Testing high-end reuse of engineering plastics from used electronic products

Prepared by

Minnesota Office of **Environmental Assistance**

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Introduction

In an effort to support the recycling of used electronic products in Minnesota and the region, the Minnesota Office of Environmental Assistance (OEA) developed a project designed to work within existing markets to develop demand for engineering plastics from used TV housings. The OEA's work on this project was funded by the U.S. Environmental Protection Agency's (EPA) Region 5 office. Some specific objectives of the project were to support electronics product stewardship efforts, identify opportunities and barriers to closed-loop recycling of plastics from electronics, and determine how recycling of these plastics might reduce the production of greenhouse gases.

Background

In 1999 and 2000, the OEA managed a demonstration project to learn more about the costs and barriers to recycling used electronic products on which this project was developed to build.[1] Local communities and industry partners were involved in collecting, demanufacturing, processing, and recycling used electronics. In the process, the participants collected valuable information, including statistics about the plastics from electronics. The study found that over 4 percent by weight of material collected was plastics. Of those plastics, 56 percent was identified as high impact polystyrene (HIPS), which was found most often in television housings in the form of black flame-retardant HIPS (FR-HIPS). Results also indicated that FR-HIPS could be separated into a discrete stream that could be marketed for high-end applications.

1999-2000 Collection Event. *Plastics from televisions and other electronics collected at these events were separated, identified, and processed to determine recycling feasibility.*

Using information from the 1999-2000 demonstration study, this project was designed to develop new, competitive, domestic demand for engineering plastics without government subsidies. In order to accomplish this goal, the OEA, the Wisconsin Department of Natural Resources (WDNR), the Illinois Department of Commerce and Economic Opportunity (IDCEO), and the EPA collaborated with Sony Electronics (Sony) and electronics demanufacturers (recyclers) in the EPA Region 5 states to establish a recycling infrastructure. This involved identifying and selecting a plastics processor to collect post-consumer plastics from the recyclers and process the material into plastic pellets that meet necessary specifications for Sony's applications. The potential for greenhouse gas reduction resulting from using post-consumer plastics in place of virgin plastics was also to be evaluated.

The Work Plan and Memorandum of Understanding

Project participants developed a work plan (see Attachment A, *Work Plan*) to identify and implement specific steps toward the project's goals. The following tasks were identified:

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[1] Minnesota Office of Environmental Assistance. *Recycling Used Electronics: Report on Minnesota's Demonstration Project.* www.moea.state.mn.us/plugin/report.cfm

1. The OEA will coordinate project partners (EPA, WDNR, IDCEO) to identify sufficient volumes of plastics from recyclers to meet the production schedule by plastics processor and Sony. This includes assisting the processor to train and inform recyclers on material preparation and shipping.
2. OEA, EPA, and Sony conduct Request for Proposal (RFP) process for selecting a processor for the project and select the processor.
3. Sony prepares to accept recycled plastics for manufacturing purposes.
4. OEA, EPA, Sony, WDNR, IDCEO, recyclers, and selected processor develop a process to collect and record relevant information throughout the project.
5. OEA will coordinate a delivery schedule between the recyclers and the processor. Sony and the processor will develop a schedule as well.
6. OEA and EPA will assess greenhouse gas reduction as a result of the project.
7. OEA will write interim and final reports to summarize results and circulate among interested parties and develop a distribution plan for outreach.

Sony's requirements for the recycled plastics were included in the work plan. Sony verbally committed to using the plastics collected in the project for 12 to 18 months if a minimum amount of plastic (approximately 100,000 pounds per month) was guaranteed. A memorandum of understanding, presented in Attachment B, *Memorandum of Understanding*, was drafted by the OEA to be signed by the project participants after project initiation. The OEA, EPA, WDNR, and IDCEO were signatories on the memorandum.

Recycler Participation Survey

Because Sony would need at least 100,000 pounds per month of black FR-HIPS, project participants first needed to determine whether that amount would be available in the region and ensure that it would be provided. For the purposes of the project, recyclers are defined as companies, governmental units, or nonprofit organizations that collect and demanufacture discarded electronic products for reuse and/or recycling.

Over 25 recyclers in Minnesota, Wisconsin, Illinois, and Ohio were surveyed regarding their interest in the project and how much plastic material they generate per year. They were also asked how they handled the material for shipment and what their storage capacity was. Of those surveyed, five recyclers (20 percent) expressed interest in participating in the project. These five recyclers are:

- Asset Recovery Corp, Saint Paul, Minnesota
- 5R Processors, Glen Flora, Wisconsin
- Cascade Asset Management, Madison, Wisconsin
- United Recycling Industries, Franklin Park, Illinois
- UNICOR, Elkton, Ohio

Attachment C, *Survey and Results*, gives a summary of the results from the five participating recyclers. From the estimates provided by these five companies, the OEA and EPA identified over 100,000 pounds per month of black FR-HIPS. However, over the course of the project, this estimate lowered, and the OEA began searching for other sources. An additional potential participant, PPL Industries, which demanufactures electronics for Hennepin County, Minnesota, was identified. However, they were not able to estimate quantities of black FR-HIPS received at their facility. Additional possibilities identified for providing more plastics included two facilities that are not located in Region 5: UNICOR's Atwater, California facility and supplemental post-industrial HIPS from non-electronics sources provided by the processor.

