ALTERNATIVES TO PAINTING AUTOMOTIVE PLASTICS PARTS

A Market Forecast for North America through 2004

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Executive Summary

North American demand for coatings for plastic automotive components has historically shown strong growth through the 1980's and early 1990's, driven by the strong growth rate of plastic resins displacing metal. The overall demand has remained high during the late 1990's due to unprecedented new car builds. However, when analyzed on a "per vehicle" basis, the growth of plastic coatings shows slower growth. The author has analyzed the North American automotive market and has concluded that the coatings growth for plastics will show marked slowing through 2004 with average demand per vehicle growing at 1.5-1.9%/yr. The primary factors causing the slowing are:

- Slowing of the growth of the plastic substrate
- Improving plastic resin technologies that preclude the need for coatings
- Other alternative decorating technologies with lower costs and that address the negative environmental issues associated with paint

This paper provides an in-depth analysis of the impact of emerging alternative technologies noted in the last two factors. The emergence of new decorating technologies will vary by plastic part, by supplier preference and by OEM design criteria. By 2004, ChemQuest estimates that molded-in color and film laminate together will have taken 7-9 points of market share from paint. The effect of this share loss combined with the slowing of the substrate growth will culminate in a slowing of demand. Furthermore, any slowing of car builds will have an additional effect, possibly causing the total demand for coatings to have stagnant or negative growth.

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Introduction/Methodology

ChemQuest Group, Inc., is a management consulting specializing in the Coatings, Adhesives, Sealants, and Automotive Industries with offices throughout the United States and Europe. ChemQuest has analyzed these industries continuously since 1975, mainly through proprietary (single client) studies as well as multi-client industry studies. This paper was developed from on-going research into the use, trends and dynamics of the automotive coatings and plastics industries.

The methodology for this paper was to research the impact on paint demand stemming from the emergence of alternative decorating technologies. This research included analysis of each alternative technology and its:

- supplier-stated features/benefits
- underlying fundamental costs
- environmental impact
- product performance
- comparison of technology to current and future customer needs

A "probability of displacement" was assigned to each alternative to reflect the chance of that technology replacing paint before 2004. Finally, interviews were held with key individuals throughout the automotive plastics market to validate the future use of these technologies and to calibrate the forecast to actual use and/or testing of these technologies in the automotive market today.

Most projections were based on the average surface area per vehicle (SAPV). Market size (available surface area) was estimated for 1999 and projected to 2004 based on a constant car build of 17MM(million) units/yr. The scope of this study was North America.

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Analysis of the Automotive Plastics Coatings Market through 2004

Automotive Body Plastics Applications - Slowing Growth in North America

The growth of plastic resin usage on a weight per vehicle (WPV) basis slowed considerably during the 1990's after phenomenal growth in the 1970's and 1980's. The average plastics WPV has been essentially flat for three model years, at a time when the overall vehicle weight has shown a slight increase. Importantly, the relative use of plastics has actually slipped slightly. This slowing of growth has been attributed to several factors:

- Decreased design and engineering emphasis on vehicle weight savings
- Fewer "low hanging fruit" opportunities for substitution of metals by plastics
- Increasing relative cost of plastics versus metals
- Substitution (actually cannibalization) of high-density plastics by low-density plastics

Less emphasis on weight savings

The average weight for a North American vehicle has risen for 7 model years in a row from approximately 3,100 lbs. in the early 1990's to approximately 3,300 lbs. in 1998. However, the WPV usage of plastics has been approximately 250 lbs. for the last four years – in essence losing relative ground to other materials. Both of these statistics can be interpreted both as an underlying trend of less emphasis by the automakers on vehicle weight during the 1990s and apathy on the part of the consumer regarding vehicle weight.

The cause of this trend is suggested to be the lessening of automaker focus on fuel economy. Until the surge in light trucks and sport utility vehicles (SUVs), the North American makers have largely met the Corporate Average Fuel Economy (CAFE) regulations set in 1975. Design engineers switched their focus to cost reduction, safety and recycle issues. These design priorities set the criteria driving material choice today.

