Moving Toward Sustainable Plastics

2006/7 Report Card of Leading Automakers

A Report by the Ecology Center

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Abstract

Plastics use in automobiles is large and growing. Today, nearly 50% of vehicle interior components are made of polymers. In many cases these plastics have chemical additives that are toxic and off-gas to contaminate the air and dust inside vehicles. Also of concern, these materials are added to the waste stream and incinerated or landfilled at the end of vehicle life, causing contamination of land and air. With vehicle sales and plastics usage both on the rise, the use of sustainable plastics that are healthy and safe for vehicle occupants, and provide reusable feed stocks at the end of their useful life is of increasing importance. In this report we have provided a comprehensive review of automaker activities relating to sustainable plastics. We have found that there is a heightened effort within the auto industry to use bio-based materials in vehicles. We have also found that some manufacturers have made significant strides in phasing out problematic plastics, such as PVC, and switching to more recyclable materials that have fewer toxic chemical additives. While there is progress in the industry, some automakers are falling far short of their competitors. And, even the leading automakers can still do more to increase the sustainability of materials in their vehicles.

2006 Automotive Plastics Report Card

The Policies and Practices of Eight Leading Automakers

THE ECOLOGY CENTER

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ECOLOGY CENTER

The Ecology Center is a Michigan-based nonprofit environmental organization that works for safe and healthy communities where people live, work and play. The Center's Clean Car Campaign works to address environmental and health impacts of the production, use and disposal of vehicles in the U.S.

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INTRODUCTION

According to the American Plastics Council, the average vehicle contains 250 pounds of plastic, which accounts for about 12% of a vehicle by weight.[1] While this figure is already large, it stands to increase in coming years as new applications for polymers emerge.[2]

Of growing concern, a significant proportion of plastics are used inside the vehicle. Today, nearly 50% of vehicle interiors are made of polymers.[3] This causes concern since many dangerous chemical additives are put into plastics. These additives off-gas or leach from the plastics, and contaminate the air and dust inside vehicles, which occupants breathe and touch.

Also of concern, vehicle sales are increasing in the U.S., with a 2% increase in sales since 2003.[4] This will eventually lead to an increased flow of plastics entering the waste stream at the end of vehicle life. Many of the plastics currently used are not easily recycled, thus they will likely end up in landfills or incinerators, where their chemical additives will contaminate land, water and air. If they happen to be recycled, they can pose health risks to workers at recycling facilities who handle the plastic scraps.

With vehicles sales and plastics usage on the rise, the use of sustainable plastics is of increasing importance. Plastics need to be designed using bio-based, recyclable materials that are healthy and safe for workers, vehicle occupants and the environment.

This report card is the second in a series of automotive plastics report cards. In it, we take a look at automakers' policies and practices regarding plastics and determine how each company measures up. The first report, titled *Moving Towards Sustainable Plastics—A Report Card on the Six Leading Automakers*, was published in February 2005.

This report unfolds in four sections:

- A description of our evaluation methods and modifications we have made since last year
- An overview of plastic chemical additives and why they are a growing concern in the automotive sector
- The plastics report card, including grades for each automaker on their goals and progress towards sustainable plastics
- Recommendations on the steps needed to transform the auto sector into an industry that uses safe and healthy materials

The report presents a vision of sustainable plastics and an opportunity for dialogue with automakers on how to transform their use of plastic materials.

REVISED METHODS

In this second edition of the Ecology Center's automotive plastics report card, we have strived to provide a comprehensive review of automaker policies and activities relating to sustainable plastics. This year we have added two automakers to our evaluation: Hyundai and Volkswagen. These automakers rank seventh and eighth in US vehicle sales. Our evaluation now includes the top eight manufacturers selling to the US market: DaimlerChrysler, Ford, General Motors, Honda, Hyundai, Nissan, Toyota, Volkswagen.

TABLE 1 **The 19 Sustainable Plastics Grading Criteria**

Overview Topics
1. Web Access
2. Resource Use Policies
3. Chemicals Policies
Goals and Objectives
4. Use of Bio-Based Materials
5. Use of Recyclable Plastics
6. Use of Recycled Plastics
7. Halogen Reduction - PVC
8. Halogen Reduction- BFRs
9. Cabin Air Quality Improvement
10. End-of-Life Vehicle Recycling
11. Plastics End-of-Life Management
Reporting Progress
12. Use of Bio-Based Materials
13. Use of Recyclable Plastics
14. Use of Recycled Plastics
15. Halogen Reduction - PVC
16. Halogen Reduction - BFRs
17. Cabin Air Quality Improvement
18. End-of-Life Vehicle Recycling
19. Plastics End-of-Life Management

Together, they account for 94% of total vehicle sales in the U.S. A break down of automakers sales is provided in Appendix A.

As with our previous report, we developed a set of criteria related to plastics policies with which to evaluate automakers. Last year we had 17 topics in our evaluation; this year we have added two additional topics—brominated flame retardants and cabin air quality—for a new total of 19. We have done this in order to emphasize the growing importance of chemical additives and their impact on vehicle occupant health and the environment. A discussion of these topics is included in the following section.

We also modified our grading criteria. We refined the criteria in order to measure progress using metrics that are similar to those automakers use when planning and designing their vehicle lines. For example, we established 10 years as a realistic time frame for the redesign of all vehicle models. And, we are now placing more emphasis on the plastics chosen for new models as they are launched, rather than the entire vehicle fleet.

For the "Chemicals Policies" topic, we are now evaluating automakers based on their commitment to reduce the use of chemicals identified on the Oslo-Paris Convention's (OSPAR's) Chemicals for Priority Action list. The OSPAR list identifies chemicals that pose risks to the marine environment due to their persistency, ability to bioaccumulate, and toxicity. OSPAR, an independent, international organization manages the list. The organization makes sure that chemicals on the list have been thoroughly researched and references peer reviewed studies that support claims of negative environmental impacts. We feel it is the most credible and expansive list of harmful chemicals available and that it represents a set of chemicals that should be avoided in all products during all phases of their life cycle.

A detailed description of our evaluation and grading methods can be found in Appendix B.

INCREASING CONCERN ABOUT CHEMICAL ADDITIVES

Vehicle interiors contain a cocktail of chemical compounds that off-gas and leach from trim panels, carpeting, seating, electronics and other parts into the air and dust that passengers breathe. Since our 2005 report, we have witnessed increasing public concern about these chemicals and their potential to cause human health effects.

While many chemicals used in cars pose risks, halogenated organic chemicals—such as polyvinyl chloride (PVC) and brominated flame retardants (BFRs)—cause some of the greatest concern. Many of them are toxic, persist in the environment, bioaccumulate, and have been associated with serious health effects throughout their life cycle. When used in vehicles, they pose risks to workers who manufacture vehicle components, as well as people sitting inside their cars.

Halogenated organics can also be extremely hazardous at the end of vehicle life. The majority of plastics in vehicles end up as auto shredder residue (ASR), which is often incinerated or used as a feedstock in blast furnaces for the production of steel. When burned in this way, plastics that contain halogenated organics can create dangerous chemicals, such as dioxin—a likely carcinogen as well as a reproductive and developmental toxicant.[5]

Because of the dangers associated with halogenated substances during all stages of their life cycle, our evaluation now includes three topics specifically relating to halogens: "Reduction of BFRs", "Reduction of PVC" and "Improvement in Cabin Air Quality." While we believe that the entire set of halogenated organic chemicals should be avoided in automotive applications, these three topics represent first steps that automakers can take to phase them out of their products.

Brominated Flame Retardants

BFRs, most notably poly-brominated diphenyl ethers (PBDEs), are a group of halogenated organic chemicals that pose risk to vehicle occupants and the environment. PBDEs are added in large amounts to many interior vehicle components, including seating, trim panels and wiring, in order to impart fire resistance. They persist in the environment and levels of these chemicals in the food chain and in human bodies are rising rapidly. Studies have found that PBDEs may cause liver, thyroid and developmental toxicity, among other health problems.[6]

In a recent report, the Ecology Center found that vehicle interiors are a significant source of PBDE exposure for many Americans. The study found that levels of PBDEs in vehicle dust are more than five times higher than levels detected in homes and offices. More troubling, the study findings suggest that UV rays and heat may cause deca-BDE—the predominant PBDE used in autos today—to breakdown inside cars into more problematic and more toxic compounds, such as penta-BDE and octa-BDE, which have been banned by government health agencies and the auto industry due to their toxicity.

