact of Laura’s efforts has been significant. EMC has eliminated unnecessary foam in software packaging to enable curbside recycling, implemented “bulk packaging” solutions that dramatically reduce packaging per unit, and designed more compact, reusable pallets for internal packaging. Many of Laura’s packaging re-designs have focused on low-hanging fruit – the “ugly” packages that present clear opportunities for improvement.

Though impact has been difficult to quantify without data collection protocols in place, EMC estimates that the company eliminated 13,000 kilograms of waste by developing a returnable and reusable package for large orders. From 2008 to 2009, the total weight of packaging used for EMC core products dropped by an estimated 30% due to innovations in reusable packaging.\(^8\)

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\(^8\) EMC Sustainability Report, 2009.
**Packaging Data Collection**
Currently, EMC does not collect much data on packaging. EMC requests and receives useful information from its packaging suppliers, including weight of each type of package and number of each type of package purchased by each EMC facility. Rather than tracking the amount of packaging actually shipped from EMC facilities, the company uses this supplier data to compute basic statistics for sustainability reporting, thus assuming that all packaging purchased is utilized.

In 2010, EMC completed a one-time assessment of packaging weight to product weight ratio as part of Alyssa Caddle’s efforts. Though this information allowed for interesting analysis, the inputs are not collected regularly or continuously. Package weights are provided by packaging suppliers, but packaging engineers have difficulty collecting data on EMC product weights.

From time to time, packaging engineers will work with someone in EMC’s Global Product Operations Sustainability group to estimate the impact of a specific packaging improvement. Using the Sustainable Minds tool, changes in packaging content and weight can be translated into equivalent number of cars taken off the road or trees planted, and the results are usually publicized either within EMC or as part of sustainability reporting. However, these assessments are only completed for select improvements.

**Gap Analysis**
After researching industry best practices and understanding the packaging process at EMC, we identified several gaps between the two. Due to these gaps, EMC has been unable to successfully move forward with packaging improvements. To be the “best in breed” on sustainable packaging, EMC will need to work towards resolving these differences and foster innovation in packaging sustainability. Several of these gaps are well understood by EMC employees, and EMC has taken a critical first step by scoping this project to develop recommendations for a more formalized sustainable packaging program.

**Improvements Are Ad-Hoc**
Despite the significant progress that EMC has made on packaging sustainability, improvements have been ad-hoc. Changes have targeted “ugly” packages and “obvious” opportunities identified on the plant floor by EMC staff. Such packaging redesigns have been successful and appropriately praised in
outward-facing EMC literature, but ad hoc improvements are not scalable. As opportunities for improvements become more challenging to identify or where alternative packaging redesign opportunities vie for competing resources, EMC staff will face greater difficulty in maintaining forward progress without a formalized process for packaging sustainability.

**Lack of Clearly Established Goals and Targets**
EMC has published its areas of focus (see Figure 4) and has publicized the success that has been achieved. While there is energy behind sustainable packaging improvements from employees all the way up to the senior level at EMC, near- and long-term goals for packaging improvement have not been established or communicated. Without goals and targets, EMC cannot identify new opportunities for improvement or choose among competing packaging redesign choices. Goals can offer a common destination towards which employees can strive. Such goals and targets must work in harmony to provide the correct incentives for corporate sustainability efforts. When functioning properly, assessing the sustainability-related performance, whether by an employee, department, or a plant will be a matter of tracking progress against the established goals.

**Relevant Data Not Currently Captured**
Prior to establishing targets, appropriate data must be collected to establish a baseline against which improvements can be measured. EMC currently lacks the necessary systems to generate the data required to undertake a systematic sustainability initiative in packaging. Recent efforts to gather company-wide packaging information, led by Alyssa Caddle, stalled due to significant data acquisition challenges. For example, EMC tracks the material content in each package type and the number of different types of packaging purchased. However, the use of packaging is not tracked at the plant level, and therefore must be approximated using purchasing records. This method can provide a general sense of packaging use, and may indeed be deemed sufficient for near-term efforts, but it nonetheless presented a significant barrier to forward progress for Alyssa and could not be resolved with the limited resources available. A push into greater packaging sustainability will also require locating and integrating data from outside of EMC, such as lifecycle Global Warming Potential of various packaging materials.
Unclear Responsibility and Resource Constraints
Future sustainable packaging improvements will rely on accurate data to track progress and prioritize efforts. Additional resources are needed for data collection, implementation, and execution of the recommended solutions. However, it is not just a challenge of resource level, but also of responsibility. Though packaging design is centralized, the roles and responsibilities with respect to packaging sustainability are not clearly defined. Projects span organizational departments and therefore they can be difficult to manage and coordinate. Communication across divisions also presents challenges.