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The continued strong demand for light trucks/SUVs, the impact this demand has on automakers' ability to comply with CAFE requirements and the wake-up call consumers received in 2000 with the spike in fuel prices should alter this trend somewhat. ChemQuest forecasts that weight reduction will increase in importance to designers and engineers over the next five years. However, the importance will not be to the levels seen in the early 1980s, and will eventually be overshadowed by other priorities such as cost, marketing and recyclability. There should be a slight uptick in WPV usage of plastics as a result of this trend.

Fewer "low hanging fruit" opportunities for plastics

The less design/performance challenging components of the automobile were converted to plastic many years ago. Substitution of metals by plastics has slowed in recent model years as engineers struggled with performance, crashworthiness and cost issues. At the same time, the metals industries have made great strides in the cost/performance balance of their materials versus plastics, and have stepped up the marketing of their efforts. The best example of this effort is the retrenching seen by the steel industry to address the threat of aluminum and plastics as substitutes for steel. Through the American Iron and Steel Institute (AISI), the steel industry has shown a united front in such initiatives as the UltraLight Steel Auto Body (ULSAB) project. Such a coordinated effort will slow the inroad of plastics, especially in exterior body and chassis components.

ChemQuest forecasts that plastics will grow in areas where plastic offers benefits other than cost and weight reduction, such as fuel tanks (extra capacity and safety) and engine intake manifolds (improved engine performance). These applications are more technically challenging and will be harder won in the next five years. Noteworthy is the fact that these applications require little or no paint.

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Increasing relative cost versus metals

ChemQuest forecasts that plastics will continue to have a raw material cost disadvantage versus steel for the next five years. Furthermore, design efforts such as the ULSAB will give steel additional advantages in cost for body applications. This will lead to a widening gap in the advantage of steel in those body applications where raw material cost is a major cost component.

Cannibalization of high-density plastics by low-density plastics

While the substitution of steel by plastics has slowed, there has been much substitution among the various plastics resin types. In general, the strongest trend has been from high-density materials such as RIM to low-density materials such as TPO. This "cannibalization" is being driven by lower material cost – both $/lb. as well as less material per component. While this trend has significantly altered the WPV, it has not had significant impact on the *volume* of plastics per vehicle, and hence the surface area per vehicle (SAPV).

ChemQuest forecasts this trend to continue for the next five years with the effect of slowing the WPV growth of plastics, but having little effect SAPV.

ChemQuest forecasts that the combined effect of these trends will keep overall plastics WPV growth to <1%/yr. through 2004. However, the plastics SAPV will most likely grow at a faster rate of 1.3-1.7%/yr, driven mostly by increasing vehicle size (from both styling and product mix effects) and increasing plastics penetration into exterior panels.

To understand how these trends interact with the emergence of alternatives to painting, ChemQuest broke down the surface area of the automobile into three categories:

- **Interior trim** – instrument panel skin, bolsters, door trim panels, door handles, bezels, glove box doors, air bag covers, etc.

- **Exterior trim/fascia** – fascia, body side trim and cladding, rocker panels, pillar covers, grilles, license pockets, door handle pockets, mirror housings, etc.

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- **Exterior body vertical/horizontal panels** – door panels, quarter panels, fenders, hoods, roof panels, deck lids, etc.

Each category has a different set of performance criteria, substrate types and value chain drivers. The differences between each category are significant and result in varying probabilities of displacement for each of the alternative technologies. Each category is discussed in more detail in the sections that follow.

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Alternatives for Decorating Interior Plastics – Significant Growth of Molded-In Color

ChemQuest estimates the 1999 North American market size for interior trim at 562MM ft^2/yr. This estimate assumes car builds of 17MM units/yr. The market is estimated to be growing at 1.1%/yr, which will take it to 594MM ft^2/yr in 2004.

The graph below is a breakdown of the market by part type.