The Processor

Attachment D, *Request for Participation,* contains the RFP document that was advertised in Plastics News from April 15 through May 5 (3 issues). The RFP includes a summary and timeline of the project, a description of qualifications and specifications sought and submittal and contact information. The OEA coordinated advertising and distribution of the RFP and answered questions and accepted responses from interested parties.

The OEA received approximately 40 inquiries about the RFP and 11 companies submitted qualifications. The responses were reviewed by EPA, OEA, and Sony. Of the responders, Talco Plastics (Corona, Calif.) was selected based on qualifications, availability of supplemental material, experience working with Sony, and location.

On October 30, 2002, representatives from the EPA, OEA, and Sony visited Talco Plastics' recycling facility in Corona, California. The purpose of the visit was to tour the facility and discuss the project. The representatives also visited Sony's recycled plastic injection molder, AMS Plastics, in Mexicali, Mexico, on October 31 to discuss their needs regarding quality and quantity of material. The molder currently produces post-consumer recycled HIPS television housings for Sony from non-electronic sources, such as industrial spools.

The OEA and EPA coordinated with recyclers to send samples of plastics to Talco for their initial assessment of the quality and types of the material. At Talco's request, recyclers sent material representative of all types of plastics generated from their demanufacturing of electronics. Talco found that all of the recyclers had black FR-HIPS material in their plastics that could be recycled; however, only one provided samples that contained a majority of non-HIPS plastics that would need to be separated out before shipment to Talco.

Lessons Learned

When the project began in November 2001, it was scheduled for one year. Due to unanticipated delays, it was extended an additional year to end November 2003. The ultimate objective of coordinating a regular schedule of sending post-consumer FR-HIPS from electronics to Sony for manufacture into TV housings was not achieved. Instead, barriers to this objective as well as future opportunities were identified.

Delays

During the original planning of the project, participants had already identified a processor with experience in separating and processing plastics from electronics. The plan, therefore, did not include the RFP process. Unfortunately, this processor was not able to participate in the project. In order to replace the processor and identify other similar processors, the project participants decided to include the RFP process in the work plan. This process added considerable time to the project that could not have been anticipated.

Another unanticipated delay resulted from transportation issues. After Talco was selected as the new processor, recyclers discovered that the cost of transporting their individual small quantities of baled plastics to California would be cost-prohibitive. In order to find a more cost-effective way of shipping the material, the project team pursued the possibility of selecting a company to serve as a point where material from all the recyclers could be consolidated before shipment. In addition, the company would have the capability to grind the material prior to shipment to increase the density of shipped material and, therefore, reduce costs per pound. Nxtcycle, an electronics demanufacturing company based in Arizona, was approached about participating in the project by using their Lacrosse, Wisconsin consolidation facility as a consolidation point for this project. They agreed to participate and began assisting the project team with contacting the participating recyclers.

Economics

Transportation costs proved to be a major hurdle for the project, particularly because of the location of the processor. The cost of shipping the material may have been substantially reduced if the material could have been shredded in the region before it was transported to California. However, even after a consolidation point was identified, recycling the material still was not deemed cost effective.

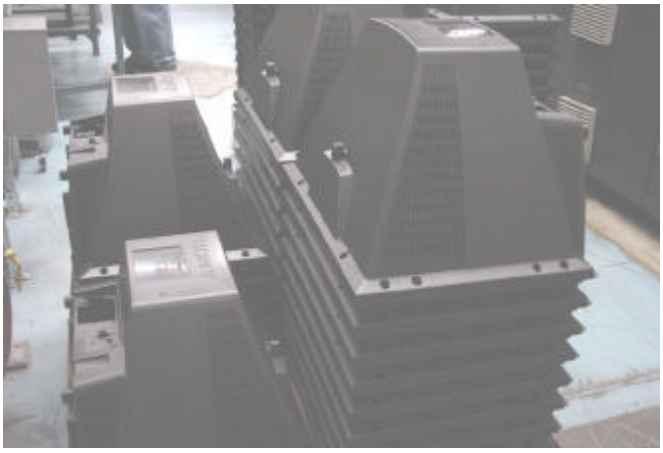
Recyclers found that their costs to handle, bale, and store the plastics for recycling exceeded their costs to bale and send the plastics to a landfill or waste-to-energy facility, despite revenues offered for the plastic by the consolidation point. One recycler estimated its costs as the following:

Sorting and storing	3¢ per pound
Baling	5¢ per pound
Transporting	3¢ per pound
TOTAL	11¢ per pound

Nxtcycle was willing to pay three cents per pound for the material. Therefore recycling would cost 8¢ per pound (11¢ per pound minus 3¢ per pound = 8¢ per pound).

~~2~~ Disposing of the plastic as an industrial waste costs the recycler 5¢ per pound, which includes transportation.

At the estimated costs and price for the material, it does not appear economically feasible to either transport the material directly to the processor or ship the material to a local consolidation point.



