ABSTRACT

Consumer packaging, most notably in the form of metal cans, paperboard boxes, plastic tubs and aseptic cartons can be a significant part of dry groceries’ cost and environmental impact. As such, packaging improvements can result in significant benefits such as reductions in component costs, improvements in shelf life, and increases in transport efficiency through weight reduction and improved cube utilization, and in-store shelf utilization. In turn, these benefits can also drive product sales and enhance customer value. Furthermore, many packaging enhancements can also lead to supply-chain reductions in Green House Gases (GHG) and other environmental improvements.
MISSION

1. In this project, our MIT team worked with Environmental Defense Fund (EDF) and Walmart to examine the potential use of alternative packaging for its dry grocery private labels. Specifically, the team explored the customer benefits and sustainability implications (such as reduced environmental impacts) through packaging enhancements or substitutions for steel cans within Walmart’s Great Value private brand. The team also conducted research and interviews to identify barriers to entry and benefits of adoption for can alternatives, and assess consumer attitudes toward packaging changes. Finally, the team made recommendations on the use of packaging alternatives in Walmart’s Great Value private brand, and the likely pilot categories that could initiate a packaging transformation in food and consumables.

OUR APPROACH

2. Prior to looking at packaging alternatives, our team first examined the overall supply chain (such as the industrial structure, performance, competitive landscape) that leads to the use of steel cans in food packaging. Our premise was that Walmart could also use its market power to encourage suppliers to further enhance the design and manufacture of the steel cans to reduce cost and improve sustainability. Next, we researched material databases like Mintel and interviewed packaging suppliers to have a deeper understanding of the packaging alternatives currently available. Due to the lack of detailed LCA data, we developed a matrix framework based on Walmart’s “7R’s of Sustainable Packaging” to evaluate identified alternatives, using results of existing LCA studies to assess their sustainability. We supported this analytical framework with cost-benefit trade-off analyses based on secondary research and
interviews with suppliers and MIT faculty experts on materiel. Furthermore, we derived consumer insights and acceptance level on packaging alternatives from interviews with overseas retailers who have had experience of introducing these alternatives in Europe and South America.

UNDERSTANDING THE SUPPLY CHAIN BEHIND THE STEEL CAN

3. In our study of the supply chain behind the steel can, our team looked at four separate industries that are interrelated within the context of using steel cans as food packaging (see Appendix 1). We also analyzed the performance of each industry, the products and services offered, and the overall competitive landscape. The Iron and Steel Manufacturing industry produces the rolled steel sheets that are the starting material for downstream steel processors. The Steel Rolling and Drawing industry is one such downstream steel processor that makes cold-rolled sheet shapes, the starting material for can and container manufacturers. The Metal Can and Container Manufacturing industry focuses on making cans and containers from metals, of which steel cans are essential products used in food packaging. The Canned Fruit and Vegetable Processing industry represents the wide spectrum of products created by processing fruits and vegetables, and these requires steel cans to retain quality and shelf life.

4. A key observation is the Iron and Steel Manufacturing and Steel Rolling and Drawing Industries have import levels that substantially exceed export levels due to a large US market and loss of competitiveness by US producers. While industry globalization has historically remained low, its pace might be picking up due to an increase in acquisition and merger
activities in the last few years. In contrast, the Metal Can and Container Manufacturing Industry is not directly threatened by cheap foreign imports due to the need to locate their facilities close to the markets they serve to minimize transport costs and increase efficiencies. However, this industry has continually under-performed the average growth of the US economy, reflecting the maturity of its customer market and external threats it faced from packaging alternatives such as glass, plastics and laminates (i.e. Tetra Pak). For the Canned Fruit and Vegetable Processing Industry, imports continue to be strong from countries like China (the world’s largest producer of fruits and vegetables), Mexico and Canada (due to their proximity to US and NAFTA). Apart from imported food, other significant competition to the industry includes fresh produce (due to transport and storage improvements) and frozen food products. Their popularity is resulting in lower sales and downward pressure on prices.

ANALYSIS OF PACKAGING ALTERNATIVES

5. Innovation in packaging has been rampant this past decade with the increased focus on sustainability and as companies try to look towards new avenues to make improve profitability and long term sustainability of their organizations. Sainsbury’s recent launch in the UK of milk in 2-pint plastic pouches has resulted in 75% less plastic being used\(^1\) compared to the bottle, while Kellog’s new cereal boxes are using 8% less material and are made from 100% recycled paperboard.\(^2\) Heinz recently launched lighter weight steel cans for products such as beans and soups in the UK, Australia and New Zealand, while packaging infant food jars in paper sleeves instead of plastic shrink-wrap. These examples are illustrative of the shifts towards more renewable materials, lower material and energy consumption in the manufacturing process,
higher recyclability and removing unnecessary layers of packaging. It is against this industry backdrop that we study packaging alternatives for dry groceries to steel cans, including Tetra Recart cartons, glass containers, plastic flexible packaging (or commonly known as retort pouches) and steel cans.

Steel Cans

6. The steel “tin” can was patented in 1810 and primarily used by the British Army at its introduction. Steel cans are made of steel that is coated with tin to provide corrosion resistance. Most cylindrical food cans have parallel round tops and a vertical side. The majority of steel cans in the market are internally lined with a plastic called Bisphenol A (BPA) to extend shelf life of the canned food. Recently, there has been much debate over the health and long-term effects of BPA on the body. While some countries such as Canada and Denmark have banned BPA use in baby bottles and products, others like Japan and European Union concluded the chemical was safe based on the scientific findings.³

7. **Recyclability.** Steel Can is the most recycled food container in the United States. In 2008, approximately 65.2% of all steel cans are recycled and that figure has grown over four
fold since 1988 (see Chart on next page). Steel is one of the most easily recovered products for waste management companies because of its magnetivity. Waste management firms simply run a giant magnet over the waste steam to collect the valuable resource. It is estimated that using recycled steel in the production process saves 75% of the energy versus using virgin materials. On average, steel cans contain 28% post consumer recycled content and 33% total recycled content. The recyclability of steel is a key preference driver among “can fan” consumers. Hence its opportunity lies within increasing the rate at which cans are recycled. Marketers and can educate consumers to influence the perception and behavior of consumers. Furthermore, there has been continuous innovation over in the steel can industry. Over the last 25 years, the thickness of the steel can has been reduced by about 30% from 0.20 to 0.14 millimeters, with ongoing efforts to further reduce it to 0.12 millimeters. In addition, Ball Corporation has developed an innovative peel-able resin lid for the steel can to further reduce its overall weight.

(Source: http://www.recycle-steel.org)

8. **Production.** The production of steel cans require significant amounts of energy. Iron ore is first extracted from the earth where it is then molten and formed into sheet metal. The heavy sheet metal is then transported to the canning operation where it is heated to a point where the steel can be molded into lids and walls for the filling process. After filling, the cans are
stamped and labeled for shipment. According to Franklin Associates, 376 million Btu’s of energy is required to package 100,000 pounds of tomatoes, almost twice that when packaged with Tetra Recart cartons (see Table below).

### Energy by Life Cycle Step for the Packaging and Filling of 100,000 Pounds of Diced Tomatoes
(Million Btu per 100,000 Pounds of Tomatoes)

<table>
<thead>
<tr>
<th>Step</th>
<th>Million Btu</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetra Recart System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Production</td>
<td>163</td>
<td>85.7%</td>
</tr>
<tr>
<td>Container Production</td>
<td>9.39</td>
<td>4.9%</td>
</tr>
<tr>
<td>Transport from Production to Filler</td>
<td>4.61</td>
<td>2.4%</td>
</tr>
<tr>
<td>Filling/Retorting</td>
<td>10.2</td>
<td>5.4%</td>
</tr>
<tr>
<td>Transport from Filling to Distribution Center</td>
<td>1.60</td>
<td>0.8%</td>
</tr>
<tr>
<td>End of Life</td>
<td>1.41</td>
<td>0.7%</td>
</tr>
<tr>
<td><strong>Total Energy</strong></td>
<td><strong>190</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Steel Can System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Production</td>
<td>303</td>
<td>80.7%</td>
</tr>
<tr>
<td>Container Production</td>
<td>51.5</td>
<td>13.7%</td>
</tr>
<tr>
<td>Transport from Production to Filler</td>
<td>1.42</td>
<td>0.4%</td>
</tr>
<tr>
<td>Filling/Retorting</td>
<td>6.70</td>
<td>1.8%</td>
</tr>
<tr>
<td>Transport from Filling to Distribution Center</td>
<td>4.09</td>
<td>1.1%</td>
</tr>
<tr>
<td>End of Life</td>
<td>8.77</td>
<td>2.3%</td>
</tr>
<tr>
<td><strong>Total Energy</strong></td>
<td><strong>376</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: Franklin Associates, a Division of ERG

### Tetra Recart Cartons

9. Founded in 1951, Tetra Pak is a food processing and packaging company originally from Sweden. The company is most famously known for being the pioneer in allowing liquids such as milk to be packaged and stored under room temperatures for up to a year. Tetra Pak packaging consists of three different materials – paper, polyethylene and aluminum. In addition to these materials, there are three layers of low-density polyethylene (LDPE) used to adhere, laminate and seal the package (see Diagram below). The biggest layer of the package is paper (75%), followed by polyethylene (20%) and then aluminum (5%). Tetra Pak has a portfolio of ten product lines, but only the Tetra Recart carton can handle food particulates. With Tetra Recart,
food products, such as beans, vegetables, tomatoes, soups and sauces, can be sterilized inside the carton, which makes them shelf stable up to 24 months.