Currently, packaging sustainability projects fall “outside” an employee’s day-to-day responsibilities. This suggests widespread dedication to sustainability from EMC sustainability “champions,” but also indicates that sustainability is not perceived as something that all employees should be thinking about each day. A “best-in-breed” packaging sustainability program integrates sustainability into all aspects of the business and is not a separate group of efforts. It is not surprising then that sustainability in packaging lacks sufficient resources; projects taken on “outside” of work are difficult to support with limited resources.

Beyond human resources, there also exists a lack of effective tools. Sustainable Minds sustainability indicators is incomplete and just a starting point for Lifecycle Analysis (LCA). With proper human resources in place who “own” sustainability challenges as an official part of their job description, it will be easier to identify and make requests for effective tools, to manage cross-boundary sustainability projects, and to see them through to success in a timely manner.

Designing EMC’s Sustainable Packaging Program

Program Objectives
The design of EMC’s packaging sustainability program must fit well within the broader context of EMC’s corporate sustainability goals and product positioning. Based on our understanding of how sustainability fits into EMC’s corporate strategy, we recommend the following objectives for EMC’s packaging sustainability program:
• **Align Packaging Sustainability with Broader Corporate Sustainability Priorities:** EMC’s corporate priorities for sustainability are climate change, energy, material waste, and water. The lifecycle of a package touches on all four of these broad corporate sustainability priorities.

• **Enable Cost Savings:** EMC’s sustainability program prioritizes the business case for sustainability. Initiatives focus on the most cost-effective ways to improve sustainability of operations, capturing the benefit of the “low-hanging fruit.” Thus, packaging improvements should aim to enable long-term savings for EMC, or at least remain cost-neutral. Additional costs and benefits can be hard to assess, including the benefits of positive customer perception.

• **Support Product Positioning:** EMC’s customers are businesses that are working towards their own sustainability goals, and EMC currently markets its products as sustainable options that can help businesses achieve their sustainability goals (via energy efficiency, etc.). Packaging must support that product positioning.

**Program Scope**
A successful program begins with a well-defined scope. Though inbound, outbound, and internal packaging differ with regards to packaging design process and EMC control, the lifecycle for each type of packaging is the same. The MIT team and EMC agreed that all three categories of packaging should fall within the sustainability program scope.

Several aspects of packaging sustainability are outside the scope of this initiative, including packaging for non-EMC products like office supplies, social sustainability factors like labor and toxicity, and regulatory issues. Such areas are covered elsewhere in EMCS corporate procedures and guidelines. The packaging sustainability program presented here focuses on the direct and indirect environmental impact of the packaging from raw material extraction, design and production, use, and end of life.

Our recommendations address the full lifecycle of packaging to provide a framework for EMC to think broadly about its packaging operations and compare sustainability measures across packaging categories. Though the scope is broad, we focus on aspects of packaging design and usage that EMC has influenced over to provide actionable recommendations. For example, the source of packaging materials can be considered during the design process and thus falls under EMC’s control in its outbound packaging choices. Conversely, the packaged subcomponents EMC receives from its suppliers give the company the opportunity to control end of life decisions, such as recycling or composting.

**Identifying Areas of Focus**
A truly encompassing sustainability plan must consider the full lifecycle of the product in question or else it runs the risk of overlooking significant environmental impacts. Calculating metrics farther
upstream and downstream in the lifecycle can be challenging, but allows for a truer comparison of the environmental impacts of packaging choices. Although obtaining accurate data from outside EMC’s walls is more difficult, it is very important. Even loose approximations are better than assuming that the environmental impact of a package starts and ends within the wills of EMC or begins with its supplier and ends at its customer.