TV Housings. *New TV housings at an injection molding facility. TV housings represent a high-end use of plastics recycled from old TVs, creating a more efficient closed recycling loop.*

The price the processor was willing to pay is another economic factor affecting the feasibility of the project. Although this price was not revealed, the recyclers felt it was not sufficient to offset the cost of shipping the material directly to the processor by the individual recyclers, even for the recyclers with larger quantities. The processor's price was affected by a number of factors, including the costs of additives, testing requirements, and the price Sony was willing to pay. During the course of the project, Sony began requiring certification that materials supplied to Sony did not contain any chemicals identified by Sony as harmful to the environment. Sony purchasers wanted the processed product tested according to the Underwriter's Laboratory (UL) procedures to meet their listing requirement. UL is now developing a test protocol specifically designed to address recycled resins that would include a traceability factor. It is not known whether the new recycled test will decrease the cost of testing requirements.

One of the factors affecting the price for the material is the price of virgin resin. When the price of virgin is high, demand for recycled, and therefore price, increases. During the project, the price of virgin remained low. Low prices may be due to a number of reasons, including low oil prices and the increasing competition from overseas resin. More and more resin is being imported every year from Asia. Polystyrene imports increased by 12 million pounds from 2001 to 2002.[2]

[2] Esposito, Frank. "More processors buying overseas resin." *Plastics News,* August 18, 2003.

Supply

As mentioned previously, the project team also faced the challenge of supply. Original estimates of quantities of FR-HIPS available from recyclers were lowered after the project team began contacting recyclers again to discuss consolidating the material. Recyclers were simply receiving less material from their customers. Some of this was due to the normal flux in the quantity of material produced, often varying by season. However, much of it, recyclers say, is due to a recent increase in exports of whole TVs overseas for refurbishment or recycling.

In addition, the project team hypothesizes that recyclers who did not agree to participate in the project may be sending their plastics overseas for recycling. It is common knowledge in the industry that the price of shipping electronics overseas for sorting and recycling is still lower than sorting and recycling in the U.S. The cost of equipment in China is considerably less expensive and the labor force is also paid much lower wages. In fact, one recycler estimates that it can receive 3 or 4 times the U.S. price on the international market. Another estimated it could send unsorted plastics to China for a gain of 6 cents per pound, but would need to sell its plastics for 10 to 12 cents per pound in the U.S. to regain the cost of separating the material.

The project team may have also underestimated the readily available supply of FR-HIPS from the beginning. The original estimate was based on OEA's previous demonstration project, which relied on mostly residential collections. Black FR-HIPS is found mostly in TVs and would, consequently, be more prevalent from residential sources. But recyclers tend to have a more steady stream of electronics from businesses, and residential material is more sporadic.

Flame Retardants

Two types of polybrominated diphenyl ether flame retardants were recently banned in California, sparking debate about their effects on humans and the environment. These flame retardants are not used today in the manufacture of TV housings. A third type, called deca-PBDE, is used in TV housings and was not banned. It represents more than 95 percent annual use of PBDEs.[3] This type is being studied in Europe, but has not been conclusively proven to accumulate in humans.

Because of their relatively high price, flame retardants would likely also have affected the cost of processing the plastics for Sony's use. Because that phase of the project was not reached, it was not studied further. However, the project team recognizes that the cost of developing a product with a high flame retardant rating may have been cost prohibitive due to the high costs of the additive and the low value of recycled HIPS in the marketplace.

Greenhouse Gases

This project had the potential of diverting over 100,000 pounds per month of engineering plastics for at least one year. In turn, the recycled material would have replaced the need for an equivalent amount of virgin plastics. This could result in a significant decrease in greenhouse gases (GHG) produced during the life cycle of the plastics.

Currently, no model exists to specifically predict the reduction of greenhouse gases by recycling FR-HIPS from electronics into new electronics. However, the EPA is finalizing a study to develop a set of emission factors for carpets, personal computers, and selected building materials.4 These emission factors quantify the life-cycle GHG impacts of managing these materials using a variety of waste management practices, including source reduction, recycling, combustion, and landfilling. The study focused on TVs instead of personal computers and did not assume the high-value plastics will go into other high-value applications, but rather, into an asphalt mix.

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[3] Toto, DeAnne. "Growing Pains," *Recycling Today*. July 15, 2003.
[4] U.S. EPA. May 2003. Draft Background Document for Life-Cycle Greenhouse Gas Emission Factors for Carpet and Personal Computers.

Even if the potential 100,000 pounds per month of high-value plastics collected for this project were used in the production of asphalt, 16.2 metric tons of carbon equivalent in process energy would have been saved. According to Mike Biddle of MBA Polymers[5], he can save an estimated 96.5 mega-Joules of energy by recycling these plastics as opposed to creating virgin.

Recommendations

Although the project did not produce the originally planned results, the opportunities identified and lessons learned make the project a success. The OEA recommends that project participants continue to monitor the market and pursue similar programs in the future when opportunities are present. All of the barriers faced during this project have the potential to change, sometimes dramatically, leaving the possibility for opportunities in the future. The recommendations in this section have been identified as ways to encourage the recycling of black FR-HIPS as well as other plastics from electronics.