(Source: http://www.tetrapak.com)

10. **Recyclability.** Due to the multi-layer composition of Recart cartons, many waste management firms are unable to recycle the package. According to Tetra Pak, about 58 million Americans, representing only 20% of the US population, have the opportunity to recycle the package, and they represent certain communities from only 26 states. However, only five percent of Recart cartons are actually recycled\(^6\). The Tetra Pak website claims that they “are looking for ways to aggressively expand carton recycling within the next three years.”\(^7\) The process of recycling Recart cartons is fairly simple. First, the waste management company collects and bales the cartons, and sends these to the recycling facility. Baled cartons are then dropped into a machine filled with water called a “pulper”. Then, the cartons will rub against one another and will begin to delaminate, separating the paper fibers from the polyethylene and aluminum. The mixture, a brown slurry of water and pulp, can be recovered to make new paper products. As paper is recycled, the fibers become increasing shorter, thereby weakening the strength and limiting the potential uses to an average of five uses. One advantage of Tetra
Pak recycling is that the fibers used in the carton are long and of high-strength. They are able to withstand the pulping process allowing it to decrease its dependence of virgin fibers.

11. **Renewable Resource.** As mentioned earlier, paper represents about 75% of materials used to make Recart cartons. In turn, paper is a product of trees, a renewable resource. However, polyethylene and aluminum foil are both not made from renewable resources. Sainsbury, a retailer in the United Kingdom and Ireland, recently incorporated Recart cartons in their private label products but the paper used in manufacturing is from Forest Stewardship Council (FSC) certified forests.\(^8\) This added measure has helped to ease customers’ concerns on the risk of deforestation associated with the production of paper.

12. **Processing and Supply Chain.** A positive benefit of the Tetra Recart cartons is the reduced energy (see Para 8) and package weight. According to Franklin Associates, 6,350 pounds of Tetra Recart packaging is used for every 100,000 pounds of tomatoes. This represents a 61% reduction when compared to the use of steel cans. The Tetra Recart carton is also a more efficient package when transporting and shelving the product. The rectangular shape package allows for an optimal cube-out\(^9\) and release of 30-40% more shelf space\(^10\). It also requires no secondary packaging. In addition, such packing efficiency also enables lower fuel and energy consumption throughout the logistics and transportation of the product.

**Glass**

13. Glass is an amorphous solid material that is typically brittle and optically transparent. Glass is commonly used for both resealable and non-resealable packaging in the form of jars.
and bottles. Glass is also commonly reused and recycled. Glass is a large component of household and industrial waste due to its weight and density. The glass component in municipal waste is usually made up of light bulbs, bottles, broken glassware, and other items. In addition, the methods of creating glass products have a significantly high defect rate of about 40%\textsuperscript{11} and add to the waste.

14. **Recyclability.** Glass recycling is the process of turning used glass into new usable products. Glass waste is usually separated by chemical composition. Depending on the end use and local processing capabilities, the glass might also have to be separated into different colors. Glass recycling uses less energy than manufacturing glass from sand, lime and soda, and every ton of waste glass recycled into new items saves 315 additional kilograms of carbon dioxide from being released into the atmosphere during the creation of new glass.\textsuperscript{12}

15. **Reusability.** According to the Waste Hierarchy (see Appendix 2), reuse of glass containers is preferable to recycling. However due to the weight of glass, this recommendation can be skewed by the locations of the reuse and recycling facilities. Refillable bottles are used extensively in many European countries, Canada and until recently, in the United States for the last 50 years. For example, in Denmark, 98% of bottles are refillable, and consumers return 98% of these refillable bottles\textsuperscript{13}. Such high statistics are similarly reported for beer bottles in Canada. These reuse systems are typically supported by container deposit laws and other governmental regulations. Furthermore, in some developing nations such as Brazil and India, the cost of new bottles often incentivizes manufacturers to collect and refill used glass bottles for selling carbonated and other beverage drinks.
16. Across the US, methods of waste collection and recycling rates vary due to legal regulations by the state and local level lawmakers. Large municipalities often have their own, unique waste management systems. For example, many cities do curbside recycling where recyclable household waste is collected on a weekly or bi-weekly basis. Single unit residents set out in special containers in front of their homes, while apartment dwellers usually use shared containers that may be collected by the city or by private recycling companies, which can have their own recycling rules. In some cases, glass is specifically separated into its own container because broken glass is hazardous to the workers who manually sort the co-mingled recyclables.

**Flexible Packaging (Pouches)**

17. Flexible packaging is typically made of plastic or foil to form packaging for items as bags, pouches, envelopes, sachets and wraps. The end product is an easily yielding material creating a pliable shape. A common example of a flexible packaged product is the children’s lunch juices, where the pouch is typically made of plastic and foil films. The touted benefits of flexible packaging compared to rigid plastic, steel and glass packaging include less waste, energy and greenhouse gas emissions through the product lifecycle (including manufacturing and transportation), more opportunities for energy recovery via both waste to energy facilities and waste to fuel/feedstock technology due to the high BTU fuel content. In terms of consumer benefits, some flexible packaging offers re-sealability, microwave-ability, freeze-ability, and reduced damage rates. In addition, flexible pouches eliminate the sharp edges, broken glass, and metal filings that are possible with other packaging systems.
18. **Recyclability.** One key concern raised about flexible packaging is its non-recyclability, especially when its rigid metal, glass, and plastic alternatives are both more recyclable and more recycled. As a counter argument, flexible packaging manufactures have stated that flexible packaging enables them to recycle more internal scrap materials in a closed loop. Furthermore, with less product source packaging, there is less waste generated that would end up in a landfill. Overall, flexible packages are so much lighter than rigid packages that recycling of the latter cannot offset the significant source reduction and waste prevention advantages of the former. As an illustration of this point, a Use-less-stuff (ULS) report “Review of Life Cycle Inventory Study for Tuna Packaging” concluded that to deliver an equivalent amount of tuna, the 12-ounce pouch consumes the least amount of energy, generates the least greenhouse gas emissions, and creates the least amounts of solid waste (see Table on next page). The flexible packaging does significantly better than its alternatives across all three categories based on weight or size, even though it is not recycled.

19. The logic behind these findings is that lighter flexible packaging consume less energy and materials while generating less solid waste and greenhouse gases in its manufacturing and end-product supply chain processes than its rigid counterparts. In addition, size still matters, even for flexible packaged goods. Larger sizes are more efficient than smaller ones, since packaging volume increases faster than the material weight needed to contain the volume of end product, assuming the increased amount of product delivered by larger packages is consumed as intended.
ANALYTICAL FRAMEWORK BASED ON 7R’S OF SUSTAINABLE PACKAGING

20. To compare these packaging alternatives, our team developed an analytical framework based on the 7R’s of Sustainable Packaging (see Appendix 3) that Walmart advocates within its Packaging Sustainable Value Network. The 7R’s framework has its roots in the Waste Hierarchy of “reduce, reuse and recycle” but greatly expands the role of “rethink” in developing ways to reduce the environmental impacts, particularly greenhouse gas (GHG) emissions, consumption of non-renewable energy and raw material, and pollution through air acidification and eutrophication. As these elements are not explicitly captured in Walmart’s 7R’s framework, we incorporated these under the “Reduce” component.

21. From our analysis, Tetra Recart scores high on renewable, given its 75% paper content, but challenges remain with the penetration of recycling post-use. Many waste management firms are unable to recycle the package and the current 20% capability does not stack up well compared to the goal of getting the municipal recycling rate up to 35% by 2011. Investments to
expand the carton recycling are expected to see a longer time frame of at least three years (see Para 12). Other strengths include a lower package weight and optimal package design that result in cost savings and lower transportation costs. In a study “Comparative Life Cycle Assessment of Tetra Pak packaging Synthesis”15, Bio Intelligence Service did a comparative LCA for 400ml-sized food packaging, such as Recart cartons, pouches, steel cans and glass containers (see Appendix 4). With the exception of glass (72% used vs 28% in US), the recycling rates for the other packaging that are assumed in the LCA are similar to the 2008 rates in the US. The environmental impacts of Tetra Recart and pouches are significantly lower than the impacts of the steel can and glass container for all the impact indicators (see Chart below). The only observed difference for the indicator of eutrophication comes from the cardboard production for the Recart. In summary, Tetra Recart is superior on Reduce, Renewable and Revenue when compared to steel cans and glass containers. Its performance on Revenue is similar to that of flexible pouches.