To identify appropriate areas of focus for EMC, we considered EMC’s sustainability priorities, the environmental categories recommended by industry groups like SPC and GPP, and the focus of other companies considered “best in class.” After a thorough assessment of relevance and impact, we chose indicators which were most relevant to EMC and its operations with consideration for ease of implementation. We recommend that EMC focus on four categories of packaging sustainability: Packaging Material Content, Packaging Design and Performance, Packaging Use, and Overall Impact. In general, these four categories cover unique portions of the packaging lifecycle and also can be assigned to unique employees or teams within EMC.

**Indicators and Metrics**
The full set of lifecycle indicators from industry groups such as the Global Packaging Project or Sustainable Packaging Coalition presents an overwhelming array of choices. We developed a limited set of indicators that work in unison, not overlapping and not leaving any holes. Our intent is to provide a simplified list that allows for a complete picture of packaging sustainability.

Instead of just looking at metrics that can be implemented right now, we include metrics critical in providing overall vision even if they present implementation challenges given EMC’s current capabilities. Some metrics will naturally be easier to measure than others. Yet, because the metrics integrate holistically (and in some cases progress can be obtained on a given metric at the expense of another metric), it is critical that the whole set of metrics is considered together in order to provide meaningful guidance on sustainable packaging performance.
Metrics were selected so that many can be considered at the individual package level to enable sustainable choices during packaging design. All metrics can be aggregated to the corporate level so that EMC can track progress over time.

Below is the list of indicators and metrics that we have identified for EMC’s sustainable packing program.

### Packaging Content

<table>
<thead>
<tr>
<th>A. Recycled Content</th>
<th>Weight of recycled material : total weight of material x used</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Recyclable Packages</td>
<td># recyclable packages shipped : total # packages shipped (Yes/No for each package)</td>
</tr>
<tr>
<td>C. Renewable Content</td>
<td>Weight of renewable materials : total weight of packaging</td>
</tr>
</tbody>
</table>

### Packaging Design & Performance

<table>
<thead>
<tr>
<th>D. Material Weight</th>
<th>Weight of packaging materials : weight of product and packaging system</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. Production Efficiency</td>
<td>Weight of material utilized : total weight of material used in production</td>
</tr>
<tr>
<td>F. Reusable Packages</td>
<td># reusable packages : total # packages shipped</td>
</tr>
<tr>
<td>G. Reusable Cycles</td>
<td>Number of cycles prior to withdrawal from system</td>
</tr>
<tr>
<td>H. Optimal Cube Efficiency</td>
<td>Volume of packaging : volume of pallet capacity</td>
</tr>
<tr>
<td>I. Product Damage</td>
<td># units damaged or wasted : total units shipped</td>
</tr>
</tbody>
</table>

### Packaging Use

<table>
<thead>
<tr>
<th>J. Reuse Rate</th>
<th>Number of cycles utilized : optimal number of cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. Packaging Used</td>
<td>Weight of packaging shipped : weight of product and packaging shipped</td>
</tr>
<tr>
<td>L. Actual Cube Efficiency</td>
<td>Shipped volume of packaging : volume of pallet capacity</td>
</tr>
</tbody>
</table>

### Overall (Aspirational)

| M. Lifecycle GWP | Mass of CO2 equivalents : mass of packaging materials used |

### Packaging Content

- **Recycled Content:** This measures how much of packaging material is from recycled materials in effort to increase the recycled content. It needs to be managed without compromising the integrity and the function of the packaging in protecting the product itself. It will be most appropriate to measure per type of material so those heavier materials do not skew the data of the lighter materials.

- **Recyclable Packages:** This measures what percentage of packages shipped are recyclable by the end customer. In addition to using recyclable materials, it is important to provide appropriate communication to the customer to encourage recycling.

- **Renewable Content:** This is similar to the Recycled Content but focuses on renewable materials used for packaging. Good examples that are currently being developed are bamboo and mushroom as packaging materials.