Increase demand. One way to improve the market price for post-consumer FR-HIPS is to demand post-consumer recycled content when purchasing electronics. Already, the U.S. EPA is pursuing this avenue with its Federal Electronics Challenge (FEC). The FEC was recently developed to encourage federal agencies to purchase environmentally responsible electronics and responsibly manage end-of-life electronics. It will provide agencies with valuable information and guidelines for contracting. As part of the challenge, coordinators of the FEC may include recycled content recommendations for plastics. Although the federal government is not a large purchaser of televisions, the FEC will hopefully increase the demand for other recycled plastics and serve as a model for other purchasing programs.

Limit export. Although the export market can be variable, it negatively affects the supply and price of domestic plastics and should be discouraged as a means of marketing electronics. One way to do this is to encourage the use of domestic markets. Again, purchasers can help by demanding recycled content in their electronics. Government agencies, nonprofits, and businesses may also wish to specify in their contracts with recyclers that export should be limited. For example, the state of Minnesota's electronics recycler does not export any part of the electronics it collects from the state, as specified in its contract.

Collection. Improving the cost-effectiveness of collection and processing of electronics, especially from residential sources, is a major issue in the National Electronics Product Stewardship Initiative (NEPSI). NEPSI is a national initiative among various stakeholders to develop solutions for electronics end-of-life management. Stakeholders include governments, manufacturers, retailers, recyclers, and environmental groups. The NEPSI goal, to set up a system to collect and recycle electronics, is an important part of improving the economic feasibility of recycling the plastics from electronics.

Improve cost-effectiveness. Perhaps one of the best ways to make plastics recycling from electronics cost-effective may be to build a vertically integrated recycling manufacturing facility. The facility could accept electronics for demanufacturing, process the plastics in-house, and produce a product or series of products from the processed plastics to sell on the market. Such a facility could be a contract manufacturer for a company like Sony to produce its TV housings. Transportation and "middle-man" costs would be saved in this scenario.

Study other plastics. The OEA also recommends that other types of plastics from electronics be considered for future studies. During the project, recyclers emphasized that the majority of the plastics they receive is white plastics, such as acrylonitrile butadiene styrene (ABS) and polycarbonate ABS (PC-ABS). In the 1999-2000 study, black plastic was the most prevalent because the study used material from residential collections, not businesses. Residential collection is more cyclical, especially in Minnesota because of cold winters.

[5] Speaking at the Stakeholder Dialogue on Recycling Engineering Thermoplastics from Used Electronic Equipment on May 22, 2003

Attachment A

Work Plan

Project Objective and Summary
The purpose of this project is to learn about the barriers and opportunities to recycling plastics from used electronic products in the manufacture of new electronic products. The project planners seek to advance the establishment of closed-loop recycling for engineering plastics. The project is designed to utilize existing markets to create new, competitive domestic demand for engineering plastics. It is the intent of project participants that upon completion of the project new domestic markets for recycled engineering plastics will exist as self-sustaining, non-subsidized markets.

Plastics represent a large portion of the material composition of used electronic products. Finding viable markets for this material is essential for the development of a cost-effective recovery system for used electronics. Exploring and developing these markets are important because the plastic components of electronic products may contain as much or more residual value than any other single component or material stream recovered from these products. This project seeks to learn how to better exploit the residual value of these plastics and assumes that the best markets for this purpose are those markets which best utilize the original properties of the material.

Analysis of pilot projects to collect and recycle end-of-life electronics indicates that economies of scale may be achieved by the development of a larger collection infrastructure, and that a predictable, high-volume stream of used electronics can reduce transportation costs and foster greater demand for the secondary materials recovered. Analysis by the State of Minnesota also indicates that post-secondary engineering plastics can be processed to meet strict specification standards set by electronic product manufacturers for use in new products.

The Minnesota Office of Environmental Assistance, Wisconsin Department of Natural Resources, and the Illinois Department of Commerce and Community Affairs will collaborate with Sony Electronics, recyclers, and a processor selected through a Request for Proposal (RFP) process. This collaboration will assess the feasibility of developing a market for the plastic material derived from post consumer electrical and electronic equipment. The U.S. EPA Region 5 will support these efforts and aid in the production of a publication that presents findings.

This project will be evaluated for success based on the ability of participants to meet the production schedule of a large original equipment manufacturer for a specified period of time. The implications for reduced greenhouse gases (GHG) by the use of post-consumer plastic over virgin commodity for new product will also be evaluated.

Participants
Minnesota Office of Environmental Assistance, U.S. Environmental Protection Agency (EPA) Region V, Sony Electronics, Inc, Wisconsin Department of Natural Resources, Illinois Department of Commerce and Community Affairs, a plastics processor that can meet manufacturing specifications and demand schedules, and electronic product recyclers from Region V states and beyond.

Synopsis of the Project

The immediate goal of the project is to recycle post-consumer engineering plastics in high-end uses. This will be accomplished using existing business structures with little if any direct financial support. The project seeks to improve current recycling market conditions for engineering plastics by conducting a visible demonstration of the potential for using quality post-consumer supply for high-end manufacturing use.