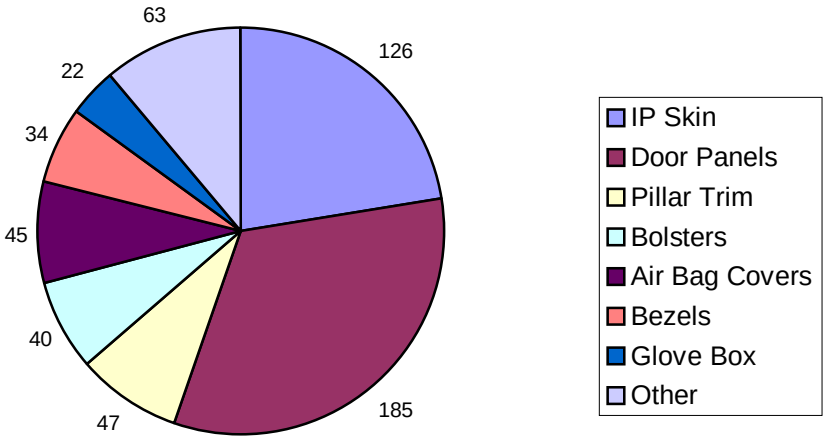

Figure 1 1999 North American Market Size for Interior Trim (MM ft^2/yr)

The market growth will come mostly from styling changes and from the trend toward a product mix of larger vehicles. Growth from displacement of metal will be negligible, as the penetration of plastics at the expense of metal is essentially complete in this category.

The primary determinant of interior coatings growth will not be the growth of plastic substrate surface area, but rather the current trends that favor use of alternative technologies such as molded-in color.

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Those trends are:

- Increased usage of TPO
- More molded-in color
- Component integration and fewer materials of construction

There is interdependency among these trends ultimately driven by the design engineers' need for lower component cost, more efficient assembly and to a lesser extent, enhanced recyclability.

Increased usage of TPO

For cost reduction, many hard trim applications are moving toward TPO as the material of choice. In addition to penetrating the hard trim components (at the expense of ABS), TPO is moving into instrument panel (IP) skins replacing vinyl, and into air bag doors/covers replacing RIM and thermoplastic polyester. TPO has a low surface energy and is therefore difficult to paint causing molders to consider alternatives to painting. In many cases TPO requires surface treatment or an adhesion promoter to prepare the surface to accept paint.

Furthermore, as TPO becomes the resin of choice across all interior trim, there will be less issues of color mismatch caused by use of dissimilar molded-in color resins – another indirect benefit for molded-in color allowing it to be pulled along with the growth of TPO.

Improving performance of resins

Performance issues, specifically fade resistance and mar resistance as well as color and gloss consistency, have hampered the use of molded-in color. However, it appears that the use of molded-in color is poised to pick up pace as resin suppliers work to overcome these through resin modifications. Concerns regarding fade resistance and chemical resistance have decreased as TPO and polypropylene have increased in usage. The prevalence of TPO has resolved many color fade and match issues by converging the materials choice to one generic material that eliminates the historical problem of interior mismatch caused by differential color fade among many materials. Gloss and "feel" are still open issues for molded-in color, and solutions could come in the form of a clear

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coating or film laminate. By the 2004 model year, molded-in color should have nearly equal market share with paint for interior trim.

Fewer components and materials of construction

Recyclability concerns are driving further consolidation of components and materials. This will accelerate the decline of coatings usage due to difficulties in separating the coating from the plastic. The trend toward fewer components and modular construction will drive fewer material choices further easing color match concerns as well as decreasing costs and improving recyclability.

The net effect of these trends will be a sharp decline of 3.3%/yr in the usage of interior coatings and a sharp increase in the use of molded-in color. As the OEMs' marketing efforts continue to drive design differentiation, there will be more use of interior appearance as a point of differentiation. This should cause a slight increase in film laminate use, both for special appearance effects (woodgrain, graphics) as well as special esthetics such as "soft-touch" grow. Below is a forecast of the market share of each technology.

