2005 State of the Recycled Plastic Lumber Industry
Presented by Alan Robbins

The established goals of the Plastic Lumber Trade Association (PLTA) are to establish standardized testing procedures, promote standards of quality within the industry and promote the use of recycled plastics. The PLTA also strives to facilitate cooperative projects that contribute to a firm, equitable and business-like basis that is consistent with the best interests of the plastic industry and cooperatively work with groups and government agencies on matters of material interest. The organization aims to increase public awareness and promote the acceptance and use of plastic lumber products for consumer, commercial and government use as well as act and function as a clearing house of information for the industry by collecting statistics and information that will aid the growth of the plastic lumber and other associated industries. Over the years, the industry has entered into a more mature business cycle of greater growth and market acceptance. To demonstrate the accomplishments of the industry over the past years, we will review the American Society of Testing Methods (ASTM) accomplishments, review the success of development projects that explore the structural use of plastic lumber, survey the competing technologies, analyze the current and developing markets, view the stages of business cycle development, glimpse at the trends in raw materials supply and offer a few thoughts for the future of the PLTA.

**American Society of Testing and Materials (ASTM) Test Method Development:**
A number of ASTM standards that pertain to quality and testing of plastic lumber were modified during the standard four to six year review process. Those include D6108-03, D6109-05 and D6111-03. Copies of these revised standards can be purchased from ASTM. The following standards represent the significant amount of work and effort of many members of the ASTM D20.20.01 Plastic Lumber Committee. For this we offer our sincerest thanks to the individuals involved.

- D6108-03, Standard Test Method for Compressive Properties of Plastic Lumber and Shapes
- D6109-05, Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products
- D6111-03, Standard Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement
- D6112-97, Standard Test Methods for Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
- D6117-97, Standard Test Methods for Mechanical Fasteners in Plastic Lumber and Shapes
- D6341-98, Standard Test Method for Determination of the Linear Coefficient of Thermal Expansion of Plastic Lumber and Plastic Lumber Shapes Between -30F and 140F (34.4C and 60C)
- D6435-99, Standard Test Method for Shear Properties of Plastic Lumber and Plastic Lumber Shapes

- D6662-01, Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards
- E108 (Modified), Residential Decking Flammability (Burning Brand Test)

D6662-01 is currently undergoing a regularly scheduled review. The working item for that review is WK2843, Standard Specification for Polyolefin-Based Outdoor Structural-Grade Plastic Lumber.

The process for conducting the Precision and Bias (P&B) review for each of the above ASTM Standards has begun and is being conducted under the direction of Dr. Prabhat Krishnaswamy and Richard Lampo. There is a five-year window of time for this work to be completed after a standard is established. The ASTM committees and testing laboratories are working cooperatively to insure the validity of each standard. Standards currently undergoing the P&B review include D6112-97, D6117-97, D6341-98 and D6435-99, which is has the most narrative changes being made to it.

The D20.20.01 subcommittee has had significant ballot activity on Document X-20-43, Standard Specification for Thermoplastic Composite Lumber for Outdoor Structural Applications and work continues on X-20-51: Standard Specification for Polymeric Piles.

Due to interest from the government sector to develop the appropriate test methodology utilizing recycled materials for large scale marine/waterfront structures, a spin-off ASTM committee was formed, D20.20.04 for Marine Waterfront Applications. The D20.20.04 subcommittee has begun ballot work after many years of technically backfilling X20-51: Standard Specification for Polymeric Piles. This subcommittee has also given a presentation at "Ports 2004" about their work in polymeric pilings and is anticipating an additional presentation at the future "Ports 2007" conference.

Another ASTM committee focused on evaluating standards for composite lumber is D07.02.07, the subcommittee on wood plastic composites under the jurisdiction of committee D07 on Wood. This committee, chaired by Dave Gromala and Dr. Bob Tichy, have been busy to move materials through the building codes. Their work has been predominately on wood composites but there is some overlap and much debate occurring between D07 and D20 committees on the proper test methodology of these material systems.

Two standards have been completed by the ASTM D07.02.07 subcommittee.

- D7031-04, Standard Guide for Evaluating Mechanical and Physical Properties of Wood-Plastic Composite Products
- D7032-05, Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails)

In addition to this work a new standard is being developed that establishes the procedure for assigning engineering design values for structural uses.