### Packaging Design & Performance

- **Material Weight:** This measures the weight of packaging materials relative to product weight. Instead of just looking at the individual product to packaging, it should include all the packaging materials required to ship a product from the manufacturing to the customer, including primary, secondary, and tertiary packaging, as well as pallets. Since EMC’s products are highly valuable, it is critical that the packaging protects the integrity of the product to the customer. However, it is also important not to over-package beyond the required protection.
• **Production Efficiency:** This is to minimize any waste of materials during the production of packaging materials. By comparing the material utilized to the total material required, EMC can measure the production efficiency as well as identify opportunities to reduce costs.

• **Reusable Packages:** This measures the percentage of packages that are reusable packages out of the total number of packages shipped in order to encourage the development of reusable packaging. In developing reusable packing, it important to understand the likelihood, GWP, and costs of returning the packaging to EMC facilities.

• **Reusable Cycles:** This measures how many times a reusable package can be utilized before it needs to be disposed. Measuring both Reusable Packaging and Reusability together is important, as the increasing the number of cycles may offer significant cost savings.

• **Optimal Cube Efficiency:** This assesses how many packages can be accommodated in EMC’s standardized pallet capacity by design. By increasing the cube efficiency, EMC can reduce both GWP and costs.

• **Product Damage:** Tracking product damage ensures that the product’s integrity is protected despite the sustainable packaging initiatives. It is important to balance the function of the packaging with the sustainability of the packaging, particularly because the economic and environmental cost of discarded product can be much higher than that of discarded packaging.

**Packaging Use**

• **Reuse Rate:** This measures the actual number of times that a reusable package was utilized compared to the target number of cycles. It is important to track actual reuse, as designing for reuse is not impactful unless packages are actually being used multiple times.

• **Packaging Used:** This represents the total weight of packaging and is used to encourage factory-floor employees to use as little packaging as possible. During time crunches, employees often ship orders using many individual boxes instead of taking the time to pack multiple products in the same package (i.e. installing components inside server instead of shipping components and server separately).

• **Actual Cube Efficiency:** This measures the actual volume of packages that have been shipped compared to the total volume of pallets available. It is not to be measured against the Optimal Cube Efficiency as each will have a different target; however, it is meant to measure the discrepancy that may occur due to numerous operational challenges.

**Overall Impact**

• **Lifecycle GWP:** This metric assesses the overall CO₂ and CO₂ equivalent emissions, by weight, associated with the full lifecycle of EMC packaging. Similar to Gross Domestic Product (GDP) for assessing a country’s economy, GWP is close to an all-encompassing metric, but with similar shortcomings. GWP is most useful in measuring progress year-over-year, rather than comparing absolute value from one company or product to another. Though measuring GWP can be difficult, it captures a significant portion of the environmental impacts of operations. Although material waste is not thoroughly captured by GWP, it is significantly covered by other metrics included in our recommendations. Although it is a significant resource commitment, we feel that it provides such useful insight and aligns so well with EMCS larger climate change and energy sustainability goals that it should be included. Even water use is indirectly covered by GWP since energy and water are closely linked.

**Additional Considerations**

Aside from the four focus areas, we also have identified a number of considerations that will be crucial to implement a comprehensive sustainable packaging program. Though the suggested set of metrics
does not include any economics factors, the economics of various packaging improvement options will be a key consideration. Based on our interviews, it appears that unless packaging improvements are cost-effective or at least cost-neutral, they will be difficult to implement within EMC. Economics, like technical feasibility or required man-hours, is a factor that must be considered in addition to the sustainability goals and should aid in prioritizing efforts. EMC should assess the full economic picture, including less tangible costs and benefits that may be difficult to estimate, like the benefits of positive customer perception or the costs of data collection.

Communication to the customer regarding reusability or recyclability of packaging is critical to minimizing a package’s lifetime impact. EMC does not have direct control over what the customers do with packaging upon receipt, so unless customers are educated about reusability and recyclability, the benefits of having packages that are designed for multiple uses or for specific means of disposal can be lost.

EMC should consider revising the specification for inbound packaging to address packaging sustainability. While the spec currently focuses more on product characteristics and operational issues, the addition of packaging sustainability criteria based on the metrics above will enable EMC to improve inbound packaging, the type of packaging over which EMC has had the least control in the past. Encouraging sustainable design for inbound packaging will not only contribute to EMC’s packaging sustainability efforts, but also help to teach suppliers. This will help to solidify relationships with suppliers, as the criteria will likely spark a conversation between EMC packaging engineers and suppliers.