Non-halogenated alternatives to deca-BDE exist, as well as alternative materials that are inherently more resistant to flames than conventional petroleum-based polymers. Some companies have begun to phase-in these alternatives in their products, including Dell, Apple, IBM, Hewlett-Packard, Ikea, Samsung Electronics, Sony and others.[7]

Because of the risks associated with deca-BDE exposure, the high concentrations of deca-BDE found in vehicles, and because industries have begun to demonstrate the feasibility of replacing it with alternatives, we find it reasonable to expect the auto industry to restrict their use of these chemicals as well. For these reasons, we have added BFRs, with particular focus on deca-BDE, as a topic in our evaluation. The detailed grading criteria for this topic can be found in Appendix B.

Polyvinyl Chloride and Interior Cabin Air Quality

Another halogenated substance, PVC, is also of concern in automobile interiors. PVC is a plastic commonly used in many vehicle components, including seats, arm rests, dashboards, trim panels, wiring and sealing. It contains large amounts of the halogenated vinyl chloride monomer, which is a likely carcinogen, and creates dioxin when heated during production or burned in disposal.[8,9]

In addition to vinyl chloride, PVC also contains plasticizers called phthalates. These chemicals off-gas from PVC and are deposited on dust particles and windshields, where they cause fogging. When inhaled or ingested by vehicle passengers, phthalates can lead to a number of health problems, including damage to the liver and testes, reproductive effects, and possibly cancer.[10]

As with last year's evaluation, in this report we take a look at automaker's progress in phasing-out PVC. In addition, we have also added "Improvement in Cabin Air Quality", which evaluates automakers progress in lowering the overall levels of phthalates, halogenated organics, and other volatile organic compounds (VOCs) in the air inside vehicle passenger compartments. The detailed grading criteria associated with these topics can be found in Appendix B.

Related Ecology Center Reports

More information about PBDEs and phthalates can be found in our report *Toxic at Any Speed*, available at: *www.ecocenter.org/toxicatanyspeed.shtml*

A complete description of the impacts of PVC can be found in our previous plastics report card, available at: *www.ecocenter.org/sustainable plastics*

We evaluated each automaker based on the 19 topics noted above and then calculated an overall grade point average (GPA). Below is a summary of the GPAs and grades for each company.

TABLE 2 **Automaker's Overall Grades and GPAs**

Company	Grade (GPA)
Toyota	C+ (2.4)
Ford	C (1.9)
Honda	C (1.8)
DaimlerChrysler	D+ (1.4)
General Motors	D (0.9)
Hyundai	D (0.9)
Nissan	D (0.9)
Volkswagen	D- (0.7)

The tables on the following pages provide details of each automaker's individual grades.

Discussion of Findings

The most significant progress in the past year was made in three areas: biobased materials, interior air quality and PVC reduction. The efforts in these three topic areas have differentiated the leaders from the laggards. Below we provide a detailed description of our findings for these topics.

Since last year, there has been limited progress in the other topic areas, thus we do not explain our findings for those topics in detail below. We also found that there was limited activity regarding our new topic "Brominated Flame Retardents" and thus do not provide additional details regarding that topic either.

TABLE 3 **Automaker's Grades for Web Access and Resource Use**

Topic	DaimlerChrysler		Ford		GM		Honda	
Web Access — Can Easily Locate Information on the Topics Below	C	Provided Environmental Report and Sustainability Report, as well as information on website.	B-	Provided a printed Sustainabilty Report as well as an html version with significant additional information. Additional relevant information also included in environmental section of website.	A-	Provided a print version and html version of Corporate Social Responsibility Report. Information could be viewed by topic or by region. Opel's Environmental Report also found on GM website.	B-	Provided a North American Environmental Report as well as a corporate/worldwide Environmental Report.
Inputs - Resource Use								
Resource Use Policy	C-	Clear commitment to sustainable materials at the global level. No global or NA commitment to EU or Japanese type recycling legislation.	B	Clear commitment to sustainable materials at the global level. Global commitment to EU / Japanese type recycling legislation.	D	General commitment to sustainable materials. No global or NA commitment to EU or Japanese type recycling legislation.	B	Commitment to using sustainable materials at the global level. Commitment to EU / Japanese type recycling legislation in NA.
Use of Bio-Based Materials Goals and Objectives	B-	General goal to further increase the proportion of natural fibers from renewable resources. Measurable goals for some vehicle lines (A, B & S-class).	B-	Goal to increase the use of biomaterials, such as PLA, soy-based products, hemp fibers. Commitment also indicated by research activities.	F	No goals or commitments relating to bio-based materials.	D	General commitment to use biomaterials is indicated by R&D activities.
Use of Bio-Based Materials Status	B	Provided quantitative progress related to goals for A and S-Class.	B-	Provided quantitative information on progress. Significant research also ongoing.	D-	Research is ongoing within the company.	C	Provided qualitative information on progress. Using a bio-based fabric in fuel cell vehicles in next three years. Research and development also ongoing.
Use of Recyclable Plastics Goal and Objectives	D	Commitment to use recyclable plastics.	C-	Goal to choose more recyclable materials (not specific to plastics). Commitment to recyclable plastics is indicated by R&D activities (Model U).	D	Commitment to use "easy to recycle materials" (not specific to plastics).	D	Goal to increase recyclability of vehicle (not specific to plastics).
Use of Recyclable Plastics Status	C-	Provided qualitative progress in replacing PVC with more recyclable plastics (not listed in public documents). Did not include list of preferred plastics.	C-	Provided quantitative progress in introducing recyclable materials in 2007 vehicles. Did not include list of preferred plastics.	D	Provided list of recyclable parts in Vectra. Did not include list of preferred plastics.	C	Provided qualitative progress in replacing PVC with more recyclable materials.
Use of Recycled Plastics Goal and Objectives	C-	Commitment to use recycled over virgin materials in the plastics sector, but no commitment to increase use. Commitment to increase the proportion of of recycled resins that comes from vehicle-related waste flows.	C-	Goal to continuously increase the amount of recycled material used in each vehicle line (not specific to plastics).	D-	Commitment to "choose recycled over virgin material whenever possible" (not specific to plastics).	D	Commitment to increase the use of recycled materials (not specific to plastics).
Use of Recycled Plastics Status	C	Provided qualitative and quantitative examples of where they have switched to recycled plastics, eg. recycled materials are approved for 13% of the plastics they use.	B	Provided qualitative and quantitative progress in using recycled resins in several models/ parts. Overall, 5% improvement in # of parts with recycled content between 2004 and 2005.	C	Provided qualitative and some quantitative information on use of recycled resins.	C	Provided qualitative information on recycled resin usage in Legend and in certain parts.

Letter grades were assigned based on the criteria listed in Table 10 in Appendix B. Grades were then converted into the following numberical equivalents in order to calculate GPA:

0 = F 0.5 = D- 1 = D 1.5 = C- 2 = C 2.5 = B- 3 = B 3.5 = A- 4 = A

TABLE 3 **Automaker's Grades for Web Access and Resource Use**

Topic	Hyundai		Nissan		Toyota		Volkswagen	
Web Access— Can Easily Locate Information on the Topics Below	C-	Provided Hyundai and Kia Sustainabilty Reports. Also included some information on website, but less than in report.	C-	Provided Environmental and Sustainability Reports. Also included some information on website, but less than in report.	A-	Provided a North American report on its NA website. Provided a coporate environmental report on its corporate website, as well as links to several regional reports and an environmental section with relevant information.	C-	Provided pdf version of Sustainability Report on its corporate (German) website. Also provided limited additional information sheets on website.
Inputs - Resource Use								
Resource Use Policy	D	General commitment to sustainable materials. No global or NA commitment to EU or Japanese type recycling legislation.	D	General commitment to sustainable materials. No global or NA commitment to EU or Japanese type recycling legislation.	B	Clear commitment to using sustainable materials at the global level. Specific commitment to EU / Japanese type recycling legislation in North America.	D	General commitment to sustainable materials. No global or NA commitment to EU or Japanese type recycling legislation.
Use of Bio-Based Materials Goals and Objectives	F	No goals or commitments relating to bio-based materials.	F	No goals or commitments relating to bio-based materials.	B	Measurable goals for the use of bio-based materials (15% renewable or recycled resin by 2010, 20M tons eco-plastic by 2020). Did not set any interim objectives.	D	General commitment to use bio-based materials is indicated by its progress in using them, but no goals set.
Use of Bio-Based Materials Status	F	No activities or progress relating to bio-based materials.	F	No activities or progress relating to bio-based materials.	B-	Provided qualitative information on use of bio-based materials, not related to stated goal. Also provided information on R&D activities.	C	Provided qualitative examples of where company is using biomaterials.
Use of Recyclable Plastics Goal and Objectives	D	General commitment to increase recyclability (not specific to plastics).	D	General commitment to increase recyclability (not specific to plastics).	C-	General commitment to use recyclable materials (not specific to plastics). Commitment to recyclable plastics is indicated by its R&D activities (TSOP).	F	No goals or commitments relating to recyclable materials.
Use of Recyclable Plastics Status	C	Provided quantitative and qualitative progress in switching to more recyclable plastics. Provided list of preferred plastics.	C	Provided quantitative progress in reducing usage of thermosetting parts. Provided list of reyclable parts in certain vehicles.	C	Provided qualitative and quantitative progress in using TSOP in several parts. Provided list of preferred plastics.	D	Provided limited information on recyclability of certain parts.
Use of Recycled Plastics Goal and Objectives	D	General commitment to increase the use of recycled materials (not specific to plastics).	D	Commitment to increase the use of recycled materials (not specific to plastics).	B	Measurable goal for the use of recycled materials (15% renewable or recycled resin by 2010).	D-	Commitment to use recycled plastics.
Use of Recycled Plastics Status	C	Provided qualitative information on where they have switched to recycled materials.	C-	Provided quantitative information on recycled plastics in Modus.	C	Provided information on the development and use of its own recycled materials made from ASR.	D	Provided information on the process for selecting materials with recycled content.

Letter grades were assigned based on the criteria listed in Table 10 in Appendix B. Grades were then converted into the following numberical equivalents in order to calculate GPA:

0 = F   0.5 = D-   1 = D   1.5 = C-   2 = C   2.5 = B-   3 = B   3.5 = A-   4 = A

TABLE 4 Automaker's Grades for Substances of Concern

Topic	DaimlerChrysler		Ford		GM		Honda	
Inputs - Substances of Concern								
Substances of Concern Policies	C	Commitment to supporting a "pre-cautionary approach to environmental challenges". No commitment to reduce OSPAR chemicals beyond the EU ELV targeted substances.	B	Commitment to reduce substances of concern is indicated by R&D research. Clear commitment to reduce some OSPAR chemicals beyond the EU ELV targeted substances.	C	Commitment to "reducing the use of substances of concern in vehicles". No commitment to reduce OSPAR chemicals beyond the EU ELV targeted substances.	B	Clear goal to eliminate EU ELV targeted substances globally and ahead of regulation schedule. Clear commitment to reduce OSPAR chemicals beyond the EU ELV targeted substances.
Halogen Reduction - PVC Goals and Objectives	D-	Commitment in 2001 Environmental Report to minimize use of PVC. Those activities were completed, and no further targets were defined (not from public documents).	D	No commitment specific to PVC, but commitment to certify vehicles to TUV standard, which limits PVC.	F	No goals or commitments relating to PVC.	B-	Goal to "expand PVC-free technologies for remaining applications wherever feasible" in NA and globally.
Halogen Reduction - PVC Status	C	Provided qualitative information on substitution of PVC with more recyclable materials in certain components (not in public documents).	D	Provided information on vehicles certified to TUV standard, which limits PVC.	F	No activities or progress relating to PVC.	A-	Provided qualitative and quantitive information on how the company has eliminated PVC.
Halogen Reduction - BFRs Goals and Objectives	F	No goal to reduce deca-BDE. The substitution of flame retardants containing halogen compounds is an issue within the research depts (not in public documents).	D	Commitment to assess brominated substances and study opportunities to eliminate, including deca-BDE (not in public documents).	F	No goal to reduce BFRs or deca-BDE.	C	General commitment to assess all brominated substances and study opportunities to eliminate (stated in report).
Halogen Reduction - BFRs Status	C	Provided qualitative information on use of BFRs. Does not use BFRs in seat cushions, seat covers, roof linings, IP or side trim panels (not in public documents).	B-	Ford has eliminated deca-BDE from materials that occupants come in contact with (not in public documents).	D-	Research is ongoing within the company.	F	Qualitative information on phasing out penta and octa, but no information on deca-BDE.
Cabin Air Quality Improvement Goals and Objectives	F	DCX has internal regulations for the emission of volatile and condensable substances from vehicle interior materials. Limit values are undisclosed.	B-	Commitment to certify "as many as possible existing and future models" to TUV standard. Volvo is also certifying textiles and leathers to Oeko-Tex standard.	F	No goals or commitments relating to cabin air quality.	C	Commitment to meet JAMA agreement ahead of schedule, unclear whether they are meeting the standard in NA.
Cabin Air Quality Improvement Status	F	No public certification met.	B	Provided information on vehicles that are certified to TUV and Oeko-Tex standards.	D-	Research is ongoing within the company.	F	No activities or progress relating to cabin air quality.

Letter grades were assigned based on the criteria listed in Table 10 in Appendix B. Grades were then converted into the following numberical equivalents in order to calculate GPA:
0 = F   0.5 = D-   1 = D   1.5 = C-   2 = C   2.5 = B-   3 = B   3.5 = A-   4 = A

TABLE 4 **Automaker's Grades for Substances of Concern**

Topic	Hyundai		Nissan		Toyota		Volkswagen	
Inputs - Substances of Concern								
Substances of Concern Policies	B-	Commited to using "eco-friendly materials". Some commitment to reduce OSPAR chemicals beyond the EU ELV targeted substances.	C	Commitment to reduce "environmental impacting substances". Limited commitment to reduce OSPAR chemicals beyond the EU ELV targeted substances.	B	Goal to expand "activities to reduce substances of concern." Clear commitment to reduce OSPAR chemicals beyond the EU ELV targeted substances.	D	General commitment to "avoiding the use of pollutants". No clear commitment to EU ELV targeted substances or any other OSPAR chemicals.
Halogen Reduction - PVC Goals and Objectives	C	Goal to "severely limit or replace PVC".	F	No goals or commitments relating to PVC.	C	Goal to reduce "PVC resin usage".	F	No goals or commitments relating to PVC.
Halogen Reduction - PVC Status	C	Provided qualitative information on substitution of PVC with more recyclable materials in certain components.	F	No activities or progress relating to PVC.	C	Provided qualitative information on substitution of PVC with more recyclable materials in certain components.	F	No activities or progress relating to PVC.
Halogen Reduction - BFRs Goals and Objectives	F	No goals or commitments relating to BFRs or deca-BDE.	F	No goals or commitments relating to BFRs or deca-BDE.	D-	No goal to reduce deca-BDE. General commitment to consider switching to alternative materials in the future.	F	No goals or commitments relating to BFRs or deca-BDE.
Halogen Reduction - BFRs Status	F	No activities or progress relating to BFRs or deca-BDE.	F	No activities or progress relating to BFRs or deca-BDE.	D	Toyota does not use BFRs except deca BDE.	F	No activities or progress relating to BFRs or deca-BDE.
Cabin Air Quality Improvement Goals and Objectives	D	Commitment to improve cabin air quality is indicated by research activities.	D	Commitment to uphold the JAMA agreement.	B-	Goal to reduce cabin VOC levels in all new vehicles globally by 2010. Target levels are undisclosed.	F	No goals or commitments relating to cabin air quality.
Cabin Air Quality Improvement Status	F	No activities or progress relating to cabin air quality	C	Provided qualitative and quantitative information on cabin VOC levels.	C	Provided list of vehicles for which interior VOCs have been reviewed and reduced, but did not provide any numerical data.	F	No activities or progress relating to cabin air quality.