For products that are not included within the applicable building code, local building officials often rely on a code evaluation report to verify that the product complies with the intent of the Code. The primary system within the United States to accomplish this is the International Code Council's Evaluation Service (ICC-ES). The ICC-ES currently has two paths (called "acceptance criteria" or "AC's") for obtaining an evaluation report for decking products – AC109 and AC174. The former includes its own evaluation criteria and references both D20 and D07 test methods. The latter relies primarily on the testing and evaluation procedures defined within D7032. This was accomplished in July of 2005 and has resolved much of confusion created by the evolving nature of the ACs. However, because these acceptance criteria for decking products have changed frequently over the past several years, problems linger regarding discrepancies between older "legacy" reports and the new evaluation reports. ICC-ES staff believes that this problem will resolve itself as jurisdictions adopt new versions of the building codes.

**Technologies**

As has been reported in previous State of the RPL Industry reports, there are several technologies and polymer resin systems competing within the marketplace. We are seeing a significant broadening of various materials systems competing for market share. Bio-composites (wood/plastic) resin systems have significantly moved to the forefront of the market.

Plastic lumber has enjoyed significant growth in recent years, gaining increased prominence in residential retail markets. A factor worth mentioning which may have contributed to the growth of RPL over the past few years has been the cessation of the production of chromated copper arsenic (CCA) treated wood prompted by the environmental and health threat posed by the leaching of chemicals into soil and water. This development dramatically increased the demand for alternative materials systems along with presenting a challenge to the lumber industry to convert to other processes for the replacement of the current pressure-treated lumber.

**Single Polymer Resin Systems** made from recycled HDPE (high density polyethylene) showed little growth during 2005. Just a few years ago, the continuous extrusion of structurally formed HDPE was the clear leader in the all-plastic decking board markets. However, part of the market share enjoyed by single polymer resin systems has been lost to the greatly expanding bio-composite market. This is in part due to the high cost of input into HDPE decking. Some manufacturers are looking to cushion the cost of inflated HDPE prices by adding fillers to their product such as wood and flax which will be further discussed in the bio-composite section of the report.

There were at least 15 single polymer resin products available at the end of 2005. None of these manufacturers seemed poised to expand production capacity of their single polymer resin products at the close of the year.

**Extrusion Flow-Molding Systems** continue to be developed, adding new technologies and products to the array of plastic lumber available. SPS Inc. (Tilsonburg, Ontario) has created a flow-molding system used by numerous U.S. plastic lumber rail tie manufacturers. Pushtrushion by Woodshed Technologies (Winona, Minnesota) has

emerged as an extrusion technology in the past two years that is also being used in the production of RR ties and marine applications. For plastic lumber products used in railway and marine applications, flow molding systems seem to dominate over continuous extrusion manufacturing methods which are used for products with less demanding applications.

**Fiberglass Reinforced RPL** products hold a small share of the plastic lumber industry. Despite the slow growth of the product, some of the more uniquely engineered projects have been designed utilizing the fiberglass reinforced material systems. Two of the most visible projects have been designed by M.G. McLaren Engineering (West Nyack, New York). This includes the award-winning, load bearing H15 arched bridge constructed in New Baltimore, New York. This project was done in cooperation with Mr. Keith Lashway of the New York State Department of Economic Development (Albany).

Fiberglass reinforced RPL has also shown promise when tested for use in marine applications. Plastic marine pilings have been shown to last for at least eleven years at New York City's Tiffany Street Pier, suggesting they could easily replace the chemically or creosol treated woods currently used in marine applications in a cost-effective manner. Researchers at Rutgers University have secured patents on two fiberglass polymer formulations that increase the stiffness properties of products to mimic that of new softwoods such as pine. Of course, the desirable properties found in new softwoods diminishes over time, a problem that occurs at a much slower rate in the fiberglass reinforced RPL products.

Two companies make fiberglass reinforced plastic lumber including U.S. Lumber (Chicago) which acquired Trimax and Bedford (Worthington, Minnesota). The PLTA is trying to restructure around the new growth in the fiberglass market and to get test methodology for standards in place. Currently X-20-43 is in ballot and deals with the Standard Specification for Thermoplastic Composite Lumber for Outdoor Structural Applications. Finalizing this standard will help boost increased application of a variety of plastic resin building materials and structural applications.