The project intends to collect and process engineering plastics and deliver them to a major electronics manufacturer that will use the material in new product. Sony Electronics has committed to using plastics collected in this project if the project can guarantee a minimum amount of plastic, in the range of 100,000 pounds of processed plastics per month for a 12 to 18 month period. Achieving this volume of plastics will likely require twice the amount of unprocessed plastic. The project will use a qualified U.S. processor selected by Sony, the OEA, and Region V U.S. EPA. The processor will be selected through an RFP process. The OEA, U.S. EPA Region V, and states in the upper Midwest are working together to identify recyclers willing to participate in the project to meet the identified production schedule. While the program has originated in U.S. EPA Region V, recyclers from beyond Region V will be considered for participation to ensure adequate volumes of plastics are delivered on schedule to the processor. Recyclers will be asked to identify a minimum volume of material they can provide every month for 12 to 18 months. Contracts will be developed between the recyclers and the plastics processor to assure consistent quantity, quality and price. The processor will provide recyclers with guidance on quality and packaging expectations and may conduct site visits to provide specific training.

The long-term goal of the project is to build demand and raise prices for a variety of engineering plastics derived from electrical and electronic products. The project is intended to evaluate:

- Market demand for recycling post-consumer engineering plastics for the originally intended purposes of the material.
- Processing capacity to meet a manufacturer's quality control specifications and manufacturing demand schedule.
- The existing and optimal capacity and capability of the recycling and manufacturing infrastructure to produce sufficiently valuable product and support adequate prices to expand recycling of engineering plastics from electronic products and IT equipment in production processes consistent with this project.
- The climatic benefits which occur when utilizing non-virgin plastic material, i.e., the measurable cumulative energy savings throughout the supply chain generated by using post-consumer recycled material.

Specifications Required for Recycled Plastics

- Meet Sony's specification and standards for quality. See Table 1.
- Must be certified by Underwriters Laboratory (UL).
- Processor must deliver 100,000 pounds/month of specified plastic in pelletized form (flake not currently acceptable).
- Color is to be black or very near black.
- Fire retardant rating to be determined (either V-0 or HB).
- Packaging requirements must be met, as identified by Sony during Task 1.
- Selected processor will be a contracted supplier to Sony.

Table 1. Typical specification for black HIPS.

ITEM	TYPICAL	METHOD
Melt Flow(gms/10min)	5.0-8.0	ASTM D1238 200/5
Izod Impact(Ft-Lb/In)	1.2 -1.5	ASTM D 256
Vicat(deg F)	212	ASTM D638
Tensile Yield(psi)	4400	ASTM D638
Tensile Elongation(%)	25-45	ASTM D638
Form	Pellets	

Task 1a: OEA will coordinate among States, U.S. EPA Region V (EPA) and other key project partners to identify sufficient volumes of plastics from recyclers to meet production schedule by plastics processor and Sony Electronics. Assist processor to train and inform recyclers on material preparation and shipping.

Activities:

1. Identify principal partners on the project. – OEA, EPA
2. Exchange letters of understanding among OEA, Sony, and U.S. EPA Region V – all (OEA lead)
3. Identify recyclers to participate in the project. Identify the respective volume of black engineering plastic each recycler will provide the processor for 12-18 months, based on the specifications in Table 1. Additional specifications and packaging requirements will be provided recyclers by the processor (and Sony) prior to initial delivery of recyclable plastics – OEA, Illinois, Wisconsin, EPA
4. Oversee preparation and signing of contractual agreement between processor and recyclers – OEA, IL, WI
5. Oversee development of training materials and schedule between processor and recyclers – OEA
6. Establish technical review team – all (OEA lead)
7. Train recyclers on the type of plastic to be used in the project, how to package it for shipping to the processor, and how to report data – processor

Activity start/dates: November 2001 – July 2002, and then ongoing throughout project, as necessary.

Projected outcome: Initiate project to develop new market for engineering plastics among original equipment manufacturers by identifying recyclers to participate with enough plastic to get the project started.

Evaluation of outcome: Recyclers with sufficient streams of plastics that can be delivered to the processor monthly for 12-18 months will be identified and will participate in the project.

Task 1b: Conduct Request for Proposal (RFP) process for selecting a processor for the project. Select the processor.

Activities:

1. Prepare and distribute RFP to solicit processor for project. – OEA, Sony
2. Form review committee for selection of processor. – OEA (lead), EPA, Sony
3. Select processor and negotiate participation on project. – OEA, Sony

Activity start dates: December 2001 – June 2002

Projected outcome: Develop necessary materials to successfully solicit participation on project by a plastics processor.

Evaluation of outcome: Secure plastics processor committed to successful outcomes for the project.

Task 1c: Sony prepares to accept recycled plastics for manufacturing purposes.

Activities:

1. Sony tours vendor site. – Sony
2. Sony approves the processor and authorizes preliminary work by processor to begin. – Sony
3. Sony approves preliminary samples sent by processor for evaluation by Sony engineers and technicians. – Sony
4. Sony and processor (contractor/vendor) confirm UL certification of recyclate. – Sony
5. Prepare and sign contractual agreement between Sony and processor. – Sony

Activity start dates: Initial effort, November 2001 - August 2002, and then ongoing throughout project, as necessary.