Letter grades were assigned based on the criteria listed in Table 10 in Appendix B. Grades were then converted into the following numberical equivalents in order to calculate GPA:

0 = F   0.5 = D-   1 = D   1.5 = C-   2 = C   2.5 = B-   3 = B   3.5 = A-   4 = A

TABLE 5 **Automaker's Grades for Materials Management at End-of-Life**

Topic		DaimlerChrysler		Ford		GM		Honda
Outputs—Materials Management at End-of-Life								
ELV Recycling Goals and Objectives	F	No commitment beyond meeting regulations.	C	Goal to attain 85% recyclability rate of all vehicles globally.	C-	No goal set, but will likely meet EU/ Japanese recycling and recovery targets globally.	C	Goal to attain a 90% recyclability rate in NA.
ELV Recycling Status	B-	Provided qualitative and some quantitative information on how they are meeting ELV regulations and current recoverability rates worldwide.	C	Provided some qualitative information on current recoverability rates.	D	Provided list of activities relating to ELV management. Company expects to meet ELV regulations.	B	Provided quantitative information on progress toward achieving ELV recovery goals.
Plastics End-of-Life Management Goals and Objectives	D	Commitment to increase the recovery of plastics, so as to use recycled vehicle-waste in new vehicles. Commitment also indicated by participation in vehicle recycling partnership with Ford and GM.	D-	Commitment to mark polymeric parts (to facilitate recycling), and report to IMDS, but no plastic recycling goals. Commitment to plastics recycling is also indicated by participation in vehicle recycling partnership with DCX and GM.	D-	Commitment to increase plastics recycling is indicated by participation in vehicle recycling partnership with Ford and DCX.	F	No goal or commitment relating to plastics recovery in NA.
Plastics End-of-Life Management Status	D	Provided examples of plastic parts that are being recycled (bumper coverings, battery cases, and wheel arch linings.)	F	No activities or progress relating to plastics recovery.	D	Provided list of activities relating to plastics recovery (dismantling manuals, parts labeling and thermal recovery).	C	Provided qualitative information relating to plastics recovery (recycling bumpers). Exceeding the Japanese ASR recycling law in Japan.
Overall Grade	D+		C		D		C	

Letter grades were assigned based on the criteria listed in Table 10 in Appendix B. Grades were then converted into the following numberical equivalents in order to calculate GPA:
0 = F 0.5 = D- 1 = D 1.5 = C- 2 = C 2.5 = B- 3 = B 3.5 = A- 4 = A

Bio-Based Materials

Bio-based materials are increasingly being used in a range of product lines. They can lead to reduced petroleum use, reduced life-cycle carbon emissions, and in some cases reduced weight and increased recyclability of polymers. The auto industry has made a number of breakthroughs regarding these materials.

Toyota has pioneered development of an "Eco Plastic" made from sugar cane or corn that is used in the spare tire cover and floor mats of the Raum.[11] The company has built a pilot plant to manufacture the eco plastic in Japan, which so far is producing 1,000 tons of the material per year.[12] Toyota has set a measurable goal of increasing its use of the material to 20M tons by 2020 and has also set a goal of having 15% of its resin parts made from renewable or recycled materials by 2010.[13,14] At the same time, the company has also been increasing its use of natural fibers. For example, it has begun using kenaf fibers as reinforcement in certain plastic interior components instead of glass.[15]

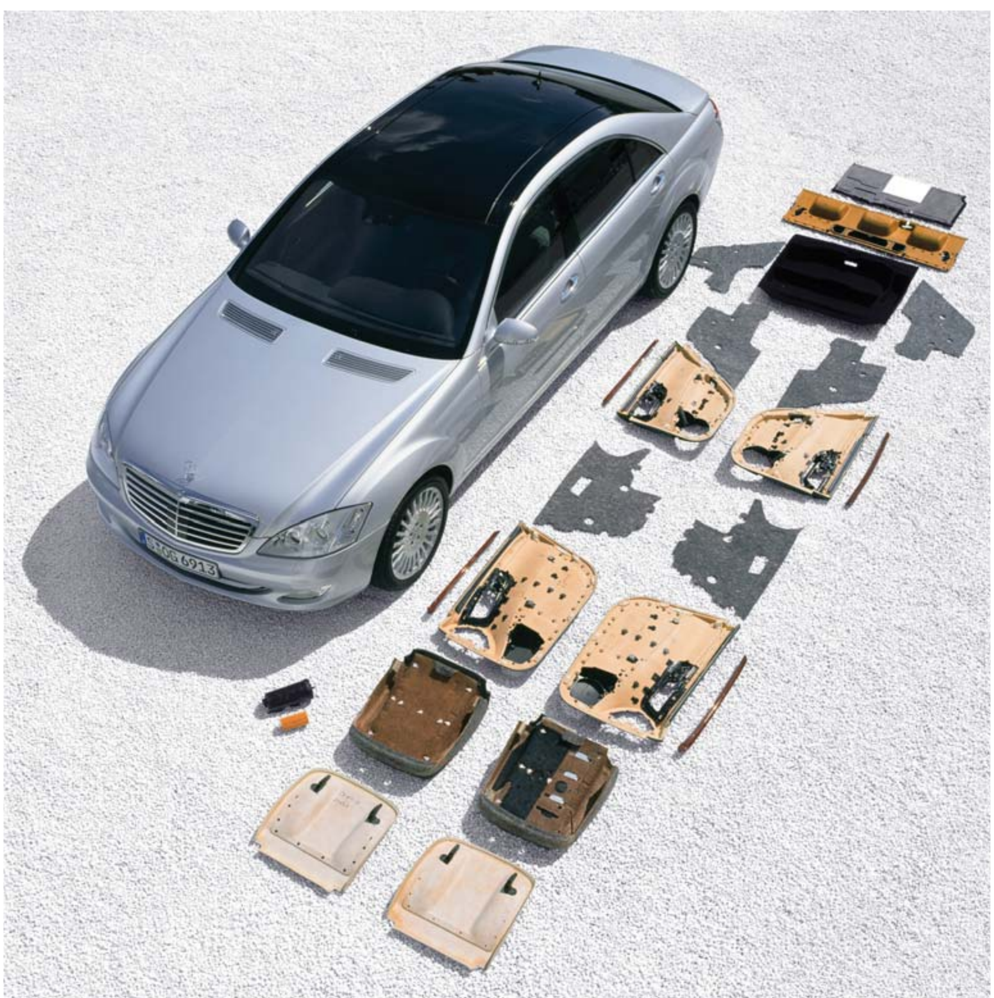
DaimlerChrysler has been another leader in bio-based fibers, pioneering the use of flax, coconut and abaca fibers. The company has been piloting these materials in their Mercedes vehicles, with the potential to roll out the technologies to other brands in the future.[16] DaimlerChrysler has set specific measurable goals for the use of natural fibers, and has achieved these goals. There are currently 26 components, with a total weight of 23kgs, made from natural materials in the A-Class.[17] This is a 98% increase in the use of bio-materials over the previous model. In the S-Class there are 27 components, totaling 43kgs, made from natural materials, which represents a 73% increase over the previous model.[18]

Ford has been a leader in a number of bio-material research activities. The company recently announced a breakthrough in development of soy-based foam for seating.[19] The new formulation replaces 40% of the standard petroleum-based polyol with a soy-derived alternative. Ford researchers are also making breakthroughs in the development of polylactic acid polymers, as well as pursuing natural fibers reinforced composites.[20] Ford first publicized its use of such materials in its Model U concept vehicle that debuted in 2003. Since then, research and development have been on-going,

TABLE 5 **Automaker's Grades for Materials Management at End-of-Life**

Topic	Hyundai		Nissan		Toyota		Volkswagon	
Outputs - Materials Management at End-of-Life								
ELV Recycling Goals and Objectives	F	No commitment beyond meeting regulations.	F	No commitment beyond meeting regulations.	B-	Goal to attain a 95% recovery rate in NA by 2015. Goal to meet EU and Japanese recovery targets ahead of schedule, and set interim objectives for this goal.	D	Goal to "recycle" 95% of every ELV.
ELV Recycling Status	D	Provided list of activities relating to ELV management.	C	Provided qualitative information on progress toward achieving ELV recovery goals.	A	Provided qualitative and quantitative information on progress toward achieving ELV recovery goals.	D	Provided list of activities relating to ELV management.
Plastics End-of-Life Management Goals and Objectives	F	No goal or commitment relating to plastics recovery in NA.	D-	Commitment to improve ASR recycling.	B	Goal to improve ASR recycling and recovery and to meet Japanese ASR recovery law ahead of schedule (70% recovery by 2015 is regulated), Goal is not global.	D-	Commitment to improve ASR recycling technology.
Plastics End-of-Life Management Status	D	Provided list of activities relating to plastic recovery (developing waste recycling technologies, marking materials).	C	Provided quantitative and qualitative examples of how they are reducing plastic waste (marking materials). Exceeding the Japanese ASR recycling law in Japan.	B	Provided qualitative and quantitative information on reduction of plastics waste (using material for RSPP, bumpers, ASR recycling facilities).	D	Provided list of activities relating to plastics recovery (labeling parts).
Overall Grade	D		D		C+		D-	

Letter grades were assigned based on the criteria listed in Table 10 in Appendix B. Grades were then converted into the following numberical equivalents in order to calculate GPA:
0 = F 0.5 = D- 1 = D 1.5 = C- 2 = C 2.5 = B- 3 = B 3.5 = A- 4 = A



Bio-based materials used in the S-Class
(Source: DaimlerChrysler)

and some of these materials have begun to enter or are close to entering the production stage. For example, the Ford Mondeo uses door inserts that are reinforced with kenaf fibers.[21] Volvo has begun piloting floor trays, pillar panels and central consoles made from flax.[22] And, the company announced that a bio-based seat fabric will be used in certain 2007 model year vehicles.[23]

Because of the many benefits that bio-based materials offer, we are encouraged by the increased use within the auto industry. Even though many of the bio-based materials being used today are being mixed with petroleum-based polymers, such as the reinforcement fibers in Mercedes vehicles, we are still encouraged by their use. Piloting these materials now can help lead to more sustainable uses in the future. We also believe that as these materials are increasingly used in auto applications, all feedstocks should be cultivated, harvested and processed in a sustainable way.