**Polymer/Polymer Systems** continues to further their market acceptance. Rutgers University has secured patents for three polymer systems formulations. Currently only one is being licensed by Polywood (Edison, New Jersey), that manufactures an immiscible polymer blend of polyethylene/polystyrene. The use of Polywood has grown in the railroad tie market place as well as structural and marine applications. Researchers at Rutgers University anticipate one more of their polymer system technologies will be licensed in 2006 by a commercial manufacturer.

Early in 2002, Rutgers University announced the formation of a new technology center, Advanced Materials via Immiscible Polymer Processing (AMIPP). Projects undertaken by the center include a number of plastic building material related projects including:

- Structural composites from recycled plastics
- High performance highway and marine structural elements from polymer/inorganic composites
- High performance marine materials for the costal infrastructure

- The "New" Jersey Shore – rebuilding the coastal infrastructure
- Boardwalks

These are very interesting multi-tier projects centering on the processing of immiscible polymer blends of various resins. Richard L. Lehman is the Director and Dr. Thomas Nosker is the principal investigator. You may view project updates on AMIPP's Web site at www.amipp.rutgers.edu.

**The PVC industry** has undergone large organizational changes in the last few years. Earlier in 2000-2001 the American Architectural Manufacturers Association (AAMA) and the ASTM collaborated to address common industry concerns within the marketplace. In 2004 however, the plastic lumber members transferred from the AAMA to the American Fence Association (AFA) where two subdivisions, the Composite Fence, Deck and Railing Manufacturer's Association (CFDRMA), and the Vinyl Fence, Deck and Railing Manufacturer's Association (VFDRMA).

The use of PVC in the decking industry has increased dramatically in the last three years with over 13 varieties of PVC or PVC bio-composite decking products available on the market. PVC decking manufacturers largely make extruded hollow products. To our knowledge, none of these PVC or PVC bio-composite decking products use any post-consumer or recycled plastic materials.

**The Polystyrene industry** has been introducing new products into the specialty lumber markets. In the lumber industry, EPS has also gained market share being featured in decking by Benchmark Foam (Watertown, South Dakota), Polywood, Eon (Mississauga, Ontario) and Everlast Plastic Lumber Inc. (Auburn, Pennsylvania). Increasingly, PS is being used in the hot tub industry and as a core material for marine applications for added buoyancy. The use of PS in building materials has gained most use in the area of insulation. To the best of our knowledge, products using polystyrene are not using post-consumer or post-industrial polystyrene.

**Bio-Composites** are defined as those material systems that combine wood or other biological materials, e.g. flax, rice hulls, etc., within a thermoplastic matrix. These products have made the most gains in growth of market share in the last few years, enjoying as high as an 80 percent market share of the plastic decking products according to the Environment and Plastics Industry Council of Canada (Mississauga, Ontario).[1] As cited earlier, one of the motivating factors for manufacturers to mix these materials with HDPE is the attractive price of the non-petroleum-based additives. In a year where the price of feedstock consumed much of the profits from record product sales, reducing the use of costly HDPE in bio-composites is enticing.

There have been many introductions of new bio-composite material systems over the past few years. If the products contain over 50 percent bio-materials, the ASTM D20 definition of plastic lumber cannot be applied. The ASTM governing body for bio-composites lies within the D7 Wood Products Committee. Some of the most visible

[1] *Special News and Views Report: Recycled Plastic Lumber and Woodfibre Composites.* Environment and Plastics Industry Council of the Council of the Canadian Plastics Industry Association (Mississauga, Ontario), March 2003. http://www.cpia.ca/files/files/files_plastics_lumber_special_report.pdf.

RPL manufacturers have diversified their product lines with bio-composites including Trex (Winchester, Virginia), CertianTeed (Valley Forge, Pennsylvania), AERT (Springdale, Arkansas) and Louisiana Pacific (Nashville, Tennessee). According to the Healthy Building Network's *Guide to Plastic Lumber*, there were at least 18 bio-composite products available in 2005.[2]

**The Markets for RPL:**

Pinpointing precise sales volume for the RPL market remains a difficult task given that most manufacturers remain privately held corporations or are operating divisions within larger corporations and their sales volumes are not presented in a format that is easily identifiable for a sales analysis tool.