(Source: http://uk.biois.com)

22. The main issue with flexible packaging is that it is non-recyclable and requires oil as its raw material, a non-renewable resource. However, when we examine the landfill impact of
packaging options, taking into consideration the recycling rates for difference packaging options and their weight per 100g of product, flexible pouches has a much smaller footprint compared to recyclable options. The effect of lighter packaging on landfills can be exemplified by the following beverage packaging example (see Table below). In summary, flexible packaging is strong on Reduce and Revenue when compared to steel cans and glass containers.

<table>
<thead>
<tr>
<th>Product</th>
<th>Product Weight (g)</th>
<th>Package Weight (g)</th>
<th>Package Wt per 100 g Product (g)</th>
<th>Recycle Rate</th>
<th>To MSW Landfill</th>
<th>MSW Landfill per 100 g Product (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Bottle &amp; Metal Cap</td>
<td>236</td>
<td>198.4</td>
<td>83.9</td>
<td>35%</td>
<td>65%</td>
<td>54.5</td>
</tr>
<tr>
<td>Plastic PET bottle &amp; Cap</td>
<td>236</td>
<td>22.7</td>
<td>9.6</td>
<td>37%</td>
<td>65%</td>
<td>5.0</td>
</tr>
<tr>
<td>Aluminum Can</td>
<td>236</td>
<td>11.3</td>
<td>4.7</td>
<td>49%</td>
<td>51%</td>
<td>2.4</td>
</tr>
<tr>
<td>Flexible Stand Up Pouch</td>
<td>199</td>
<td>5.7</td>
<td>2.8</td>
<td>0%</td>
<td>100%</td>
<td>2.8</td>
</tr>
</tbody>
</table>

(Source: http://www.flexpack.org/)

23. Steel cans and glass containers are on the opposite end of the environmental impact spectrum, performing poorly on all aspects including GHG emission, energy consumption and pollution. However, steel cans score highly on recyclability, evidenced by its 62.8% rate in 2008 (see Chart on next page). In addition, steel cans have 33% recycled content and 28% post consumer recycled content, while the use of recycled steel also saves 75% of the energy consumption. Although the steel can falters on Renewable, its existing recycling infrastructure and high recycling rates are key strengths that enable it to rank the highest on Recyclable. As highlighted in Para 15, glass scores highest on Reuse, but we need to consider the location of reuse and recycling facilities. Apart from its environment impacts, the weight of glass
containers also bring with it higher transportation and environmental costs. The high defect rate in manufacturing implies that it does not necessarily score well on Reduce either. To support the Reuse element, there needs to be additional investments in technology to support refillable systems.

24. Based on the above, we scored the various packaging options on our 7R’s analytical framework, using a scale of High (H), Medium (M) and Low (L).

<table>
<thead>
<tr>
<th>R element</th>
<th>Tetra Recart</th>
<th>Flexible Pouches</th>
<th>Glass Containers</th>
<th>Steel Cans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove</td>
<td>H</td>
<td>M</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>Reduce</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>-Non-renewable Energy</td>
<td>H</td>
<td>H^*</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>-Non-renewable Resources</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>-GHG emissions</td>
<td>H</td>
<td>H^</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>-Pollution</td>
<td>H</td>
<td>H^</td>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>

*Does not include combustion (with energy recovery).
(Source: http://www.epa.gov)
### CONSUMER ACCEPTANCE OF PACKAGING ALTERNATIVES

**Retailers’ Experience**

25. We conducted interviews with Walmart Argentina, Brazil and Chile to review and analyze the countries’ experience and consumer acceptance to sustainable alternative packaging (see Appendix 5). We discovered that consumer profiles would define the packaging of the product. We have the 1st group linked by singles living alone, or families with specific consumer habits that prefer small packages as these are practical, multifunctional and easy to store. The 2nd group comprising senior consumers prefers packaging with shorter shelf life, ergonomic characteristics, safety, and convenience and with clear, easy-to-read information and instructions. The 3rd group linked by their desire for a healthy lifestyle with high levels of safety and hygiene choose more complex packaging with greater information. The 4th group characterized by their ecological conscience demands biodegradable and recyclable packaging. The final group consisting of busy, over-worked and stressed individuals prefer convenient
packaging that is re-usable and ready-to-cook. We found that sustainability is a common term used in popular media and that customers are aware of sustainable products and their packaging. However, their actions and customer purchase behavior do not necessarily correlated with the level of awareness reported. Some of the initiatives executed in sustainable packaging included the reusable bag program, campaigns to recycle PET bottles, blankets made by recycled plastic bottles, reduced package sizes, and reduced can sizes.

**Consumer Insights**

26. Most consumers think that contemporary packaging has become disproportionate and excessive. Furthermore, consumers have started to consider sustainable packaging of the product as part of the purchasing process. As such, sustainable packaging is an important component of brands in modern times. Consumers care about environmental consequences: ethics and ecological concerns push consumers towards sustainable packaging. Furthermore, reducing the packaging footprint satisfies consumer expectations. Consumers want to “de-clutter” and sustainable packaging is a way to capture this trend. In other words, consumers around the globe want to live a simple life and sustainable packaging fits this reality. The “Buying locally” trend and online shopping are influencing the sustainable packaging industry. Consumers in India, Australia and France are most likely to buy products produced locally, while senior consumers value more localism. Younger consumers value more the packaging design when buying products. Consumers in the BRIC countries are more influenced by packaging than in other part of the globe. They do think that grocery products are over-packaged and are likely to ask for alternatives. However, consumer behavior does not always correlate with this perception. This means that consumers might report their desire for sustainable packaging but
other factors influence their purchase decisions. As a consequence of the growing importance of sustainable packaging, some consumers are willing to pay a premium.

**RECOMMENDATIONS**

**27.** The 7R’s framework provides us a useful guide to evaluating the different packaging alternatives. Based simplistically on the scores, it would appear that Tetra Recart emerges as the winner, given its superior performance on Renewable, Reduce, the potential upside from increased Recyclability over the next few years and its contribution to Revenue given the lighter package weight and lower packaging costs. The additional features Tetra Recart offers are opportunities for effective brand building and opportunities for consumer education (by having printing possibilities over the entire package. Square packages also allow for better shelf display, allowing for more effective brand impact. In addition, given that food products (e.g. tomatoes, sauces and soups) can be sterilized within the carton, they offer a stable shelf life of two years.

**28.** However, it would be flawed to look at these factors in absolute. Although flexible pouches offer no avenue for Recyclability and is made from a non-renewable resource, one cannot ignore its superior performance on environmental indicators, such as GHG, and use of non-renewable resources and energy (albeit marginally better compared to Tetra Recart). In addition, its low package/product weight ratio and minimal contribution to landfill per unit package weight do make it an alternative worth considering. In addition, the pouch also offers additional consumer benefits such as resealability and microwave heating/cooking.
29. Similarly, in countries that have a propensity to re-use glass (i.e. parts of Europe and regions where there is proximity to distribution centers) the use of glass containers would be an ideal solution. However, this requires an infrastructure of distribution and collection to be either set up or facilitated by producers. Transportation of glass containers need to be considered carefully since collection trucks cannot compact the load and all these have associated environmental costs. Given the current infrastructure, consumption and recycling patterns in the US, this option does not appear viable at the time.

30. Based on the above considerations, our team would like to offer our recommendations to Walmart in three dimensions for a major geographical market like the US. First, if Walmart’s preference is to stick to existing technology and facilities for food filling and recycling without any significant financial investments to either change or influence a change in the food packaging industry, steel cans are the way to proceed. In such a scenario, economics considerations will dominate and Walmart will not be become a market leader in sustainable packaging due to the high environmental impacts of steel cans. However, there will continue to be incremental cost and environment improvements due to advances in the steel can design (e.g. weight reduction and lid enhancement) and canning technology. But the key risk for Walmart will be future price trends and stockpiles of non-renewable energy and iron ore.

31. Second, if Walmart is seeking to improve the sustainability of its operations by investing in new technology for food filling and recycling, Tetra Recart cartons are the way to proceed. In this scenario, Walmart’s goal is to become the market leader in sustainable packaging and will
either invest directly or help facilitate the expansion of recycling facilities and rates for Tetra Recart in the US (a key weakness at the moment). Apart from significant reduction in environmental impacts, such a move will help Walmart move towards lower energy consumption and greater usage of renewable resources for its packaging needs. The key risk for Walmart is whether US consumers will accept Tetra Recart readily and adjust their waste recycling behavior accordingly.