TABLE 6 **Grades for Increasing Use of Bio-Based Materials**

Company	Grade (GPA)
Toyota	B (2.8)
DaimlerChrysler	B (2.8)
Ford	B- (2.5)
Volkswagen	C- (1.5)
Honda	C- (1.5)
General Motors	F (0.3)
Hyundai	F (0.0)
Nissan	F (0.0)

Interior Cabin Air Quality

Vehicle cabin air contains dust and particles that are off-gassed from plastic components. These particles contribute to what is known as the “new car smell.” When inhaled, they can cause strong allergic reactions in chemically sensitive passengers, as well as long-term health effects in all passengers.

In our evaluation, we found that some companies are emerging as leaders in improving the cabin air quality of their vehicles. Ford is a clear leader in this area. It is the only automaker that has certified vehicles using an independent, third party certification process—TÜV Rheinland Group’s “Allergy-Free” standard. This standard was developed to limit the concentration of organic substances such as formaldehyde, phthalates and all

Ford has certified the Focus C-MAX to the TUV standard

(Source: Ford Motor Company)

halogenated hydrocarbons in the interior of automobiles. It limits phthalate levels to 30 micrograms per cubic meter, and halogenated hydrocarbons to 10 micrograms per cubic meter.[24] So far Ford has certified four vehicles to the TÜV standard, including the European Ford Focus, Focus C-MAX, S-MAX and Galaxy.[25] The company has committed to certifying as many future vehicles to the standard as possible, indicating that Ford has realized the increasing importance of reducing occupant exposure to chemicals and is taking steps to position itself as a leader in this area.

TABLE 7 **Grades for Cabin Air Quality**

Company	Grade (GPA)
Ford	B (2.8)
Toyota	C+ (2.3)
Nissan	C- (1.5)
Honda	D (1.0)
Hyundai	D- (0.5)
General Motors	D- (0.5)
DaimlerChrysler	F (0.0)
Volkswagen	F (0.0)

While not certifying to the TÜV standard, Toyota has also made a commitment to improve cabin air quality. It has set a goal to reduce in-cabin VOC levels in all vehicles globally by 2010.[26] However, Toyota did not disclose the target VOC levels that it will be aiming to achieve.

Honda and Nissan are also taking steps to improve cabin air quality. These Japanese companies are reducing in-cabin VOCs in order to comply with the voluntary Japanese Auto Manufacturers Association (JAMA) agreement.[27,28] The agreement will take effect in model year 2007 for all automobiles manufactured and sold in Japan.[29] The standard targets VOCs, including some of the same chemicals as the TÜV standard. However, the TÜV standard includes a broader list of chemicals than the JAMA standard, and requires much lower limits.

During our evaluation, we found that some auto makers have developed their own internal methods for measuring and regulating air quality inside vehicles (e.g. GM and Hyundai). However, none disclosed their methods to us, and it is therefore impossible to evaluate their practices. For this reason, we find certification to any publicly available standard, like the JAMA standard, to be a step in the right direction. We find Ford's certification of vehicles to the TÜV standard even more encouraging. Because the standard limits phthalates and halogenated hydrocarbons to such low levels, it is likely that Ford eliminated nearly all PVC from these vehicles. Thus, Ford's certification provides evidence that automakers can refrain from using problematic chemicals and materials like PVC when designing and building vehicles.

Polyvinyl Chloride

While overall progress in phasing out PVC in the auto industry has been slow, we have found some positive examples of where companies are moving to more recyclable, less toxic alternatives. Honda is the leader in this area. In its North American Environmental Report, Honda makes a specific commitment "to apply PVC-free applications across its entire North American product line wherever feasible."[30] While other companies have made similar commitments, Honda seems to be the only company taking significant steps to follow through with its promise.

Honda has acknowledged that auto shredder residue creates dioxin when burned in incinerators, and thus has developed a strategy to reduce overall chlorine content of all vehicles.[31] Its 2006 Environmental Annual Report notes that the company reduced the chlorine content to 1% or lower in ASR for all new models released in 2005 (excluding sub-compact cars).[32]

Hyundai, Toyota and DaimlerChrysler have indicated some progress in reducing their PVC usage as well.[34,35,36] For the most part, they have only provided examples of particular parts that have been replaced with PVC-free alternatives in certain vehicles. They have not provided

TABLE 8 **Grades for PVC Reduction**

Company	Grade (GPA)
Honda	B (3.0)
Hyundai	C (2.0)
Toyota	C (2.0)
DaimlerChrysler	D+ (1.3)
Ford	D (1.0)
General Motors	F (0.0)
Nissan	F (0.0)
Volkswagen	F (0.0)

PVC-Free Components

Honda has developed and implemented PVC-free materials for interior and exterior parts, including:[33]

- Trim
- Sealants and adhesives
- Sash tape
- Sunroof rain hose
- Washer tube
- Window molding
- Weather strip
- Door molding
- Roof molding
- Floor mat
- Seat covering
- Change lever boot

Honda plans to remove PVC from other components as well over the next couple of years.

quantitative measures of progress, and thus is it unclear how successful they have been overall.

Ford has not made any recent claims to reduce PVC usage. However, it is likely that Ford has nearly or completely eliminated PVC from the vehicles that are TÜV certified. The commitment to certify more vehicles suggests that they will continue to reduce PVC in additional vehicles lines. It is clear from this example, and the example that Honda has set, that it is feasible for auto companies to design vehicles that are virtually PVC-free.

Report Card Conclusions

Together, the industry has set some significant goals, which start to paint a picture of a sustainable plastics future for autos. The best goals include:

- Use renewable or recyclable materials in 15% of all resins parts by 2010 (Toyota)
- Use 20M tons of "ecoplastic" by 2020 (Toyota)
- Continually increase the amount of recycled material used in each vehicle line (Ford)[37]
- Certify as many vehicles as possible to the TÜV standard for interior air quality (Ford)
- Expand PVC-free technologies for remaining applications wherever feasible (Honda)
- Achieve a 95% vehicle recovery rate in North America by 2015 (Toyota)[38]
- Reduce cabin VOC levels in all new vehicles globally by 2010 (Toyota)

Significant activities have also been taking place that are in line with these goals. They include:

- Honda and Ford are both using a new biofabric made from corn in upcoming vehicles[39]
- Honda reduced the chlorine content of ASR to 1% or lower in all new models in 2005
- Ford increased the number of parts made of recycled content by 5% between 2004 and 2005[40]
- Ford certified four vehicles to the stringent TÜV standard
- DaimlerChrysler and Ford are increasing their use of natural fibers
- Toyota developed a material from recycled ASR that is used for sound-proofing in many vehicles[41]
- Nissan is reaching the JAMA VOC standard ahead of schedule[42]

While there is certainly evidence of substantial progress in the industry, some automakers are moving ahead while other are falling behind. For example, just three companies—Toyota, Ford and Honda—are responsible for almost all of the goals and activities listed. Meanwhile, General Motors and Nissan received lower grades in this report than they did in our previous report.

RECOMMENDATIONS

Automakers have shown that they have the ability to design vehicles using more preferable plastics. But for these industry leaders, there is still plenty of room for improvement.

The following are a set of recommendations that automakers must adopt in order to make further progress toward safer, cleaner plastics.