A number of studies and industry assessments have been issued on the plastic lumber industry in the past few years which also speaks to the attention that the growth in RPL has demanded. One of the more recent studies published by the Business Communications Company (Norwalk, Connecticut) estimated the output of the bio-composite industry at 2.2 billion pounds in 2005 and projects growth to 3.6 billion pounds by 2009.[3]

The decking market remains the clear leader in RPL sales volumes and much of those sales are from bio-composite products. As discussed earlier in the report, bio-composites have made huge gains in the marketplace in the past few years. The recent boon enjoyed by bio-composites, particularly in the residential sector, has been aided by increased access to these products by consumers through retailers such at Home Depot (Atlanta, Georgia) and Lowe's (North Wilkesboro, North Carolina). This activity coupled with the environmental concerns of pressure treated lumber materials has added additional horsepower to the decking markets. The OEM market applications appear to have continued growth, but due to the factional nature of these markets, growth is difficult to define, though manufacturers are putting significant emphasis into this market.

The potential implications of one legal development in 2004, the class action lawsuit won against Trex for breach of warranty on bio-composite products Timbrex and Rivinite sold between 1992 and 2004, cannot be overlooked. While immediate effects of the lawsuit do not seem to include a slowdown in sales of bio-composites, if performance remains to be an issue in any of the bio-composite products, the huge market share enjoyed by composite RPL may be ceded to other RPL technologies.

The railroad tie market has picked up as well. Capacity has adequately expanded as many new manufacturers have come on-line to produce RPL railroad ties. Demand continues to be the largest factor constraining growth in this area as pricing for RPL ties remains at nearly double that of the wooden counterpart.

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[2] Brenda Platt, et al. *Guide to Plastic Lumber*. The Healthy Building Network (Washington, D.C.), October 2005. http://www.healthybuilding.net/pdf/gtpl/guide_to_plastic_lumber.pdf.

[3] Mel Schlecter. *P-186 Plastic Wood: Technologies, Markets.* Business Communications Company (Norwalk, Connecticut), May 2005.

In 2004, it was estimated that just 300,000 of the 600 million ties installed in the U.S., or 0.05 percent, were plastic.[4] Plastic railroad ties have been in commercial use for about 10 years now, which has provided substantial opportunity to demonstrate the superior performance of RPL to wood ties in certain conditions. Now that the quality of RPL for this application has been established, the only factor continuing to limit demand for plastic ties is the higher cost of the product relative to its wooden counterpart. Despite the inherent challenge of competitive pricing against wood, one leading manufacturer estimates that demand for RPL ties has still managed to double over the past five years.

Over the next few years, capacity for RPL tie production is expected to increase as larger railroad companies continue to identify opportunities to integrate RPL products into their systems where their superior performance is needed.

In addition to enjoying increased exposure among consumers, some plastic lumber operations received public support to grow their capacity in 2005. For example, three producers of plastic lumber in Pennsylvania received state grants to expand operations. BJM Industries (Kittanning) was awarded $186,653 to purchase equipment to increase production capacity by 32 percent. Everlast Plastic Lumber (Auburn) received $500,000 to upgrade equipment and Pandya, Inc. (Cambria Township) expects to boost its consumption of recovered plastics by 1,000 pounds per day with the $86,771 grant it received. As the industry continues to mature and the value of economic importance of the RPL industry becomes more widely recognized, more public funding may be allocated to support industry growth.

**Business Cycle Development:**

As described in previous State of the Industry Reports, the RPL industry business cycle can be characterized as having three distinct stages. The initial stage of the industry was marked by consolidation through the acquisition of smaller firms by larger firms, such as the acquisitions made by U.S. Plastic Lumber. The second stage of the RPL business cycle could be characterized as the start-up or re-start-up phase where many of those displaced by past consolidation or those who had been hindered by now expired non-compete agreements emerge in the market. The magnitude of activity in this second stage was hard to fully understand because much of the emergence or re-emergence was done without much public disclosure.

Today, the RPL industry finds itself in a the more mature third stage where the development of new technology and products has earned RPL greater legitimacy in the marketplace. The first wave of this activity was seen with bio-composite products. Wider distribution of these products for residential and commercial applications through common retailers is further evidence of the maturation of the RPL industry over the past few years.