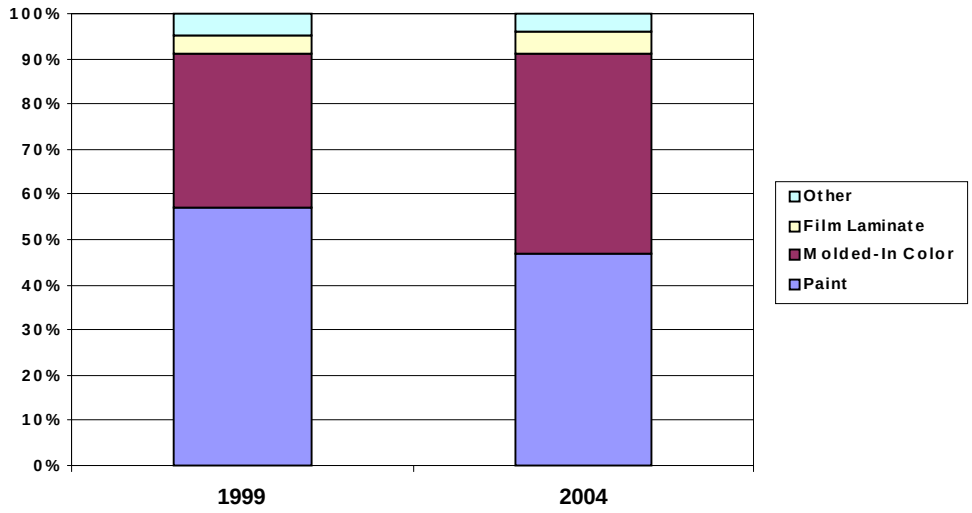

Figure 2 North American Decorating Technology Market Share Interior Trim

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Alternatives for Decorating Exterior Trim Plastics – A Mix of Technologies

ChemQuest estimates the 1999 North American market size for exterior plastic trim at 536MM ft^2/yr. This estimate assumes car builds of 17MM units/yr. The SAPV is estimated to be growing at 1.1%/yr, which will make the market 566MM ft²/yr in 2004. The graph below details the 1999 surface area by part type.

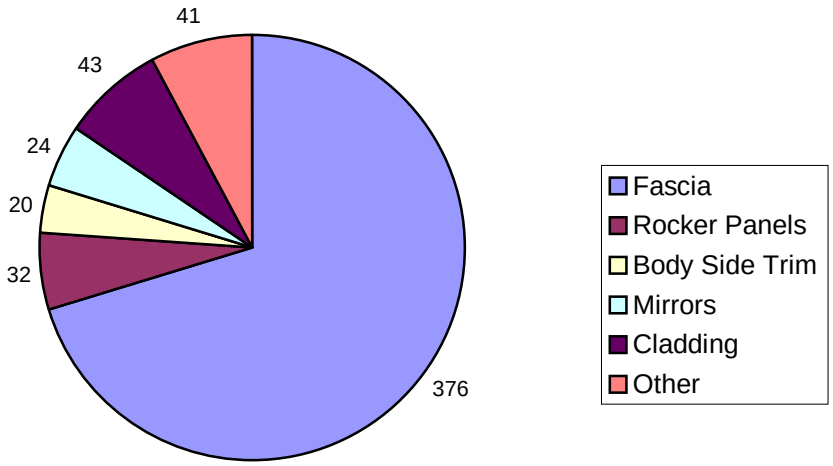

Figure 3 1999 North American Market Size for Exterior Trim (MM ft^2/yr)

Much like interior trim, the exterior trim growth will come mostly from incremental styling changes and from the trend toward a product mix of larger vehicles. Growth from displacement of metal will be negligible, as the penetration of plastics at the expense of metal is essentially complete in this category.

A shift in decorating technology is expected in this category as the result of three major trends:

Increasing Pressure to Reduce Inefficiencies in the Value Chain
The application of paint is inherently inefficient with loss due to overspray in the range of 35% to 65%. As Tier 1 and Tier 2 suppliers of exterior trim seek ways to reduce costs in line with

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OEM expectations, these inefficiencies become important areas of cost improvement. The emerging film laminate decorating technologies have the potential for suppliers to capture this value using a insert-molded colored film to decorate the plastic part. This technique results in a transfer efficiency of essentially 100%. Furthermore, film laminate can provide metallic, pearl and special effects that are not possible with molded-in color. The film laminate technology is especially well suited for exterior trim applications where match to body color is important. Film laminates will make significant inroads into paint usage in this category, especially where match to body color is important.