Projected outcome: All parties within Sony involved with the project or with the power to influence the project outcomes are aware of the project and support it.

Evaluation of outcome: Sony fully supports and promotes the project.

Task 1d: Develop Greenhouse Gas (GHG) evaluation tool to assess GHG savings as a result of the project.

Activities:

1. Identify existing GHG models that could be applied to the project, including those developed by or for U.S. EPA, the State of New Jersey, and others, as appropriate. – EPA
2. Select an appropriate matrix and modify it if necessary for use by the project. – EPA, OEA
3. Apply the matrix to information collected during the project and include that data and information in all relevant external descriptions of the project. – EPA

Activity start/dates: November 2001 - ongoing

Projected outcome: GHG information will be tracked in reference to the plastic recycled during the project.

Evaluation of outcome: Project information shared with the public and other audiences external to the project fully understand the GHG implications of the project.

Task 2: Develop a process to collect and record relevant information throughout the project.

Activities:

1. Identify information relevant for evaluating the project. – all
2. Select relevant data to collect. – all
3. Develop data tables to record the amount and type of material sent during the project by recyclers to the processor and from the processor to Sony. – OEA
4. Identify who is responsible for generating data and who will aggregate the data. – OEA
5. Train responsible parties on generating, recording and reporting of data. – OEA (lead), processor, Sony
6. Collect, aggregate and report the data. – OEA, WI, IL

Activity start/dates: November 2001 – project completion.

Projected outcome: Identify and collect relevant information throughout project. Develop a method for efficiently keeping track of material sent to the processor from recyclers, and to Sony from the processor.

Evaluation of outcome: A system for recording and evaluating the flow of materials during the project will be in place prior to the beginning of shipments. Good data from the project will be available to report to the public at the end of the project.

Task 3: Coordinate delivery schedule among recyclers and the processor. Participate in developing schedule between the processor and Sony.

Activities:

1. Review data transmission sheets with all parties prior to shipment of any materials. – all
2. Identify ability of various parties to meet shipping demand to ensure timely delivery of materials to processor and Sony. – all
3. Provide liaison to all parties. – all
4. Ensure clear communication among all participants. – all
5. Record data and track the flow of material to successfully meet separate production schedules of processor and Sony. – OEA
6. After the ninth monthly shipment from the processor, review the project to date and determine if the project will terminate in 12 or 18 months. – OEA (lead), Sony, EPA

Activity start/dates: Begin upon selection of a processor, then ongoing throughout project

Projected outcome: Delivery schedule will be established among all relevant parties.

Evaluation of outcome: Material will flow as anticipated throughout the project.

Task 4: Write interim and final reports to summarize results and circulate among interested parties.

Activities:

1. Prepare draft interim report for review (interim report is intended for internal use by project participants and will be less formal than the final report). – OEA, EPA
2. Complete interim report based on comments and distribute to project team. – OEA, EPA
3. Prepare draft final report. – OEA, EPA
4. Complete final report based on comments from technical review team and distribute. – OEA, EPA

Activity start/dates: April 2002 – midway through project, and upon completion of project.

Projected outcome: Prepare report as a tool for describing the project to other interested parties.

Evaluation of outcome: Report is completed that clearly describes the work of the project and is well-received among project participants, the technical review team, and outside parties with an interest in the work.

Task 5: Develop a distribution plan for interim and final reports and outreach materials. Print and distribute materials.

Activities:

1. Identify any outreach material or effort to develop describing the project in addition to reports. – all
2. Establish method for identifying interested parties and publicizing availability of reports. – all
3. Contact interested parties. – all

4. Make use of web technology to minimize printing of reports. – all
5. Distribute web links or copy of reports to interested parties. – all
6. Pursue additional outreach activities as identified. – all

Activity start/dates: May 2002 – completion of interim and final reports

Projected outcome: Information about the project will be made available.

Evaluation of outcome: Reports and other information on the project are available to interested parties.

Attachment B
Memorandum of Understanding

The Minnesota Office of Environmental Assistance (MOEA) is pleased to be working together with Sony Electronics, Inc. (Sony), the U.S. Environmental Protection Agency (EPA), the Illinois Department of Commerce and Community Affairs (IDCCA), and the Wisconsin Department of Natural Resources (WDNR) on an EPA Region V Grant project to assess the feasibility of recycling post-consumer black engineering plastics from electronic products. This memorandum is intended to document the understanding between Sony, EPA, IDCCA, WDNR and MOEA regarding the responsibilities of each for this project.

As you know, each participant has agreed to specific responsibilities, which are outlined in the enclosed Project Work plan. If the work plan is acceptable, please indicate your understanding and assent by signing below. By participating in this project, MOEA hopes to promote public health and environmental protection and ensure that post-consumer electronics generated in the United States are recycled in an environmentally safe manner rather than exported to developing countries. MOEA is looking forward to working with Sony, EPA, IDCCA, and WDNR to promote self-sustaining, non-subsidized domestic markets for recycled engineering plastics.