**Raw Materials:**

Perhaps the single largest market force affecting revenues in the RPL industry this year was the historically high pricing of raw materials – both for virgin resins and recovered

[4] Jan H. Schut, "They've Been Working on the Railroad." *Plastics Technology Magazine Online*, April 2004. http://www.plasticstechnology.com/articles/200404fa3.html.

plastics. Despite record sales enjoyed by some RPL firms, posting a profit in 2005 was a challenge.

If the economic trends of publicly traded firms in 2005 can act as a weather vein for larger market trends in the industry, they demonstrate the magnitude of the effect high raw materials costs have had on profits for RPL manufacturers in a year that boasted record sales but slim profit margins. In the second quarter of 2005, Trex reported a loss despite marginally strong sales of $75 to $85 million dollars. Trex officials blamed poor weather for reduced demand for products but also cited record high materials prices as a cause of the profit loss in the quarter. Trex was able to rebound in the third quarter. Both Trex and AERT reported large growth in sales over 2004 levels. Trex had net sales in the third quarter of 2005 of $77.4 million, up 20.2 percent from the year-earlier level. Net income in the 2005 period of $5.2 million was down 26.8 percent. Trex officials said that high scrap plastic prices were a key cause of the slump in income.

AERT had sales of $23 million in the third quarter, up 21 percent over the year-earlier level. Earnings rose 10 percent to $1.65 million. AERT cited the same reason for thin profit margins (high raw material prices). Nonetheless, the company plans to expand. AERT has raised about $3 million of the $5 million required to build a 60,000-square-foot decking production facility in Springdale, Arkansas.

Large price increases were seen both materials used in the production of virgin resin and in recovered materials. In particular, the price of natural gas was volatile in 2005. The year opened at attractive prices, averaging close to $6.25 per MMBTU in the month of January. Those prices, however, would not hold with unprecedented increases seen beginning in August which peaked in October (fig. 1). U.S. natural gas price increases can be directly correlated with the slowdown in production that resulted from Hurricanes Katrina and Rita which knocked production off-line at many refiners in the Gulf of Mexico.

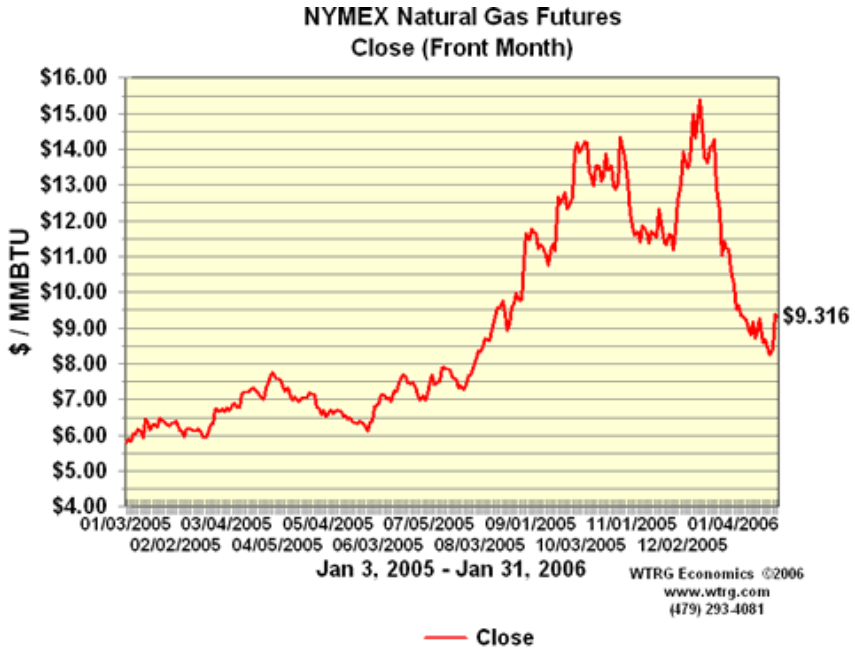


**Figure 1. Source: NYMEX Natural Gas Futures Prices, http://www.wtrg.com/daily/gasprice.html**

RPL manufacturers that use recovered PE largely consume film plastic (LDPE, LLDPE, and occasionally HDPE) and/or HDPE containers. The price inflation of HDPE containers is an example of the spike in post-consumer resin (PCR) that occurred in 2005. PCR HDPE posted a near 60 percent gain over prices in 2004 by the end of the year (fig. 2). Contributing factors to the feverish rise in the HDPE market include increased demand from new end users, a shortage of off-spec resin and little opportunity for processors to build reserves because of tight supply. The entrance of new end users into the HDPE colored bale market seeking relief from shortages in off spec-resin pinched traditional consumers.