Continuing Need to Reduce the Effects of Decorating on the Environment

Painting processes will see continued pressure to reduce emissions over the next five years. New regulations limiting or eliminating emissions of hazardous air pollutants (HAPS) are expected to be promulgated in the next two years. Furthermore, greenhouse gases such as carbon dioxide (emitted from paint baking operations) are increasingly being targeted for reduction. While use of waterborne and high-solids paints have allowed suppliers to meet VOC regulations, the next round of HAPS and greenhouse regulations are expected to cause many suppliers to rethink their use of paint. There will be increasing interest in film laminate, molded-in color, and 100% solids UV curable paints as means of addressing this trend.

Technology Improvements in the Performance of the Alternatives

Film laminate and molded-in color have improved in exterior durability and mar resistance. The most notable progress in molded-in color is the use of ionomer resin for solid colors on several Chrysler models since 1994. Molded-in color remains limited in ability to produce acceptable metallic colors, but promising improvements in molding techniques may commercially emerge toward 2004. Film laminates are as durable as paint, and in some tests, such as chip resistance, show superior performance to paint.

The Changing Mix of Decorating Technology

The decorating technology mix is expected to moderately change over the next five years as paint is slowly replaced by dry film laminate, molded-in color and UV-cure coatings. Figure 4 shows the forecast for this category.

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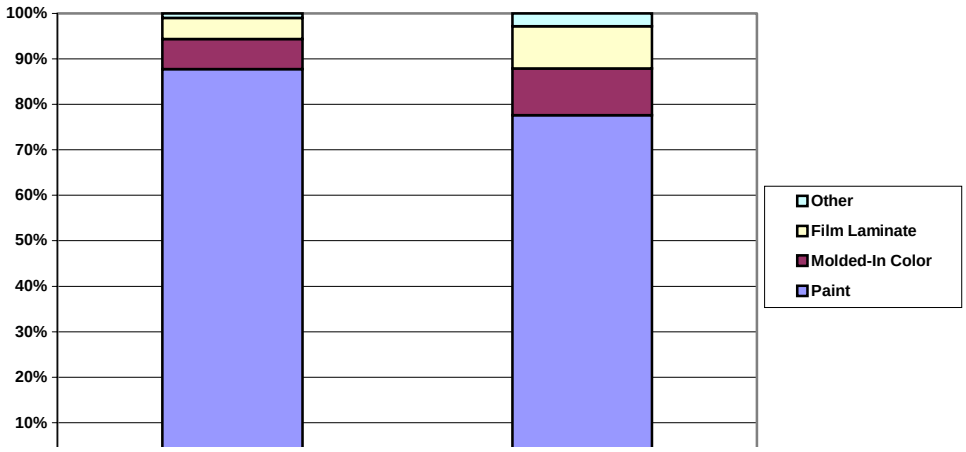

Figure 4 North American Decorating Technology Market Share Exterior Trim (MM ft^2/yr)

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Alternatives for Decorating Exterior Body Panels – A Stronghold for Paint

ChemQuest estimates the 1999 North American market size for exterior body panels at 113MM ft^2/yr. This estimate assumes car builds of 17MM units/yr. The SAPV is estimated to be growing at 4.5%/yr, which will make the market 141MM ft^2/yr in 2004. The graph in Figure 5 details the 1999 surface area by part type

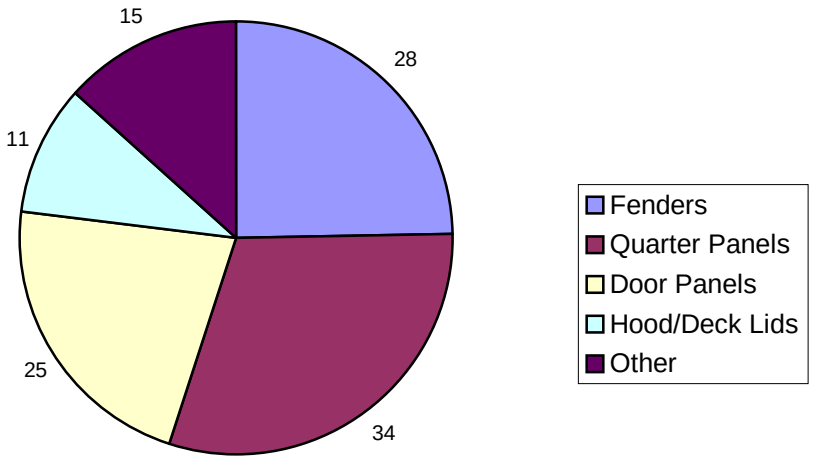

Figure 5 1999 North American Market Size for Exterior Body Panels (MM ft^2/yr)