32. Third, given the various cost-benefit tradeoffs of the packaging alternatives, Walmart might wish to take a middle-ground approach between economics and sustainability and consider sustainability from the perspective of the waste hierarchy. In such a scenario, flexible pouches are the way to proceed, as the key benefits are the ability to reduce material use at source and the associated environmental impacts, while lowering transportation costs due to the low package/product weight ratio. Consumers are also likely to accept flexible pouches more readily due to benefits such as ease of heating/cooking from microwave and steaming. However, as these pouches are made from a non-renewable resource, the key risk for Walmart is future price trend and stockpile of oil.
APPENDIX 1: THE SUPPLY CHAIN BEHIND THE STEEL CAN
(Source: http://www.ibisworld.com)

1. In our study of the supply chain behind the steel can, we looked at four separate industries that are interrelated within the context of using steel cans as food packaging. While examining these industries in detail, the team sought to uncover the interdependencies between these industries through the supply chain to manufacture steel cans and use them in food packaging. Apart from this main objective, the analyses also covered at the industry level the performance of each industry, the products and services offered, and the overall competitive landscape. The four US industries listed below are linked within a supply chain to produce steel cans for the purposes of providing packaging for processed food based on fruits and vegetables.

   A. **Iron and Steel Manufacturing.** This industry produces the rolled steel sheets that are the starting material for downstream steel processors.

   B. **Steel Rolling and Drawing.** This industry is one of the downstream steel processors that make cold-rolled sheet shapes, the starting material for can and container manufacturers.

   C. **Metal Can and Container Manufacturing.** This industry focuses on making cans and containers from metals, of which steel cans are essential products used in food packaging.

   D. **Canned Fruit and Vegetable Processing.** This industry represents the wide spectrum of products that are created by processing fruits and vegetables, and requires some form of packaging to retain their quality and shelf life.

3. One key observation is the Iron and Steel Manufacturing and Steel Rolling and Drawing Industries have import levels that substantially exceed export levels due to a large US market and loss of competitiveness by US producers. While industry globalization has historically remained low, its pace might be picking up due to an increase in acquisition and merger activities in the last few years. In contrast, the Metal Can and Container Manufacturing Industry is not directly threatened by cheap foreign imports due to the need to locate their facilities close to the markets they serve to minimize transport costs and increase efficiencies. However, this industry has continually under-performed the average growth of the US economy, reflecting the maturity of its customer market and external threats it faced from packaging alternatives such as glass, plastics and laminates.

4. For the Canned Fruit and Vegetable Processing Industry, imports continue to be strong from countries like China (the world’s largest producer of fruits and vegetables), Mexico and Canada (due to NAFTA and their proximity to US). Apart from imported food, other significant competition to the industry includes fresh produce (due to transport and storage improvements) and frozen food products.
A. Steel and Iron Manufacturing Industry

Industry at a Glance (2010)
Industry Performance

1. The Iron and Steel Manufacturing industry is expected to make gains in 2010, as it seeks to recover the 2009 economic recession in the US. During this period, activity in key use industries such as automotive production, construction and white goods manufacturing declined substantially, sending steel prices plummeting from its high levels in mid-2008. Conditions should improve as the US moves out of recession in 2010. Steel production is expected to rise to 64.3 million metric tons (from 58.1 million metric tons in 2009) and revenue is expected to expand by about 11% to $71 billion from higher output and prices (having declined by 49% in 2009). In contrast, industry revenue stood at $93 billion in 2005.

2. As the US market for steel is larger than domestic production, imports are substantial. The local market is valued at about $86 billion in 2010, while imports should amount to about $24 billion. Exports are considerably smaller, estimated at about $9 billion. For the next five years, improvements in economic growth will lead to improving demand conditions, particularly from the construction, automobile and the general manufacturing sectors. As a result, industry revenue is expected to expand annually by about 5.2% between 2010 and 2015.

Products and Markets

3. **Products and Services.** In the US, 41% of steel is produced in blast furnaces (in a process that involves heating pig iron and coke to produce steel), while the rest comes from electric arc furnaces (which essentially recycle scrap steel). Despite higher rates of capacity utilization at blast furnaces over the period 2003-2007 (in response to stronger demand and prices), the proportion of steel manufactured by this process continued to edge down. The decline might have been higher, if not for rising steel scrap prices, which curtailed the growth in production from electric arc furnaces. Blast furnace production fell sharply in 2009, as demand slumped and prices fell. The industry’s main product is hot-rolled steel sheet and strip, which accounts for nearly one-third of sales. The second-largest product category is hot-rolled steel bars and shapes, plates, structural shapes and piling. Other important products are cold rolled steel sheet and strip, and steel pipe and tube.

4. **Major Markets.** Downstream steel processors, such as manufacturers of pipe or rolled steel products are one of the key markets of this industry, absorbing about 23% of local steel production. Steel service and distribution centers also play an important role, representing
about 23% of total demand. While automotive production and construction each accounts for substantial portions of the steel demand, these can be quite volatile, reflecting shifts in vehicle demand by consumers and building activity. Other industries account for smaller but stable levels of demand, such as packaging (about 3%). In particular, exports has been growing strongly over the last five years, from about 9% The share of revenue accounted for by exports has been increasing strongly over the last five years, rising from 9% in 2004 to 14.5% in 2009.

5. International Trade. The US imports much more steel than it exports (see graphs below). The major sources of imports are China, Canada, Brazil, Mexico, Korea and Japan. Countries with an advantage in terms of import tariffs (Canada and Mexico), proximity (Brazil) and costs (China) have enlarged their market share. China is growing rapidly in importance, with steel imports rising progressively from 7.2 million metric tons in 2004 to 12.9 million metric tons in 2008. However Chinese imports fell to 8.1 million metric tons in 2009 as local output slumped and demand from overseas wilted. For US steel exports, NAFTA is a key enabler in making Canada a major market and Mexico a substantial market. Under NAFTA, most of the trade between the United States, Canada and Mexico has been on a tariff-free or reduced tariff basis since its commencement in 1994.
6. **Business Locations.** The Great Lakes region of the US accounts for the largest share of Iron and Steel Manufacturing industry revenue. The reasons are two-fold: first, it is the center of the US car industry; second, its waterways are historically an important means of transporting iron ore, coke and steel outputs. The other major steel-producing region is the Mid-Atlantic (about 21% of revenue) and the Southeast (about 20% of revenue).

**Competitive Landscape**

7. **Basis of competition.** Steel producers compete on both price and product quality within various product groups (e.g. sheets, bars, rods and strip). Within the same product category, there are price variations based on the thickness of the steel and its composition. In addition, customers may be willing to pay a premium for steel supplies that are consistently on time and on specification. Furthermore, competition occurs not only between US steel producers, but also with both imported steel products and alternative products, such as those based on other metals like aluminum, or in some cases, timber.

8. **Barriers to Entry.** One key obstacle is the high level of capital needed to maintain and upgrade existing operations. Substantial economies of scale have also restricted entry to very large facilities. However, these barriers can be overcome as new technology makes smaller plant (especially mini-mills linked with electric arc furnaces) more competitive. Another obstacle is the large financial obligation and costs that most steel manufacturers have for retirees (in the form of pensions and health benefits), which could hinder restructuring. In some instances, takeovers were only made possible when the target company moved into Chapter 11 bankruptcy protection, allowing its business or assets to be acquired without assuming the legacy costs.

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<td>Technology change</td>
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<td>Regulation and policy</td>
<td>Light</td>
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<td>Industry assistance</td>
<td>Medium</td>
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**Source:** www.ibisworld.com

9. **Industry Globalization.** Indicators (such as level of foreign ownership and extent to which US iron and steel mill operators are involved in operations overseas) suggest that the level of industry globalization is low. US steel producers’ reliance on exports is usually fairly low, although US export share exceeded 17% in 2009 as producers diverted product from the declining local market. However, globalization has increased with merger activity. In particular, US-based International Steel Group merged with Netherlands-based Ispat International, which in turn became part of the ArcelorMittal, the world’s largest steel maker.
B. Steel Rolling and Drawing Industry

Industry at a Glance (2010)
Industry Performance

1. **The Steel Rolling and Drawing industry is expected to generate revenue of about $10 billion in 2009, compared with $12 billion in 2005. Industry revenue is expected to ease by 0.9% in 2010 in response to still weak demand conditions. Due to the recession, revenue plummeted by over 17% in 2009, as both output and prices declined significantly.** The local market for rolled and drawn steel is valued at about $11 billion in 2010. The value of imports will exceed that of exports by a considerable margin in 2010, with the former expected at about $1.4 billion in 2010 and the latter at about $421.3 million. In this industry, there are about 420 establishments and 343 enterprises operating. **Industry performance is expected to improve in the next five years as economic conditions pick up, causing increases in both production and prices. Revenue is forecasted to expand at an annual rate of almost 3% up to 2015.**

Products and Markets

2. **Products and Services.** The industry manufactures two major products: Wire (about 44% by revenue); and cold rolled shapes (about 56%), such as plate, sheet, strip, rod and bar.