**Program Implementation**
Implementing a sustainable packaging program will go a long ways toward supporting EMC’s business objectives as they relate to sustainability. Not only will it support EMC’s aspiration to be “best in breed,” but also it can also facilitate cost savings and further support EMC’s branding as an energy-efficient and environmentally friendly storage solution provider. Such a large shift in operations, procedures and mindset is complicated and will take time. The process for change must be catered to
the specific organization within which it is to be implemented. An implementation plan for EMC is outlined below.

Clarifying Responsibility and Accountability
In order to support a sustainable packaging program, EMC needs to obtain and develop human resources to manage the data collection, benchmarking, and measurement of sustainability metrics. In our discussions with EMC, the major roadblock to continuous progress has been a lack of resources and clear lines of responsibility. Clear roles and responsibilities must be defined for each individual on the sustainable packaging team. Individuals should know who is responsible for which metrics. Because the recommended set of metrics and indicators need to be managed holistically, it is critical to set the expectations and relationships aligned with goals so that the overall team can drive the sustainable packaging program.

Assigning Resources
Laura Nelson is well-suited to implement changes in packaging design, and we recommend that she be given partial responsibility for achieving targets on design metrics. Due to lack of bandwidth and the complexity of sustainability choices, Laura will need additional support in order to ensure successful implementation. Capturing the relevant data for the GWP metric could be a single person’s full time job and would involve working with multiple stakeholders within EMC and outside of the company to gather accurate data. We recommend that someone who focuses on sustainability at EMC be assigned to support Laura make decisions that incorporate sustainability goals, including material choice and material sourcing. Additionally, members of other groups within EMC, like GAME, should be part of the sustainable packaging team.

Collecting Data
After acquiring resources, the next step is to enable data collection. Though data collection can be challenging and sometimes costly, it can provide ancillary benefits in addition to supporting the
sustainable packaging initiative, like providing data for other purposes or exposing opportunities for improvement in other areas (e.g. operations, supply chain, etc.). In order to implement our recommendations, EMC must collect and analyze all the data needed to assess the aforementioned metrics. *Figure 5* highlights data requirements at each step in the packaging flow for both inbound and outbound packaging.

**Establishing a Baseline**
Once data are collected, baselines for each metric should be established based on EMC’s current packaging usage over a one-year period. When possible, data should be collected broadly across all types of packaging. To date, data has been retrieved retroactively to evaluate the progress made by a given sustainability initiative. By collecting standardized data across all packaging types, EMC will be able to use the information proactively – to identify further areas for improvement and packaging innovation.

**Setting Targets**
EMC should establish specific, time-bounded targets for each metric. Targets should be based on an assessment of baseline data, broader operational targets and challenges, and feasibility. EMC should not shy away from setting seemingly ambitious targets, as lofty targets will inspire innovation and allow EMC to exceed initial expectations.

**Building a Decision Tool**
Next, EMC can build a tool that will allow packaging engineers to easily understand the tradeoffs of design choices. We suggest that EMC look at Nike’s Considered Index, a tool that helps shoe designers build environmentally friendly shoes. We envision a tool that will rate a package design’s overall sustainability level, taking into account all the metrics identified above. The tool will facilitate communication of design ideas and best practices, streamline the design process while making it easier to rapidly incorporate sustainable and cost-saving design decisions, and further facilitate the establishment of metrics and targets for packaging sustainability at EMC. Such a tool could, in its early stages, be as simple as placing an “importance” or “weight” on each metric and ranking projects based on their total score. Though it is near impossible to build a tool that is 100% correct, a partial and adjustable solution will start EMC on the path to sustainability.
Real progress on sustainable packaging will require new procedures, shifts (and perhaps expansions) of areas of responsibility, and perhaps organizational re-design. These changes will undoubtedly present challenges, which EMC senior leadership should consider and expect. We have outlined some of the anticipated challenges below, focusing on organization, packaging requirements, data collection, and corporate mindset. While this is certainly not an exhaustive list, it is our hope that the sustainable packaging initiative will be more likely to succeed in the long run if challenges are anticipated before they arise.