Paint will remain the dominant technology for the following reasons:

Continued painting of body panels "in-line"

Large body panels are typically painted "in-line" at the assembly plant. As such, the use of alternative technologies is limited by the assembly line speed, incumbent capital installations and other assembly "friendly" issues such worker experience. Paint will most likely continue to be the technology of choice for metal panels for at least the next five years, and those platforms using a mix of plastic and metal panels will be inclined to continue the use of paint for plastics panels. Furthermore, many of the value chain inefficiencies and environmental disadvantages of paint are neutralized in assembly plants where scale and advanced manufacturing processes are the norm.

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Cost effectiveness of painting for large parts

Large panels have inherently less overspray per unit of surface area than small parts. Therefore, the disadvantage of painting caused by overspray is narrowed for large parts. This disadvantage varies by part configuration, with large flat parts less costly to paint than the same part decorated with molded-in color or film laminate.

The Changing Mix of Decorating Technology

The current widespread use of paint as the preferred decorating

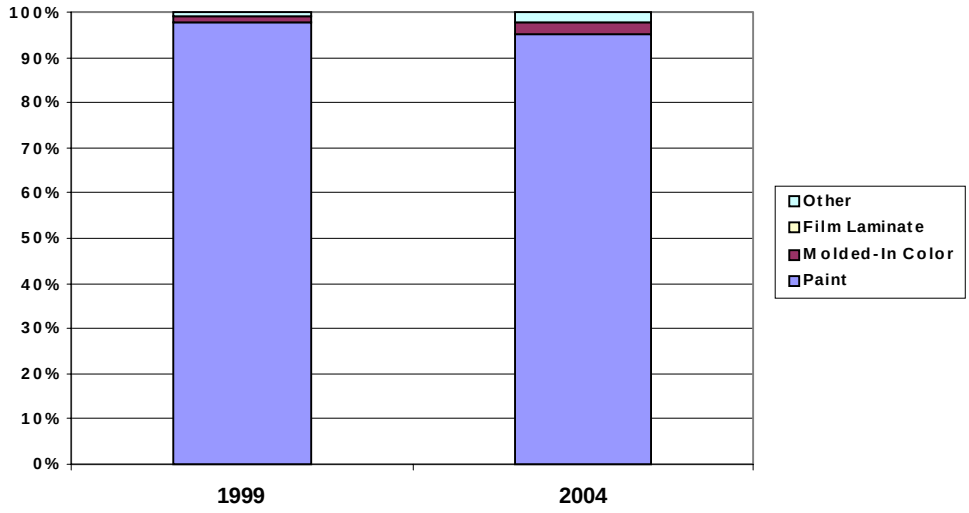

Figure 6 1999 North American Market Size for Exterior Body Panels (MM ft2/yr)

technology is not expected to change appreciably over the next five years. Figure 6 shows the forecast for this category.

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SUMMARY

Alternative decorating technologies are increasingly viable as replacements for painting plastic automotive parts. Molded-in color and film laminate hold the promise for lower costs, less environmental impact and potentially better performance for trim components. However, as the use of plastic for body panel picks up pace slightly, paint will continue to be the dominant technology for those applications and see new growth. ChemQuest forecasts that the overall plastic coatings volume growth *per vehicle* will grow at 1.4-1.8% per year through 2004. Over the next five years, the per vehicle demand for coatings for

- interior trim components will decline markedly;
- exterior trim will be flat;
- exterior body panels will grow moderately.

Any changes in vehicle demand must be added to or subtracted from this forecast to get overall market demand.

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