3. **Major Markets.** The key markets are the automotive, manufacturing and construction industries. Other significant consumers are manufacturers of appliances, containers and aerospace equipment. **In particular, container manufacturers account for 10% of industry output.** The importance of both the automotive and aerospace markets has declined over recent years, due to lower levels of production by these manufacturers.
4. **International Trade.** Imports are expected to make up 13% of the domestic demand for rolled and drawn steel in 2010. Imports jumped sharply in 2004, reflecting a loss of competitiveness by US producers, especially when compared to Chinese producers. It hovered in the range 15-19% between 2005 and 2008, before plunging to 12% in 2009. Some growth in imports is expected in 2010 as activity levels pick up, with the value of imported rolled and drawn steel expected to be about $1.44 billion in 2010. In contrast, US exports of rolled and drawn steel are much more modest and expected to be about $421.3 million in 2010. Exports have accounted for about 4% to 5% of industry revenue in recent years. Major sources of imports are China, Canada, South Korea, Mexico and Taiwan, while main export markets are Canada, Mexico, Brazil, Germany and the United Kingdom.
5. **Business Locations.** Similar to the Iron and Steel Manufacturing Industry, the Great Lakes region is the largest producer in rolled and drawn steel. Information on the spread of both employment and industry revenue for earlier years suggests that this region’s share of industry revenue is larger than its share of employment, an outcome that reflects economies of scale. Other significant regions of production include the Southeast and Mid-Atlantic. These three regions are also the major steel producing areas of the United States. Manufacturers of rolled and drawn steel are located in the same areas to benefit from ready access to supply and lower transport costs.

**Competitive Landscape**

6. **Basis of Competition.** This industry is highly competitive, with considerable potential for substitution within (but not between) product categories. Companies not only compete with each other, but also with integrated steel producers (that also make rolled and drawn steel products). Apart from price, firms also compete on quality (particularly precision of the rolling or drawing process) and the ability to meet tight delivery schedules. One of the competitive strengths of US producers in their home market is the timely delivery of goods that meet customer specifications. In addition, product range and previous experience with the same manufacturer can influence customers’ purchasing decisions.

7. **Barriers to Entry.** Apart from huge capital needed to establish or purchase manufacturing plants, prospective entrants face obstacles such as import competition, large economies of scale for major producers and existing excess capacity. To compete successfully, a firm would need sufficient capital to enter the market via a large-scale operation.

8. **Industry Globalization.** Indicators (such as level of foreign ownership and extent to which US iron and steel mill operators are involved in operations overseas) suggest that the level of industry globalization is low. The acquisition of one major player by the Japanese firm Mitsui may suggest that globalization is edging up.
C. Metal Can and Container Manufacturing Industry

Industry at a Glance (2010)
Industry Performance

1. Unlike most manufacturing industries in the US, the Metal Can and Container Manufacturing industry is not directly threatened by cheap foreign imports. Their facilities are generally located close to the markets they serve to minimize transport costs and increase efficiencies. The industry’s intermediate products are low value and high volume, causing transportation to be costly because of the bulky nature of empty metal cans and containers. As a whole, the industry has continually under-performed the average growth of the US economy, partially due to the maturity of its customer markets and competition from food and beverage companies that manufacture their own metal cans. Most of the demand is generated by food and beverage manufacturers that purchase aluminum and steel cans to package their own products. These markets have shown themselves to be resilient against economic pressures because of high demand and consumer acceptance levels for canned food and drinks.

2. However, a key threat to the viability of the industry comes from packaging substitutes, such as plastic bottles for beverages, glass bottles for beer, and glass for food and other products. This external competition has exacerbated the intense price competition that dominates the industry’s environment. These competitive pressures have subdued domestic demand and weighed upon industry revenue in the past decade. Domestic demand over the last five years contracted at an annualized rate of 1.9%, while industry revenue fell at an annualized rate of 1.6%.

Products and Markets

3. **Products and Services.** Products sold in this industry are differentiated by their size, shape and packaging. They also vary in terms of their standard or customary ordered volume. Lower sales across the industry are reflective of the increasing popularity of plastic, achieved through technological innovation that has increased applications for plastics. However, the ability to recycle metal containers and preference to use metal containers for specific packaging applications (e.g. for harmful goods) have partially mitigated the competition from plastics. The industry’s two major product segments are Aluminum Cans and Steel Cans/Tinware Products, primarily sold to the food and beverage industries. Steel cans account for about 29% of industry revenue, and more than 90% of food cans to package processed fruit and vegetables.
4. **Major Markets.** The beverage segment includes metal canned products for alcoholic beverages (40%) and non-alcoholic beverages (60%). The food segment includes metal cans for baby food, coffee, dairy products, fruit/ juices, meat and poultry, seafood, vegetables/vegetable juices, other foods (including soup) and pet food. The general packaging industry includes other metal container products such as aerosol, ammunition boxes and other containers. Food and beverage manufacturers make up the majority of industry demand and include companies such as Coca-Cola, Pepsi-Cola, Cott Beverages, Cadbury Schweppes, Anheuser-Busch, Mars, Nestle, Unilever and S.C. Johnson. Consolidation trends among beverage and food marketers have led to a concentrated customer base, while buyer concentration is high within customer markets. As such, companies operating within the major markets mentioned above tend to have higher bargaining power over manufacturers in this industry. Having higher purchasing activity and order sizes, these dominant industry players can negotiate better purchase prices. Customers’ purchase criterion generally includes delivery reliability and product performance. Other important characteristics include research and development, customer service/support and more recently, environmental sustainability of the product. Customer markets tend to view the industry’s products as being environmentally friendly because these are recyclable.

5. **International Trade.** Due to the low value and high volume of the industry’s products, it is not financially viable for countries to ship these goods internationally. Of the international trade that does occur, most products are components, such as ends and lids, rather than finished products. However, the amount of international trade of these items is slowly increasing. Major players of the industry have continued to expand their presence outside of North America, such as European and Asian countries. Some firms have entered into licensing arrangements or joint ventures to aid in their expansion.

6. By December 2010, exports are estimated to total $778.5 million, with annualized increases of 9.4% since 2006 that are attributed to strong NAFTA relations with Canada and Mexico. This factor is also at play for imports (estimated at 3.8% by December 2010) as Canada and Mexico feature again as major sources of industry
imports. With imports from Mexico growing faster than those from Canada, it suggests that competition within the US market is moving toward lower product pricing. Under these conditions, other low-cost manufacturing countries like China are also benefiting.

7. **Business Locations.** The most influential factor behind locating the industry’s manufacturing facilities is the geographic spread of its customer markets. By locating these close customer markets, transportation and distribution costs are significantly reduced. Other factors include presence of supplying industries and access to export markets through infrastructure such as seaports. As such, the industry is concentrated in areas with developed manufacturing industries such as the Great Lakes, Southeast and the West regions. In general, more populated states or regions will have a greater demand for products, but these states should also have well-established business sectors like machinery, agricultural products and food processing.

**Competitive Landscape**

8. **Basis of Competition.** The industry operates on the basis of high volumes and low margins. Firms tend to offer lower unit prices for larger volume purchases. Most businesses in the industry maintain low cost producer positions, expand through acquisitions and internal growth, and continually enhancing profitability through productivity improvements and cost reduction strategies. Transportation costs are high as there are substantial costs associated with the transportation of empty metal containers. As such, firms try to sell their metal food/beverage container products to customers close to their manufacturing plants (i.e. 300 mile radius). While strategically-located plants can give companies competitive advantage, relocation of any major customer could also be a great disadvantage. Furthermore, instead of
purchasing containers from these plants, customers can also invest in equipment and self-manufacture their containers.

9. Metal containers face competition from plastic, paper, glass and composite containers. Metal containers are considered superior to plastic, composite and paper containers in applications where their contents are either processed at high temperatures or packaged in larger quantities, or where long shelf life of the product is desirable. In addition, metal is considered better than glass because metal containers are more durable and less costly to transport. Looking forward, price competition will become more important to competitive success. Firms within the industry will need to exploit sources of cost leadership such as economies of scale, proprietary technology and lower cost materials.

10. **Barriers to Entry.** As competitive pricing is the primary means of successfully differentiating products and achieving competitive success, new entrants will need to put up huge capital to establish or purchase manufacturing plants so as to achieve required economies of scale that lower production costs. Most major players have achieved their existing economies of scale over time through many mergers and acquisitions. In addition, they hold long-term sales contracts with major customers that are deeply entrenched. These characteristics can deter the entry of new firms as these pose particularly difficult obstacles to overcome.