1. **Accelerate the elimination of halogens from auto plastics:** Auto companies continue to use halogenated substances that cause health risks to workers and vehicle occupants. Some automakers have already demonstrated the feasibility of reducing these substances in their vehicles. It is now time for all auto companies to accelerate their efforts and commit to phasing-out their use of all halogenated substances, including PVC and BFRs.
2. **Certify vehicles to an interior air quality standard:** In order for consumers to be certain that cars are healthy for passengers, auto companies must certify vehicles to a publicly available, interior air quality standard. The standard should be at least as strict as the TÜV standard and the standard's limit values and testing procedure must be available to the public.
3. **Increase the use of bio-based materials in vehicles:** Given the potential environmental benefits associated with using sustainably-sourced bio-based materials—including the reduction of petroleum use, lifecycle carbon emissions, and vehicle weight—automakers should increase their use of these materials. A number of research breakthroughs are being made that will allow application of these technologies in production vehicles. Automakers must now commit to phasing these bio-based materials into their vehicle lineup.
4. **Set measurable goals and report on progress globally:** If progress is to be made, automakers must set goals for which they can be held accountable. Progress must be reported globally, must be easily accessible to consumers, and must include quantitative data toward achieving specific goals and objectives. At a minimum these should include:
   - Eliminating the use of halogenated substances, including PVC and BFRs
   - Reducing the toxicity of plastics so as to reduce health and environmental impacts across their life cycle
   - Increasing the use of bio-based materials
   - Reusing plastic products
   - Designing plastic products for recyclability
   - Using post-consumer recycled plastics
   - Increasing recycling rates for plastic in end-of-life vehicles

Recommended Goals for Sustainable Plastics in the Auto Sector

We recommend that automakers adopt the following quantitative goals for sustainable plastics:

By 2015:

- Eliminate the use of PVC, BFRs and other halogenated substances in vehicles sold globally
- Design 95% of all plastic products to be either reusable or recyclable
- Use 50% bio-based materials, reused plastic products, and recycled plastics at the global level

By 2025:

- Use only plastics that are made without hazardous chemicals, are capable of being closed-loop recycled, and are manufactured from renewable raw materials.

APPENDIX A

U.S. CAR AND LIGHT TRUCK SALES

U.S. Car and Light-Truck Sales by Make – 12 Months – 2005

Ranking	Corporation	2005 Sales (# of vehicles sold)	2005 Sales (% of total vehicle sales)
1	General Motors	4,454,385	26.2%
2	Ford Motor Company	3,153,781	18.6%
3	DaimlerChrysler	2,529,254	14.9%
4	Toyota	2,260,296	13.3%
5	Honda	1,462,472	8.6%
6	Nissan	1,076,669	6.3%
7	Hyundai/Kia	730,863	4.3%
8	Volkswagen	310,915	1.8%
9	BMW	307,465	1.8%
10	Mazda	258,339	1.5%
11	Subaru	196,002	1.2%
12	Mitsubishi	123,995	0.7%
13	Suzuki	82,101	0.5%
14	Porsche	31,933	0.2%
15	Isuzu	12,177	0.1%
16	Other*	4,008	0.0%
	Total	**16,994,655**	100%

*Lamborghini, Maserati, Ferrari, Lotus

Source: *Automotive News*, Jan. 9, 2006

APPENDIX B
EVALUATION METHOD

To evaluate the performance of automakers in their progress towards sustainable plastics, we developed a set of 19 criteria related to plastics policies and practices. Each of the 19 topics falls within one of three core areas:

- Overview Topics (three topics)
- Measurable Goals & Objectives (eight topics)
- Reporting of Progress (eight topics)

The three "Overview Topics" are:

1. Corporate policy statements on recycling and resource use
2. Corporate chemicals policy statements
3. Web access (on the home pages of automakers) to data relevant to sustainable plastics

The eight topics for both "Measurable Goals and Objectives" and "Reporting of Progress" are:

1. Use of renewable, bio-based polymers or materials
2. Use of recyclable plastics
3. Use of plastics with recycled content
4. Reduction in use of halogenated substances—polyvinyl chloride (PVC)
5. Reduction in use of halogenated substances—brominated flame retardants (BFRs)
6. Improvement in cabin air quality
7. Reuse and recycling of end-of-life vehicles
8. Management of plastics from end-of-life vehicles

Evaluating Measurable Goals and Objectives

We define "measurable goal" as an endpoint whose achievement, and progress towards achievement, can be measured quantitatively, has a set date by which the endpoint will be reached, and specifies a geographical level of achievement (i.e., at the national, regional, or global level). In many instances automakers only stated a general commitment to the environmental topic but set no measurable goal. In our evaluation, a measurable goal is considered more ideal than a general commitment.

Here is a hypothetical example of a measurable goal for plastics:

- MEASURABLE GOAL: *Eliminate the use of PVC plastic in vehicles sold globally by 2015.*

Here is a hypothetical example of a general commitment for plastics:

- COMMITMENT: *Reduce the use of PVC.*

"Measurable objectives" are interim steps to reaching the final goal and are used to measure progress toward achievement of a measurable goal. A hypothetical set of measurable intermediate objectives:

- *Eliminate the use of PVC plastic in:*
  - *25% of vehicle models by 2009*
  - *50% of vehicle models by 2011*
  - *75% of vehicle models by 2013*
  - *100% of vehicle models by 2015*

When evaluating measurable goals we also considered whether the automaker developed any measurable goal that was not a government requirement and whether the automaker set a goal to meet higher levels of performance—including global implementation and committing to achieve goals that are beyond regulatory compliance.

Evaluating Reporting of Progress

The generic evaluation criteria for "Reporting of Progress" emphasizes whether automakers provide:

- *quantitative data*—numeric assessment of progress, e.g., In all new models sold globally since 2003, at least 25% of the plastic components are made from recycled resin.
- *qualitative data*—descriptions of activities, such as

changing from the use of PVC and polyurethane for instrument panels to polypropylene, and
- data at multiple geographical levels, especially at the regional and global levels.

In our evaluation, quantitative data is considered more ideal than qualitative data, and data at multiple geographic levels is more ideal than data in a few regional locations.

Grading Criteria

Letter grades for each topic were determined using Table 10 on the following pages. The grading scale is a typical classroom scale, with the highest grade an "A", lowest an "F". Grades were then converted into numbers in order to calculate an overall grade point average (GPA).

The GPA for each automaker was determined by adding the grades for all topics and then dividing by the total number of topics. The topics were not weighted, so each topic is considered to be of equal importance. The GPA was converted into an overall grade based on the values in Table 9.

As always, we welcome and encourage feedback on this report and our evaluation methods. To submit your suggestions, please send an email to: *sustainableplastics@ecocenter.org*

TABLE 9 **Letter Grades and Their Numerical Equivalents**

Letter Grade	Numerical Equivalent
A	3.8-4.0
A-	3.5-3.7
B+	3.2-3.4
B	2.8-3.1
B-	2.5-2.7
C+	2.2-2.4
C	1.8-2.1
C-	1.5-1.7
D+	1.2-1.4
D	0.8-1.1
D-	0.5-0.7
F	0.0-0.4

TABLE 10 **Plastics Report Card Topics and Criteria for Evaluating Performance of Automakers**