MOEA:

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Bill Sierks, Strategic Operations Manager Date

EPA:

_____

Robert Springer, Director, Waste, Pesticides, and Toxics Division Date

Sony:

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Douglas S. Smith, Corporate Director, Environment, Safety and Health Date

Illinois DCCA:

_____

Reginald Willis, Manager, Division of Recycling and Waste Reduction Date

Wisconsin DNR:

_____

Cynthia Moore, Recycling Team Leader Date

Attachment C

SURVEY RESULTS

Participants

Out of 28 demanufacturers that were contacted, four responded to the survey and agreed to participate. Two that were not on the original list contacted were identified later in the project, and one of these agreed to participate.

Quantities

One recycler estimated they produce 100,000 pounds per month. An estimated total of 114,333 pounds per month of black HIPS was produced by four of the recyclers. The fifth recycler, identified later in the project to obtain additional material, did not know how much black HIPS they processed each year.

Price

The recyclers' current sense of the market for HIPS when the survey was conducted ranged from one to ten cents per pound for unprocessed plastic up to 18 cents per pound for clean HIPS. One recycler felt that the market had been consistent and stable over the past 1.5 years.

Processing and Storage

All five except one were able to bale the plastics. Four had enough storage capacity for 40,000 pounds or more for 4 to 6 weeks.

Attachment D

Request for Participation (RFP)
Recycling Market Development Project for Engineering Plastics

Processor Sought to Prepare Recycled Black Engineering Plastics from Recyclers for Manufacturing Process

RFP Application Open Until Filled

The Minnesota Office of Environmental Assistance (OEA) is a state agency that works to protect Minnesota's environment and assure a sustainable economy through waste prevention and resource conservation.

The purpose of this solicitation for proposal is to identify a plastics processor that can consistently prepare recycled HIPS to meet a manufacturer's quality control specifications and manufacturing demand schedule for 12 to 18 months.

Background

The Minnesota Office of Environmental Assistance (OEA), Sony Electronics, Inc. NA (Sony), and U.S. Environmental Protection Agency Region V (U.S. EPA), seek a qualified processor of plastics to be a principal partner in a project to recycle post consumer black engineering plastics from electronic products. The processor will be responsible for supplying Sony Electronics with an estimated 100,000 pounds per month of UL-certified recycled HIPS, delivered to a Sony-designated facility near San Diego.

The OEA, in coordination with U.S. EPA and other states in Region V, will coordinate efforts to identify recyclers who can produce consistent monthly quantities of black plastics to provide to the processor. The processor will be responsible for supplying recyclers with quality and shipping specifications for the recycled plastic. This responsibility may require the processor to provide written guidelines and training to recyclers involved in the project.

Specific recyclers will be identified to supply sufficient recyclable material monthly to the processor in order for the processor to meet its demand schedule with Sony. The processor may rely on the Minnesota OEA and U.S. EPA Region V to assist in the identification of recyclers to help aggregate enough pre-processed recycled HIPS from post-consumer sources.

Minnesota Office of
Environmental
Assistance

Tina Patton
Minnesota Office of Environmental Assistance
520 Lafayette Rd N Suite 200
St. Paul MN 55155-4100
651-215-0214 or 800-657-3843
<tina.patton@moea.state.mn.us>

Participants
Minnesota Office of Environmental Assistance (OEA), U.S. Environmental Protection Agency (U.S. EPA) Region V, Sony Electronics, Inc, Wisconsin Department of Natural Resources, Illinois Department of Commerce and Community Affairs, a plastics processor that can meet manufacturing specifications and demand schedules, and electronic product recyclers from Region V states and beyond.

The core Project Team includes representatives from Sony, the OEA, and U.S. EPA.

Qualifications Sought

The project team seeks a plastics processor capable of consistently preparing 100,000 pounds per month of high impact polystyrene (HIPS) resin for delivery to a production facility in San Diego. The HIPS must be Underwriters Laboratory (UL) certified. Processor must be able to meet all criteria set forth in the section titled, "Specifications required for recycled plastics," and in Table 1, below.

Specifications required for recycled plastics

- Meets Sony's specification and standards for quality. See Table 1.
- Must be certified by Underwriters Laboratory (UL).
- Processor must deliver 100,000 pounds/month of specified plastic in pelletized form (flake not currently acceptable).
- Color is to be black or very near black
- Fire retardant rating to be determined (either V-0 or HB).
- Packaging requirements must be met, as identified by Sony during Task 1.
- Selected processor will be a contracted supplier to Sony.

Table 1. Typical specification for black HIPS

ITEM	TYPICAL	METHOD
Melt Flow (gms/10min)	5.0-8.0	ASTM D1238 200/5
Izod Impact (Ft-Lb/In)	1.2 -1.5	ASTM D 256
Vicat (deg F)	212	ASTM D638
Tensile Yield (psi)	4400	ASTM D638
Tensile Elongation (%)	25-45	ASTM D638
Form	Pellets	

Evaluation Criteria for Prospective Processors
The successful applicant will meet all criteria described in this solicitation. The project team will begin reviewing applications upon receipt.

Project Timeline

The project team would like to conclude preliminary aspects of the project in the Spring of 2002 (May 2002). This will include selecting the processor, identifying recyclers and volumes of material for the project, and testing by Sony engineers of preliminary samples prepared by the processor.