11. **Industry Globalization.** From a global perspective, the industry operates on in a decentralized manner mainly because of the low value to volume nature of its products. Manufacturing facilities are located in close geographical proximity to the markets it serves. All the major players have manufacturing facilities located domestically and overseas. Furthermore, the customer markets of the industry are also highly globalized, such as Coca-Cola, Pepsi-Cola, Cadbury Schweppes, Mars, Nestle and Unilever. Being in the food and beverage market, these customers have also implemented geographically dispersed business models, which partially explains the structural characteristics of the industry.
D. Canned Fruit and Vegetable Processing Industry

Industry at a Glance (2010)
Industry Performance

1. Players in this industry create, package and distribute a diverse range of food products that are fruit and vegetable based. Ready-to-eat canned products and juices are the two largest components, each bringing in over one-fifth of the industry’s annual revenue. The remainder is comprised of soups, sauces, baby foods, jams, jellies, packaged salads and dehydrated varieties. The single largest threat is competition from fresh produce markets, which is able to compete in more markets due to improvements in transportation and storage technologies. In addition, frozen food products and imported products are also becoming popular, resulting in lower sales and downward pressure on prices. The industry has responded by consolidating market share to benefit from economies of scale. But this is done at the expense of weaker industry players, resulting in a decline in industry establishment and employment figures.

2. The economic downturn has temporarily reversed these trends resulting in an expected three consecutive years of positive growth. As a result, industry revenue has achieved positive annual growth of 0.5% over the past five years. However, the anticipated recovery of the US economy by end of 2010 is expected to result in a return to slow decline of 2.9% for the next five years. Nevertheless, products of this industry are a staple of the American diet and will be present on supermarket shelves for many years to come.

Products and Markets

3. **Products and Services.** This industry represents the wide spectrum of products that are created by processing fruits and vegetables, which includes many distinct product segments. Many companies operate in just one of these segments at a time because the production and marketing competencies can vary considerably (e.g. there are very few similarities between the baby food and juice segments). Many fruits and vegetables are available in canned varieties on grocery shelves around the world. Most supermarkets have a wide range of offerings from several brands, including their own low cost brands. Canned products have lost ground to fresh varieties over recent years as advancements in storage and transportation have made fresh produce readily available throughout the country and more affordable than ever before. While there has been considerable substitution towards these alternatives, canned varieties still have a few
advantages: they are cheaper, remain edible for longer periods of time and are inexpensive for consumers to store (i.e. they can be kept in a cupboard rather than a fridge). Americans still consume around half of their fruits vegetables in processed form – especially when their budgets are strained.

4. **Major Markets.** Grocery wholesalers are the largest buyers for this industry as they have expertise in distributing to retail outlets cost effectively with minimal administration on behalf of the manufacturer. However in recent years, they have lost some ground to supermarkets and convenience stores as online ordering systems have allowed the latter to purchase groceries directly from some manufacturers. Another significant buyer is the food service industry including restaurants, bars, hotels, motels, casinos and catering companies. Economic conditions and tourism development are key factors determining the level of demand from this sector. Other food manufacturers in frozen food, bakery products and pet food buy processed vegetables and fruit as key ingredients. Demand from this market segment is driven by consumers’ tastes and ownership of pets, which is highly dependent on lifestyles and the general level of prosperity among households.

5. **International Trade.** Imports have been increasing at an annualized rate of 5.2% over the last five years, despite a decline in the value of the U.S. dollar. The majority of imports are sourced from China, who is the largest producer of fruit and vegetables in the world. The other significant sources of imports are Mexico and Canada, which can be explained by their proximity to US. In addition, some major players in the US industry have production facilities in these countries (Campbell Soup Company, for example, has production facilities in both these countries). On the other hand, exports from this industry have also been increasing over the past five years at an annualized rate of 5.5%. Export growth has accelerated in recent years, indicating that exports have been boosted by the weakness of the U.S. dollar.
6. **Business Locations.** The major fruit and vegetable processing region in the US is the West, particularly California. This state is very popular for the industry because processors are close to freshly-grown fruits and vegetables throughout California itself, as well as Mexico and Central America. In the Southeast, particularly Florida, manufacturers within this industry are significant since the climate is conducive to growing fruit and vegetables. The Mid-Atlantic is the next most significant region as the processing facilities are centered on major population centers (e.g. New York, Pittsburgh, Washington DC and Baltimore), a mass market for the sale of produce to consumers.

**Competitive Landscape**

7. **Basis of Competition.** Industry competition is intense between manufacturers since there are many both domestic and foreign companies fighting for a larger piece of a shrinking pie. This competition is gradually increasing with more aggressive promotional activity taking place to either maintain or grow sales. The major factors by which fruit and vegetable processors compete include:

- Raw materials
- Price
- Quality
- Nutritional value
- Marketing and advertising
- External competition
8. **Barriers to Entry.** Strong brands and intense competition in this industry can deter new companies from entering this industry. Barriers include substantial branding and advertising costs, costly or difficult access to existing distribution channels or prime shelf space, high capital investment in plant equipment/warehouses, scale of economies to drive cost down, and wide range of products from incumbent players. However, opportunities for entry do exist, as supermarkets usually carry a number of lower price products that are not heavily advertised or branded.

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9. **Industry Globalization.** Globalization of this industry is substantial as its companies buy much of their raw materials from the developing world, and hence, establish production facilities on-site to minimize transport costs. The three largest players in the industry, Campbell’s Soup, Heinz and Kraft all have operations in other countries. Campbell’s operates in countries like China, Japan, Australia, Puerto Rico, the Dominican Republic, and Venezuela. Kraft’s international operations accounts for over 20% of revenue.
APPENDIX 2: WASTE HIERARCHY
(Source: http://www.pca.org.au)

1. The waste hierarchy refers to the 3Rs of reduce, reuse and recycle, which classify waste management strategies based on their impact to the environment and overall desirability. The objective of the waste hierarchy is to extract the maximum feasible benefits from manufactured goods while generating the minimum amount of waste. In the past decade waste management has taken many forms, but the basic precept has remained the foundation of most waste minimization strategies.

2. The standard waste hierarchy calls for reduction of waste as the optimal solution, followed by reuse, recycling; other hierarchies also attached incineration and lastly disposal. Some critics, such as Herman Vollebergh, have raised the point that the standard hierarchy is really more fluid and dynamic. For example, in some instances recycling could be a better solution than reuse depending on the local economy, recycling center locations, and refilling center locations for the reuse product.

3. In addition to the priority of the traditional 3Rs, some waste management experts have recently incorporated a fourth R – "Re-think". Rethink implies that the present system may have elemental flaws, and to correct the waste management hierarchy theorists may need an entirely new way of looking at waste to reduce waste at the source of manufacturing. For example one form of source reduction is to increase incentives for reduced consumption and recycling. Many communities in the United States are implementing variable rate pricing for waste disposal, sometimes referred to as Pay As You Throw or PAYT, which has been effective in reducing the size of the municipal waste stream.

4. Source reduction is usually measured by efficiencies and cutbacks in waste. A more contentious approach is the reduction of toxic use, where source reduction targets reductions in the upstream use of toxic materials. Toxics use reduction stresses the more preventive facets of source reduction but has been opposed more robustly by chemical manufacturers. In addition toxics use reduction programs have been set up by legislation in some states, such as Massachusetts, New Jersey and Oregon.
APPENDIX 3: THE 7 R’S OF SUSTAINABLE PACKAGING
(Source: http://walmartstores.com/Sustainability)

1. The primary goal of the Walmart’s Packaging Sustainable Value Network is to be packaging neutral by 2025, which means all packaging recovered or recycled at its stores and Clubs will be equal to the amount of packaging used by the products on its shelves. In 2006, the Packaging Network announced its desirable principles of sustainable packaging to suppliers through the “7 R’s of Sustainable Packaging.” The “7 R’s of Packaging” are:

- **Remove**: Eliminate unnecessary packaging, boxes or layers, and harmful materials.

- **Reduce**: “Right-size” packages, optimize material strength, and design packages appropriately for contents and merchandising requirements.

- **Reuse**: Walmart has a goal that all transport packaging will be reused or recycled by 2011 through improved pallets and reusable plastic containers (RPCs).

- **Renew (able)**: Use materials made of renewable resources as measured using ASTM D6866, or select biodegradable materials that meet ASTM D6400 or ASTM D6868.

- **Recycle (able)**: Use materials made of the highest recycled content without compromising quality, including post-consumer recycled material (PCR) where appropriate. Components should be chosen based on recycle-ability post-use, with a goal of increasing the municipal recycling rate to 35 percent by 2011.

- **Revenue**: Achieve all principles at cost parity or cost savings, which requires a supply chain approach.