Topics	Grades A	B	C	D	F
Web Access Can Easily Locate Information on the Topics Below	Included on corporate owner webpage: • Environmental Report and/or Sustainability Report • Detailed data on topics covered in this report card, • All environmental reports produced by companies owned by corporation, • Global performance on topics covered in this report -broken out by continent, vehicle brand or vehicle class	Included on corporate owner webpage: • Environmental Report and/or Sustainability Report • Detailed data on topics covered in this report card, • All environmental reports produced by companies owned by corporation	Included on corporate owner webpage: • Environmental Report and/or Sustainability Report • Detailed data on topics covered in this report card	• Included on corporate owner webpage: Environmental Report and/or Sustainability Report for corporate owner	• Failed to provide any relevant information on web
Plastic Inputs—Resource Use					
Resource Use Policies	• Clearly stated commitment to setting measurable goals related to materials selection • Clearly stated goal to exceed EU ELV type recycling goals globally, without the use of thermal recovery. • Emphasized commitment to select for renewable, recyclable, reusable materials and to recycle and reuse materials at the end of the vehicle's life	• Clearly stated goal to achieve EU ELV type recycling goals in NA, while minimizing the use of thermal recovery • Emphasized commitment to select for renewable, recyclable, reusable materials / products and to recycle and reuse materials at the end of the vehicle's life	• Committed to ELV type recycling/ recovery goals in NA • Emphasized commitment to select for renewable, recyclable, reusable materials / products and to recycle and reuse materials at the end of the vehicle's life	• Emphasized commitment to select for renewable, recyclable, reusable materials / products and to recycle and reuse materials at the end of the vehicle's life	• Failed to define any design for environment vision on company webpage
Use of Bio-Based Materials Goals and Objectives	Set goal with interim objectives: • ≥50% of all virgin plastic products will be made from sustainably sourced bio-based polymers/ materials by 2025 • Set interim objectives • Committed to this globally	Set goal: • ≥25% of all virgin plastic products will be made from bio-based polymers/materials by 2025	• Set any goal for increased use of products made from bio-based polymers/materials	• Committed to use of bio-based polymers/materials	• Failed to provide any relevant information on web
Use of Bio-Based Materials Status	• Provided quantitative and qualitative data on status of goal to increase bio-based polymers/materials, and evaluated progress at different geographical levels (including national, regional, and global levels)	• Provided quantitative and qualitative data that related to the goal of increasing use of bio-based polymers/materials	• Provided some quantitative as well as qualitative examples of where the company has switched to bio-based polymers/materials	• Described activities related to the topic	• Failed to provide any relevant information on web
Use of Recyclable Plastics Goal and Objectives	Set goal with interim objectives: • Use only plastics that can be recycled into the same product (excepting plastics designed for composting); i.e., 100% closed-loop recycling, by 2025 • No down cycling of recyclable plastics. • Set interim objectives • Committed to this globally	Set goal: • Eliminate plastics that cannot be at least down cycled (excepting plastics designed for composting) after end use by 2025; i.e., 100% plastics capable of being down cycled	• Set any goal for increased use of recyclable plastics	• Committed to increase use of recyclable plastics	• Failed to provide any relevant information on web
Use of Recyclable Plastics Status	• Provided quantitative and qualitative data on status of goal to increase recyclable plastics, and evaluated progress at different geographic levels (including national, regional and global) • Specified which plastics are preferable for recycling	• Provided quantitatively data that related to the goal of eliminating less recyclable plastics • Specified which plastics are preferable for recycling	• Provided some quantitative as well as qualitative examples of where the company has switched to more recyclable plastics • Specified which plastics are preferable for recycling	• Described activities related to the topic • Specified which plastics are preferable for recycling	• Failed to provide any relevant information on web
Use of Recycled Plastics Goal and Objectives	Set goal with interim objectives: • ≥25% post-consumer recycled content in plastics by 2015 • Set interim objectives • Committed to this globally	Sets goal: • ≥15% post-consumer recycled content in plastics by 2015 • Committed to this globally	• Sets any goal for increased use of recycled content in plastics	• Committed to increase the recycled content of materials generically	• Failed to provide any relevant information on web
Use of Recycled Plastics Status	• Provided quantitative and qualitative data on status of goal to increase recycled content, and evaluated progress at different geographical levels (including national, regional, and global levels)	• Provided quantitative data that related to the goal of increasing use of recycled plastics	• Provided some quantitative as well as qualitative examples of where the company has switched to recycled materials	• Described activities related to the topic	• Failed to provide any relevant information on web

TABLE 10 **Plastics Report Card Topics and Criteria for Evaluating Performance of Automakers**

Topics	Grades: A	B	C	D	F
Plastic Inputs—Substances of Concern					
Substances of Concern Policies	• Clearly stated commitment to avoid the use of Priority OSPAR list of chemicals* in their product line and is actively transitioning out of any remaining uses at the global level • Emphasized commitment to produce non-toxic products, including all inputs and outputs across the life cycle of the vehicle • Provided list of restricted (prohibited) and reportable substances * More information about the OSPAR list of chemicals can be found at: http://www.ospar.org/eng/html/welcome.html	• Clearly stated commitment to phase out some OSPAR chemicals, including EU ELV Directive chemicals and one or more halogenated chemical that is not included in the ELV Directive • Emphasized support for non-toxic products, including all inputs and outputs across the life cycle of the vehicle • Provided list of restricted (prohibited) and reportable chemicals	• Committed to phasing out the EU ELV directive chemicals at the global level (I.e. lead, cadmium, hex, mercury) • Provided list of these chemicals • Emphasized generic support for reducing toxics in products	• Emphasized generic support for reducing toxics in products	• Failed to define a chemicals policy program on company webpage
Halogen Reduction—PVC Goals and Objectives	Set goal with interim objectives: • By 2015 eliminate all PVC • Sets interim objectives • Commits to this globally	Sets goal: • By 2015 eliminate PVC from ≥50% of models • Commits to this globally	• Sets any goal to reduce PVC usage, goal is listed on public documents	• Sets any goal to reduce PVC usage, goal is not listed on public documents	• Had no publicly stated goal to reduce PVC usage
Halogen Reduction—PVC Status	• Provided quantitative data that related to the goal of reducing PVC and evaluated progress at different geographical levels (including national, regional, and global levels)	• Provided quantitative and qualitative data that related to PVC reduction goals	• Provided some quantitative as well as qualitative examples of how the company is reducing PVC	• Described activities related to the topic	• Failed to provide any relevant information on web
Halogen Reduction—BFRs Goals and Objectives	Sets goal with interim objectives: • By 2015 eliminate all BFRs • By 2010 eliminate deca-BDE • Commits to this globally	Sets goal: • By 2015 eliminate all BFRs in ≥50% of models • By 2010 eliminate deca-BDE in ≥50% of models • Commits to this globally	• Set any goal to reduce or eliminate BFRs (including deca-BDE), goal is listed on public documents	• Set any goal to reduce or eliminate BFRs (including deca-BDE), goal not listed on public documents	• Had no publicly stated goal of eliminating or reducing BFRs
Halogen Reduction—BFRs Status	• Provided quantitative data that related to the measurable goal and objectives and evaluated progress at different geographical levels (including national, regional, and global levels)	• Provided quantitative and qualitative data that related to BFR and deca-BDE reduction goals	• Provided some quantitative as well as qualitative examples of how the company is reducing BFRs and deca-BDE	• Described activities related to the topic	• Failed to provide any relevant information on web
Cabin Air Quality Improvement Goals and Objectives	Sets goal and interim objectives: • By 2015 certify all vehicles to TUV, equivalent or stricter standard • Sets interim objectives • Commits to this globally	Sets goal: • By 2015 Certify ≥50% of vehicle models to TUV or JAMA standard • Commits to this globally	• Set any goal to increase number of vehicle models that are certified to TUV, JAMA or other cabin quality standard	• Committed to improving cabin air quality	• Had no publicly stated goal regarding cabin air quality
Cabin Air Quality Improvement Status	• Provided quantitative data that related to the measurable goal and evaluated progress at different geographical levels (including national, regional, and global levels)	• Provided quantitative and qualitative data that related to cabin air quality goals	• Provided some quantitative as well as qualitative examples of how the company is upholding cabin air quality goals/standards	• Described activities related to the topic	• Failed to provide any relevant information on web

TABLE 10 **Plastics Report Card Topics and Criteria for Evaluating Performance of Automakers**

Topics	Grades A	B	C	D	F
Outputs—Material Management at Vehicle End-of-Life					
ELV Recycling Goals and Objectives	Set goal with interim objectives: • Set clear goal to exceed EU/Japanese type ELV recycling/recovery requirements globally by a specified date • Set interim objectives • Excluded wastes disposed of in "thermal recovery."	Set goal: • Set EU/Japanese type recycling/recovery goals for for North America by a specified date • Set interim objectives • Minimized the amount of wastes disposed of in "thermal recovery."	• Set EU/Japanese type ELV recycling/recovery goals in NA	• Set any NA ELV recycling/recovery goal	• Failed to provide any relevant information on the web
ELV Recycling Status	• Provided quantitative and qualitative data that related to the ELV recycling goals and evaluated progress at different geographical levels (including national, regional, and global levels)	• Provided quantitative and qualitative data that related to the ELV recycling goals	• Provided some quantitative as well as qualitative examples of how the company is upholding its ELV recycling goals	• Described activities related to ELV recycling	• Failed to provide any relevant information on web
Plastics End-of-Life Management Goals and Objectives	Set goal with interim objectives: • By 2015, 75% capture rate of plastics at end-of-life for reuse, recycling, or composting • Sets interim objectives • Committed to this globally	Set goal: • By 2015, 50% capture rate of plastics at end-of-life for reuse, recycling, or composting	• Set goal of 25% capture rate of plastics at end-of-life for reuse, recycling, or composting by 2015	• Set any goal to increase capture rate of plastics at end-of-life for reuse, recycling, or composting	• Failed to provide any relevant information on web
Plastics End-of-Life Management Status	• Provided quantitative and qualitative data that related to plastics end-of-life management, assesses progress related to interim goals, and evaluated progress at different geographical levels (including national, regional, and global levels)	• Provided quantitative and qualitative data that relates to plastics end-of-life management goals, including data on activities in developed countries	• Provided some quantitative as well as qualitative examples of how the company is upholding plastics end-of-life management goals	• Describes activities related to plastics end-of-life management	• Failed to provide any relevant information on web