Upon acceptance of samples a final contract will be signed between Sony and the processor. At that time, material shipments will begin from recyclers to the processor. The processor may also develop contracts with recyclers. The OEA and the project team may assist the processor in preparing such contracts and to conduct training with the recyclers involved in the project.

The manufacturer and project organizers are committed to conducting the project for 12 to 18 months. In the ninth month of material shipment to the manufacturer, the principal partners on the project will convene to decide to continue the project for nine additional months or to terminate it at the end of three additional months. The decision to continue or terminate the project will be based upon success of the project to date and the ability of the project to continue without support and oversight.

A project workplan is available upon request.

Submittal and Contact Information

The opportunity will be available until filled by Sony Electronics, but for not fewer than 21 days from the date it is advertised in *Plastics News*.

Questions and submittals should be directed to:

Tina Patton < tina.patton@moea.state.mn.us >
Minnesota Office of Environmental Assistance
520 Lafayette Road North
St. Paul, MN 55155-4100
(651) 215-0214 or (800) 657-3843

Additional Information

Project Objective and Summary
The purpose of this project is to learn about the barriers and opportunities to recycling plastics from used electronic products in the manufacture of new electronic products. The project planners seek to advance the establishment of closed-loop recycling for engineering plastics. The project is designed to utilize existing markets to create new, competitive domestic demand for engineering plastics. It is the intent of project participants that upon completion of the project new domestic markets for recycled engineering plastics will exist as self-sustaining, non-subsidized markets.

Plastics represent a large portion of the material composition of used electronic products. Finding viable markets for this material is essential for the development of a cost-effective recovery system for used electronics. Exploring and developing these markets are important because the plastic components of electronic products may contain as much or more residual value than any other single component or material stream recovered from these products. This project seeks to learn how to better exploit the residual value of these plastics and assumes that the best markets for this purpose are those markets which best utilize the original properties of the material.

Analysis of pilot projects to collect and recycle end-of-life electronics indicate that economies of scale may be achieved by the development of a larger collection infrastructure, and that a predictable, high-volume stream of used electronics can reduce transportation costs and foster greater demand for the secondary materials recovered. Analysis by the State of Minnesota also indicates that post-secondary

engineering plastics can be processed to meet strict specification standards set by electronic product manufacturers for use in new products.

The Minnesota Office of Environmental Assistance, Wisconsin Department of Natural Resources, and the Illinois Department of Commerce and Community Affairs will collaborate with Sony Electronics, recyclers, and a processor selected through a Request for Proposal (RFP) process. This collaboration will assess the feasibility of developing a market for the plastic material derived from post consumer electrical and electronic equipment. The U.S. EPA Region 5 will be supporting these efforts and aid in the production of a publication that presents findings.

This project will be evaluated for success based on the ability of participants to meet the production schedule of a large original equipment manufacturer for a specified period of time. The implications for reduced greenhouse gases (GHG) by the use of post-consumer plastic over virgin commodity for new product will also be evaluated.

Synopsis of the Project

The immediate goal of the project is to recycle post-consumer engineering plastics in high-end uses. This will be accomplished using existing business structures with little if any direct financial support. The project seeks to improve current recycling market conditions for engineering plastics by conducting a visible demonstration of the potential for using quality post-consumer supply for high-end manufacturing use.

The project intends to collect and process engineering plastics and deliver them to a major electronics manufacturer that will use the material in new product. Sony Electronics has committed to using plastics collected in this project if the project can guarantee a minimum amount of plastic, in the range of 100,000 pounds of processed plastics per month for a 12 to 18 month period. Achieving this volume of plastics will likely require twice the amount of unprocessed plastic. The project will use a qualified U.S. processor selected by Sony, the OEA, and Region V U.S. EPA. The processor will be selected through an RFP process. The OEA, U.S. EPA Region V, and states in the upper Midwest are working together to identify recyclers willing to participate in the project to meet the identified production schedule. While the program has originated in U.S. EPA Region V, recyclers from beyond Region V will be considered for participation to ensure adequate volumes of plastics are delivered on schedule to the processor. Recyclers will be asked to identify a minimum volume of material they can provide every month for 12 to 18 months. Contracts will be developed between the recyclers and the plastics processor to assure consistent quantity, quality and price. The processor will provide recyclers with guidance on quality and packaging expectations and may conduct site visits to provide specific training.

The long-term goal of the project is to build demand for a variety of post consumer engineered plastics derived from scrap electrical and electronic products. As demand increases, the supply side will likewise develop, thus creating a sustainable system for regaining more value from electronic waste. The project is intended to evaluate:

- Market demand for recycling post-consumer engineering plastics for the originally intended purposes of the material.
- Processing capacity to meet a manufacturer’s quality control specifications and manufacturing demand schedule.
- The existing and optimal capacity and capability of the recycling and manufacturing infrastructure to produce sufficiently valuable product and support adequate prices to expand recycling of engineering plastics from electronic products and IT equipment in production processes consistent with this project.
- The climatic benefits which occur when utilizing non-virgin plastic material, i.e., the measurable cumulative energy savings throughout the supply chain generated by using post-consumer recycled material.