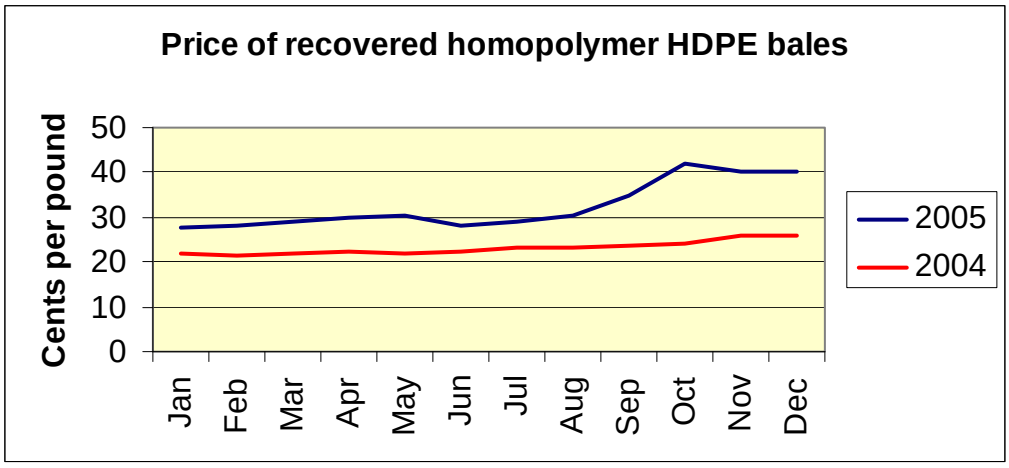


**Figure 2. PCR HDPE bale prices for 2004-2005 (Plastic Recycling Update)**
**Prices are based on truckload picked up in the eastern U.S.**

One promising development for the RPL industry in 2005 was the gains made in PE film recovery. Some of the biggest consumers of plastic bags and film are RPL manufacturers. Realizing the profitability of PE sales, large retailers such are Wal-Mart (Bentonville, Arkansas) have launched programs to recovery bags. As of June 2005, the Wal-Mart program was marketing 10 million pounds a month of PE.

However, despite the increase in PE recovery, industry players suggest that the big film consumers, such as the wood-composite product makers, will turn to consuming more bottle scrap if film supply does not meet production demands.

## The Plastic Lumber Industry in a Competitive Market

The RPL industry is beginning to mature, transitioning from a relatively young industry fighting for a place in residential and commercial building materials to becoming a relatively recognized and more widely accepted product. The consuming public is more knowledgeable about the differences within the various materials systems and how they factor into making the appropriate choice for their project needs. How the industry handles the current business challenges today will greatly influence the characteristic of the marketplace tomorrow. These are just a few questions that highlight some of the predominant challenges manufacturers can expect to confront in the near future:

- Will continuing high prices of feedstock, particularly of PE, make the production of bio-composites even more prevalent?

- Will bio-composite manufacturers be tempted to increase the use of organic fillers to reduce production costs? Will an increase in the use of these fillers compromise product quality and performance?

- Can railroad companies continue to budget for the integration of RPL ties into their systems at a premium cost?

- Because the manufacturing of RPL is inherently more costly than wood, will the industry devote the resources for research and development to find ways to improve the efficient use of products that make structures just as strong with fewer pounds of materials so it is price competitive?

- Does room remain in the national market for start-up companies to ramp up production to compete with current industry giants? Will the increased demand be met by companies who currently distribute on a national scale or does the opportunity for smaller companies to grow still exist?

**Continuing work for the development of industry**

RPL buyers continue to be vocal about the needs for material consistency, quality standards and timely delivery. For this reason, the recycled plastic lumber industry needs to be represented by a competent trade association. There needs to be a renewed commitment by all primary manufacturers, design engineers, researchers, marketers and end users to have a sound trade association representing their market interests. Focus needs to continue to be directed on working with manufacturers, such as the dairy industry, to ensure their packaging can continue to be reclaimed by industries such as plastic lumber. The core strengths of the PLTA is the work with the ASTM and to provide a forum where old and new members can discuss industry issues.

Membership applications may be downloaded from our website, www.plasticlumber.org.

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