- **Read**: Get educated on sustainability and how suppliers play a part. The Education Subcommittee of the Packaging Sustainable Value Network recommends the following curriculum for professionals to learn more about packaging design for sustainability:
  - Sustainable Packaging
    - New Thinking: The Sustainable Packaging Essentials Program
    - More information at www.pac.ca
  - Packaging Fundamentals
    - Fundamentals of Packaging
    - More information at www.iopp.org
  - Damage reduction through Simulated Distribution Testing
    - CPLP training
    - More information at www.ISTA.org
  - Sustainable Packaging Scorecard
    - Training from ECRM and Thumbprint
**Objective and method:** Tetra Pak, one of the leading milk and juice packaging producer, strives to develop environmentally friendly packaging. In this context, BIO Intelligence Service conducted a comparative Life Cycle Assessment (LCA) of 4 types of Tetra Pak packaging. The study was performed in compliance with ISO 14044 standard, including a critical review, leading to the certification of the LCA. The critical review committee included Yvan Lizard (LCA expert), Olivier Labasse (National Packaging Council), Grégoire Even and Anne-Cécile Ragot (WWF).

➤ **The Life Cycle Assessment**

The LCA is a "cradle-to-grave" approach aiming to assess the environmental impacts of the product at each step of its life cycle, by considering the inventory of all inputs, emissions and waste at each step. For the purpose of this study, the life cycle of the product was split into four:

- **Production of the packaging,** including raw material extraction, production and transport of the materials constituting the packaging,
- **Filling and secondary packaging**
- **Distribution of the packaged products to the retail outlets**
- **End-of-life,** including collection of waste generated over the life cycle of the packaging and waste treatment (recycling, incineration, landfill).

![Life Cycle Assessment Diagram](image)

➤ **Environmental impact indicators**

The role of the indicators is to express the environmental impacts of the packaging over its lifecycle. In the LCA, impacts were quantified for 11 environmental impact indicators, covering all aspects of pollution; the complete results are presented in the LCA report, available from Tetra Pak France. For this synthesis, five environmental impact indicators were selected based on current environmental concerns and on the robustness of the indicators. Less robust indicators are thus not presented in this synthesis.

The 5 selected indicators are:

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<th>Indicator</th>
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<td><strong>Global warming</strong></td>
<td>Global warming refers to the increase in the average temperature of the Earth's surface, due to an increase in the greenhouse effect, caused by anthropogenic emissions of greenhouse gases (carbon dioxide, methane, nitrous oxide, fluorocarbons (e.g. CFCs and HCFCs), and others).</td>
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<td><strong>Non-renewable energy consumption</strong></td>
<td>This indicator refers to the total consumption of energy resources which are directly extracted from natural fossil reserves such as natural gas, petrol, coal and uranium.</td>
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<tr>
<td><strong>Non-renewable resource consumption</strong></td>
<td>This indicator can be defined as the decreasing availability of natural resources. The resources considered in this impact are fossil and mineral resources, excluding biotic resources, and associated impacts such as species extinction and loss of biodiversity.</td>
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<tr>
<td><strong>Air acidification</strong></td>
<td>Air acidification consists of the accumulation of acidifying substances (e.g. sulphuric acid, hydrochloric acid) in the water particles in suspension in the atmosphere. Deposited onto the ground by rains, these acidifying pollutants have a wide variety of adverse impacts on soil, ground- and surface waters, organisms, ecosystems and materials (buildings).</td>
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<tr>
<td><strong>Eutrophication</strong></td>
<td>The release of phosphate- or nitrogen-rich nutrients to the aquatic environment increases the proliferation of certain species (microalgae, plankton ...) which can lead to a decrease in the oxygen content. This may strongly impact aquatic fauna and flora, and disturb the functioning of these ecosystems.</td>
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- **Studied packaging types**

For the LCA, the environmental impacts of four types of Tetra Pak packaging were studied and compared to the impacts of their competitors, based on the Life Cycle Assessment methodology.

The following packaging types were studied:
- Tetra Brik Aseptic 1 L (TBA 1000), with cap, for milk and juice, vs. plastic bottle;
- Tetra Gemina Aseptic 1 L (TGA 1000), for milk and juice vs. plastic and glass bottle;
- Tetra Prisma Aseptic 250 ml (TPA 250) with pull tab for juice vs. plastic bottle;
- Tetra Recart 390 ml (TRC 390), vs. steel can, glass container and Stand-Up-Pouch.

<table>
<thead>
<tr>
<th>Picture</th>
<th>1L milk packaging</th>
<th>1L juice packaging</th>
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<tbody>
<tr>
<td>Tetra Brik Aseptic (TBA)</td>
<td>Tetra Gemina Aseptic (TGA)</td>
<td>HDPE bottle</td>
</tr>
<tr>
<td>Tetra Brik Aseptic (TBA)</td>
<td>Tetra Gemina Aseptic (TGA)</td>
<td>PET bottle</td>
</tr>
<tr>
<td>PET bottle</td>
<td>Glass bottle</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tab</th>
<th>x</th>
<th>x</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cap</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

### 250 ml juice packaging

<table>
<thead>
<tr>
<th>Picture</th>
<th>250 ml juice packaging</th>
<th>400 ml food packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetra Prisma Aseptic (TPA)</td>
<td>PET bottle</td>
<td>Tetra Recart (TRC)</td>
</tr>
<tr>
<td>Tetra Recart (TRC)</td>
<td>Stand-up Pouch (SUP)</td>
<td>Steel can</td>
</tr>
<tr>
<td>Steel can</td>
<td>Glass container</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tab</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw</td>
<td>x</td>
</tr>
<tr>
<td>Cap</td>
<td>x</td>
</tr>
</tbody>
</table>

- **Secondary packaging**

<table>
<thead>
<tr>
<th>Packaging types</th>
<th>Plastic Film</th>
<th>Cardboard</th>
<th>Plastic Wrapped Cardboard Pallet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1L milk packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBA</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TGA</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEHD</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>1L juice packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBA</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TGA</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PET</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>250 ml juice packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPA</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>PET</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>400 ml food packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRC</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>SUP</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Steel can</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Glass container</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
**Boundaries of the Life Cycle Assessment**

The following figure illustrates the life cycle steps included within the Life Cycle Assessment of Tetra Pak packaging and their competitors.

The environmental impacts linked to the packaging content (milk, juice ...) as well as the impacts of the product storage and the transport between the retailer and the consumer were not taken into account in the Life Cycle Assessment. However, the exclusion of these life cycle steps does not impact the comparison of the different types of packaging.

**Main hypotheses and input data of the LCA**

The Life Cycle Assessment was carried out for France. Input data were collected accordingly for Tetra Pak and its competing packaging.

The analysis took into account the specificity of waste management in France. The waste management scenarios come from ADEME (French environment agency), and refer to 2006.

<table>
<thead>
<tr>
<th>End-of-life route</th>
<th>Cardboard</th>
<th>Plastic bottles</th>
<th>Other plastics</th>
<th>Glass</th>
<th>Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycling</td>
<td>31%</td>
<td>51%</td>
<td>-</td>
<td>72%</td>
<td>63%</td>
</tr>
<tr>
<td>Incineration</td>
<td>35%</td>
<td>24%</td>
<td>50%</td>
<td>14%</td>
<td>0%</td>
</tr>
<tr>
<td>Landfill</td>
<td>34%</td>
<td>25%</td>
<td>50%</td>
<td>14%</td>
<td>37%</td>
</tr>
</tbody>
</table>

Electricity models used for the quantification of the environmental impacts take into account country specific electric mixes. For TBA and TGA, carton rolls are produced in France (Dijon). For the TRC 390, the lamination step is carried out in Sweden (Skoghall) and printing step occurs in Switzerland (Romont).
**400 ml food packaging – Results**

Tables and figures below present the comparison of the environmental impacts of different types of 400 ml packaging that can be used for food, namely TRC 390, steel 400, SUP 400 and glass container. Results are expressed per 1000 litres.

<table>
<thead>
<tr>
<th>Environmental impact indicators</th>
<th>Unit</th>
<th>TRC 390</th>
<th>Steel 400</th>
<th>SUP 400</th>
<th>Glass 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming</td>
<td>kg CO₂ eq</td>
<td>203</td>
<td>315</td>
<td>195</td>
<td>593</td>
</tr>
<tr>
<td>Non renewable energy consumption</td>
<td>MJ</td>
<td>3583</td>
<td>5803</td>
<td>3448</td>
<td>10539</td>
</tr>
<tr>
<td>Non renewable resources consumption</td>
<td>kg Sb eq</td>
<td>1.5</td>
<td>2.7</td>
<td>1.5</td>
<td>4.1</td>
</tr>
<tr>
<td>Air acidification</td>
<td>kg SO₂ eq</td>
<td>0.9</td>
<td>1.5</td>
<td>0.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>kg PO₄³⁻ eq</td>
<td>0.17</td>
<td>0.28</td>
<td>0.13</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**CO₂**: carbon dioxide, **MJ**: megajoules, **Sb**: antimony, **SO₂**: sulfur dioxide, **PO₄³⁻**: phosphate ion

In the following figure, results for TRC 390 have been set to 100%, and the impacts of other packaging types have been calculated accordingly.