**Organizational Challenges**

The packaging sustainability initiative needs to be seen as part of the broader organizational sustainability program. Such an organizational shift may lead to disruptions in the status quo through the process of clarifying sustainability-focused responsibilities and roles. Additional human resources
need to be brought to packaging sustainability. Whether those resources come from existing employees or new headcount, the process of establishing roles and redeploying areas of responsibility will likely be fraught with political and structural challenges. A clear commitment from top management in tracking sustainable packaging metrics will be absolutely imperative in overcoming this challenge.

Packaging Challenges
Implementing a sustainable packaging initiative requires a re-ordering of priorities in the packaging redesign process. Sustainability should be top of mind for everyone that is involved with packaging, from design to use to disposal. For this to be successful, packaging sustainability must be considered at the forefront of the design process, equivalent to the priority placed on protecting the product. However, this reprioritization will challenge a few established beliefs, outlined below.

- Currently, the company is reluctant to slow the packaging design process for the sake of sustainable package redesign. In the long run, implementing a tool for sustainable packaging design should make this expectation a reality. In the short run, however, there may be some design delays.
- Packaging may need to be differentiated for geography for cultural reasons. Asian customers expect a high level of quality and appearance in external packaging, as damaged packaging is unacceptable. This leads to over-packaging in many cases. EMC will need to engineer smarter sustainability solutions that achieve sustainability targets while also meeting the Asian customer’s aesthetic expectations. While certain materials or reusable packages may not be suitable for the Asian region, Northern Europe may present an excellent opportunity to use reusable packaging. The Cork team discussed opportunities in the Netherlands as especially promising with regards to reusable/returnable packaging, where the end customer is better situated to turn the used packages back around.
- Sustainable packaging may also need to be specific to geography for logistical reasons. Logistical challenges need to be considered in packaging material choice. Shipping long-haul versus short-haul requires differing levels of product protection, and may change the Global Warming Potential of a given package solution. For example, returning reusable packaging from Asia to Europe may be less sustainable than using disposable packaging. Using bamboo sourced from a great distance may be less sustainable than using nonrenewable packaging sourced locally.
- Customizing solutions based on geography will present an operational challenge because EMC will need to pull different types of packaging for a given product based on region of delivery. This adds another consideration in addition to product design constraints.

Data Collection Challenges
Collecting, organizing, and analyzing the data needed to calculate and track metrics on an ongoing basis will be an enormous challenge for EMC at the outset. Investing the resources in doing this part of the project correctly will pay off in the long run. EMC should take a long-term vision on this effort. EMC will need to invest resources in finding sources to accurately calculate the Lifecycle GWP of packaging
materials, for example. A couple suggestions that may ease the initial data organization challenges include:

- Consider partnering with the Environmental Defense Fund or another sustainability-focused group with experience working with corporations to implement sustainability programs. The EDF has many notable and fruitful corporate partnerships, and may be a great partner for EMC.
- The SPC has a tool, COMPASS, which helps packaging designers make sustainable packaging decisions. This tool may be a valuable contributor in shaping EMC’s data management program.

**Shifting Mindset towards Sustainability**

A shift in corporate culture towards a sustainable mindset amongst those who interface with packaging will be crucial to supporting the long-term success of the packaging initiative in the face of the above challenges. Embedding environmental sustainability as a highly valued, highly relevant metric and incentivizing people to make measurable progress on sustainability metrics will translate into cost savings, increased operational efficiency, and a stronger corporate culture. To support a sustainable corporate mindset, it may be helpful to send packaging engineers and others to the annual Sustainable Packaging Symposium. EMC may consider identifying new packaging suppliers if current suppliers are not supportive of the sustainability initiatives. Finally, as sustainable packaging takes hold, EMC may consider expanding the sustainable packaging initiative beyond manufacturing into areas such as office supplies.

Our team has been inspired by the energetic dedication to sustainability that we have seen at EMC. We hope that our assessment and recommendations provide an initial roadmap to channel that energy towards forward progress. Although there may be challenges ahead, as we have outlined above, EMC is fully capable of implementing a “best in breed” packaging sustainability initiative.