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Moving Towards Sustainable Plastics in the U.S. Auto Industry

Ecology Center's

Clean Car Campaign

Claudette Juska

GPEC 2007

March 6, 2007

About the Clean Car Campaign

- **Ecology Center** works for a safe and healthy environment where people live, work and play

- **Clean Car Campaign** works to address environmental and health impacts of the production, use and disposal of vehicles

Plastics in Vehicles

Increased flow of plastics to waste stream:

- 250lbs plastic per vehicle (12% by weight), likely to increase
- Auto sales increasing

Increased exposure to chemical additives:

- 50%+ of vehicle interiors made of plastic
- Chemicals off-gas from plastic
- Average American spends 1.5 hours in car every day

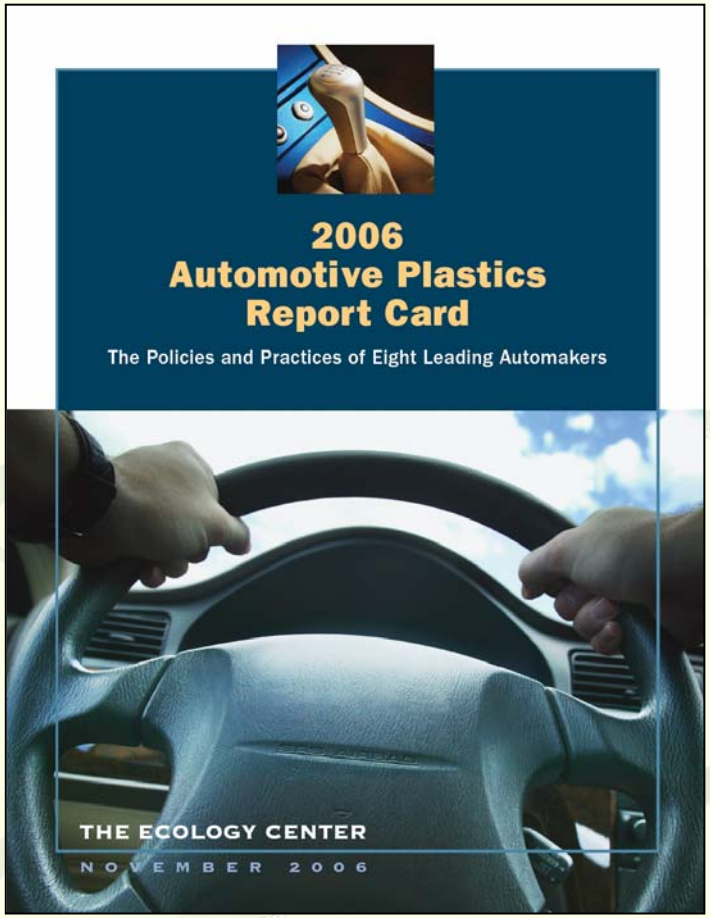
⇩ Use of sustainable plastics increasingly important

Sustainable Plastics Definition

- No hazardous chemicals throughout lifecycle
- Capable of either
  - Closed loop recycling
  - Degrading into healthy nutrients for the soil
- Manufactured from renewable raw materials and energy
- No GMOs

Plastics Report Card

- Annual assessment
- Eight automakers
- Evaluated polices and practices
- Reviewed public documents
- Requested additional information
- Typical classroom grading scale



Grading Topics
Inputs: Resource Use

- Bio-based materials
  - Advantages: Reduced use of petroleum, carbon sequestration, reduced weight
  - Examples: PLA, natural fiber reinforcements, soy-based foams
- Recyclable plastics
  - PVC least recyclable
  - TPOs most recyclable (polypropylene and polyethylene)
- Recycled plastics

Grading Topics
Inputs: Substances of Concern

- Polyvinyl Chloride
  - Still commonly used in seating, arm rests, dashboards, trim panels, wiring and sealing
  - Vinyl Chloride Monomer - EPA classifies as “likely carcinogen”, also forms dioxin
  - Phthalates - EPA cites damage to liver, testes, reproductive effects
  - PVC auto parts not easily recycled

Grading Topics
Inputs: Substances of Concern

- Brominated Flame Retardants
  - Ubiquitous
  - Bioaccumulating in humans and wildlife
  - May degrade into more harmful compounds (decaBDE -> pentaBDE, octaBDE, other?)
  - EPA cites liver, thyroid, and developmental toxicity, among other health problems

Grading Topics
Inputs: Substances of Concern

- Interior Air Quality
  - Average American spends 105 minutes in vehicle per day
  - VOCs, halogenated organics, and phthalates commonly found in cars
  - Voluntary standards: TÜV, OkoTex, and Japanese Ministry of Health

Grading Topics
Outputs: Materials Management at End of Life

- End-of-Life Vehicle Recycling
  - Recycling of vehicles
- Plastics End-of-Life management
  - Ruse and recycling of plastic parts
  - Recycling of auto shredder residue (ASR)

Progress:
Bio-Based Materials

- **Toyota** to use 20M tons "ecoplastic" by 2020.
- **DaimlerChrysler** increased use of bio-materials by 98%
- **Ford** developed soy-based foam; using biofabric for seating

Progress:
Interior Air Quality

- **Ford** certified 4 vehicles to TÜV standard
  - Limits phthalate levels
  - Limits halogenated hydrocarbons
  - Limits other VOCs

- **Toyota** set goal to lower VOCs in all vehicles by 2010

Progress:
Polyvinyl Chloride

- **Honda** set goal to “apply PVC-free applications wherever feasible”
- Already removed from majority of applications
- Indicates that virtually PVC-free vehicles are possible

Overall Grades and GPAs

Company	Grade (GPA)
Toyota	C+ (2.4)
Ford	C (1.9)
Honda	C (1.8)
DaimlerChrysler	D+ (1.4)
General Motors	D (0.9)
Hyundai	D (0.9)
Nissan	D (0.9)
Volkswagen	D- (0.7)

Conclusions

- Industry set some significant goals
- Gap growing between leaders and laggards
- Still a lot of progress needed by ALL

Recommendations

1. Accelerate the elimination of halogens from auto plastics
2. Certify vehicles to an interior air quality standard
3. Increase the use of bio-based materials
4. **Set measurable goals and report on progress globally**

Recommended Goals

- By 2015:
  - Eliminate the use of halogenated substances
  - Design 95% of all plastic parts to be either reusable or recyclable
  - Use 50% bio-based materials, reused, and recycled plastics

New Assessment Tool

www.HealthyCar.org

The Consumer Guide to Toxic Chemicals in Cars

Coming Soon!

- X-Ray Flouresence Spectometry
- Identified elemental make-up of materials in cars
  - *-- Chlorine, bromine, lead, mercury, and others…*
- Rated vehicles based on findings
- Available to consumers in March

Results of XRF Testing

Over 2400 parts tested with XRF device

Vehicle Components	Percentage Components **Cl=0 ppm**	Percentage Components **Br=0 ppm**	Percentage Components **Halogens = 0 ppm**
Center Console	50%	51%	22%
Carpet	99%	54%	51%
Door trim (hard)	88%	59%	56%
Door Trim (soft)	49%	39%	12%
Exterior Window Seal	62%	78%	47%
Front Seat (front)	95%	15%	15%
Front Seat (rear)	56%	38%	13%
Headliner	99%	41%	39%
Dashboard	80%	56%	48%
Seat base	97%	69%	66%
Shift Knob	72%	60%	36%
Steering Wheel	97%	53%	51%
Average	79%	51%	38%

Preview of Findings

“Halogen-Free” Vehicles

Make	Model
Mercedes	SLK280
Chevy	Cobalt
Honda	Odyssey
Cadillac	CTS
BMW	M3 Convertible
BMW	X3
Acura	TSX
Lexus	ES 350
Toyota	Matrix
Acura	RDX Tech
BMW	330 i

Questions?

For copy of plastics report, visit:

www.EcoCenter.org/sustainableplastics

Also visit:

www.HealthyCar.org

or contact:

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