The environmental impacts of Tetra Pak packaging are significantly lower than the impacts of the steel can and glass container for all the impact indicators.

For the indicators presented here, Tetra Recart and stand-up pouch have very similar environmental impacts. The observed difference for the indicator of eutrophication comes from the cardboard production.

**Climate change**

The advantage of the Tetra Recart packaging, compared to the steel can, comes mainly from the choice of raw materials. The renewability of cardboard, compared to steel, accounts for a large share of this advantage. The significant energy consumption of glass production explains the benefit observed for Tetra Pak packaging, compared to the glass bottle.

The figures at the right present the greenhouse gas emissions per 400 ml packaging.

- 78 g CO₂
- 81 g CO₂
- 126 g CO₂
- 237 g CO₂
APPENDIX 5. CONSUMER ACCEPTANCE TO ALTERNATIVE PACKAGING
(Source: Interviews with Wal-Mart Argentina, Brazil and Chile)

Retailers’ Experience

1. We conducted interviews with Wal-Mart Argentina, Brazil and Chile in order to review and analyze the countries’ experience and consumer acceptance to sustainable alternative packaging.

2. **Argentina.** We contacted Tomas Ventura, Private Brands DMM Merchandising. In April 2009, Wal-Mart Argentina launched the “Earth Month” initiative in all stores to increase the awareness of sustainable products. Wal-Mart Argentina offered customers nearly 400 sustainable products. Nearly 50 suppliers participated in this initiative including Unilever, GE, Philips, and P&G. During 2008, Wal-Mart Argentina launched its reusable bag program. It was the first retailer in Argentina to offer customers reusable bags. During last year, Wal-Mart and Coca Cola launched a campaign to recycle PET bottles, incentivizing customers to bring bottles to the recycling locations in the Wal-Mart stores. Tomas Ventura thought that sustainability was a common term in the media and Argentinean customers were aware of sustainable products and their packaging. However, their actions and customer purchase behavior have not correlated with the level of awareness reported.

3. **Brazil.** We contacted Maria Rita Galiza Lobato, Sustainability Projects Coordinator. During 2008, Wal-Mart Brazil opened its first sustainable store Supercenter (Campinho) that uses 25 percent less energy and 40 percent less water than other Wal-Mart Supercenters in Brazil. Moreover, Wal-Mart Brazil is working to create “Zero Impact” when it comes to waste, targeting to include in this program all stores by the end of 2010. According to the “Wal-Mart Brazil: Sustainability Dialogues” report, the consumer profiles define the packaging of the product. We have the 1st group linked by singles living alone, or families with specific consumer habits that prefer small packages, as these are practical, multifunctional and easy to store. The 2nd group comprising senior consumers prefers packaging with shorter shelf life, ergonomic characteristics, safety, and convenience and with clear, easy-to-read information and instructions. The 3rd group linked by their desire for a healthy lifestyle with high levels of safety and hygiene chooses more complex packaging with greater information. The 4th group characterized by their ecological conscience demands biodegradable and recyclable packaging. The final group consisting of busy, over-worked and stressed individuals prefer convenient packaging that is re-usable and ready-to-cook.

4. Some of the successful sustainability initiatives done by Wal-Mart Brazil are listed as follows:

   • During 2008, Wal-Mart Brazil launched an initiative that gave customers a USD$0.03 discount for every plastic bag they didn’t use. As a result, customers avoided consuming more than 1 million plastic bags.
   • Equate Cotton Swabs: Its packaging was Forest Stewardship Council (FSC) certified. This
initiative contributes to curb deforestation and the indiscriminate use of wood.

- **Blanket:** Each blanket is made of approximately 200 recycled PET bottles. Since February 2008, approximately 92,000 blankets have been sold at Wal-Mart Brazil stores that are made from 16.5 million recycled PET bottles.

- **Ol’Roy beef cutlets:** Wal-Mart reduced the package weight from 4 grams to 2.5 grams. This initiative saved annually 8.4 tons of plastic.

- **Baker’s & Chefs, Top Chef and Great Value French fries and chipsticks, and Great Value spaghetti and snacks:** Wal-Mart used ink without chemical solvents for printing. As a result of this initiative, there was a reduction of GHG emissions.

- **Top Max steel sponge and Top Chef frozen French fries:** Walmart reduced material used by 25% and 20% respectively, thereby reducing use of non-renewable material.

- **Sustax Kids (drink mix made under private label):** Wal-Mart reduced the can size by 16%, resulting in annual steel savings of 1 ton.

5. **Chile.** We contacted Jean-Pierre Frigeni, Private Brands Commercial D&S. Last year, D&S opened the first environmentally friendly supermarket in the Chile with energy efficient features. Furthermore, D&S has reduced energy usage by 5 percent annually during the last 3 years. One of its successful initiatives in packaging is the “3Rs campaign” on Reducing, Recycling and Reusing. It is a strategy that tries to reduce the use of plastic bags. D&S is the first supermarket in Chile to sell reusable bags. In April, D&S began offering recycled t-shirt bags and the supermarket is working to reduce plastic bag waste by 50% by 2011. Since 2001, D&S has offered in-store community recycling for paper, glass, and aluminum cans, as well as in-store operational recycling on carton and plastic films.

7. According Jean-Pierre Frigeni, suppliers in Chile are trying to reduce the size of the packaging. Wal-Mart Chile is offering some products with packaging 100 percent biodegradable and 100 percent recyclable. He mentioned that the sustainability data and information was not solid yet. Furthermore, there was no data about customers’ acceptance to different sustainable packaging. Jean-Pierre Frigeni thought that it was still too soon to evaluate the result of all
these sustainable campaigns.

![PANO HUMEDO- Biodegradable packaging and 100% recyclable Packaging for chips]

**Consumer Insights**

8. To expand our knowledge in sustainable marketing, we conducted an interview with Professor Glen L. Urban. He has been a professor of the MIT Sloan School of Management since 1966. Glen L. Urban is a leading educator in green marketing and new product development. He identified three segments in the sustainable packaging market. First, consumers who are willing to pay a premium for sustainable packaging and products form the “green segment.” Second, consumers that are not willing to pay extra but they are seduced by the green idea. This segment is aware of environment issues and chooses sustainable products if that means no extra costs. Consumers that think that sustainability is a fashion mode and ridiculous idea form the third segment. These customers do not recycle and do not believe in future climate change challenges. Most of the customers are located in the second group.

9. As one of the leading market research companies in sustainable products and services, Datamonitor conducted a market research in 15 countries around the world. In this report, Datamonitor found out that the majority of consumers think that contemporary packaging has become disproportionate and excessive. Furthermore, consumers are beginning to consider the sustainable packaging of the product as part of the purchasing process. Politicians are becoming aware of this new trend as evident in their efforts to develop new norms and government regulations. Moreover, retailers such as Whole Foods Markets and Trader Joe’s are working to develop alternative sustainable packaging to satisfy these new customer needs. The following are the most important findings of the Datamonitor report:

- Sustainable packaging is today an important component of brands.

- Environmental consequences should be addressed in packaging: ethics and ecological
concerns push the trend towards sustainable packaging.

• Brands should incorporate the reduce, reuse and recycle message in its packaging.

• Consumers are concerned with the environment. Reducing packaging footprints satisfied consumer expectations.

• The global economic crisis is impacting the sustainable packaging industry. Producers should be more efficient in packaging. Moreover, recycling is less commercially attractive in the global economy. Furthermore, suppliers should investigate new package shrinkage tactics.

• Consumers want to “de-clutter” and sustainable packaging is a way to capture this trend. In other words, consumers around the globe want to live a simple life and sustainable packaging fits this reality.

• The “Buying locally” trend and the on-line shopping are influencing the sustainable packaging industry. Furthermore, consumers located in India, Australia and France are most likely to buy products produced locally. Moreover, senior consumers value more localism. Buying locally and on-line shopping reduce the long distance costs making the products more environmentally friendly.

• In general, consumers take the role of brand image for granted. However, younger consumers value more the packaging design when buying products. Consumers in the BRIC counties are more influenced by packaging than in other part of the globe.

• Consumers think that grocery products are over-packaged. Furthermore, consumers request to look for alternatives. However, consumer behavior does not correlate with this perception.

• As a consequence of the growing importance of sustainable packaging, some consumers are willing to pay a premium.

• There is an increased concern about product safety, making consumers request more information about the product that they purchase. This trend conflicts with the desire of less packaging.
Endnotes


9 Cube-out means to reach the volume limit of a standard shipping container.

10 University of Arkansas/Walmart Earthster Study.


12 Waste Online, “Glass Recycling Information Sheet.”


