CHELSEA CENTER FOR RECYCLING AND ECONOMIC DEVELOPMENT

UNIVERSITY OF MASSACHUSETTS

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Recycling Market Development for Engineering Thermoplastics from Used Electronic Equipment

Summary Report of the Stakeholder Dialogue Meetings On May 10, 1999 and June 22, 1999

March 2000

180 Second Street Chelsea, Massachusetts 02150 Tel: 617-887-2300 Fax: 617-887-0399

Recycling Market Development for Engineering Thermoplastics from Used Electronic Equipment

Summary Report of the Stakeholder Dialogue Meetings On May 10, 1999 and June 22, 1999

Patricia S. Dillon
The Gordon Institute at Tufts University

Chelsea Center for Recycling and Economic Development Technical Research Program

March 2000

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The Chelsea Center for Recycling and Economic Development, a part of the University of Massachusetts' Center for Environmentally Appropriate Materials, was created by the Commonwealth of Massachusetts in 1995 to create jobs, support recycling efforts, and help the economy and the environment by increasing the use of recyclables by manufacturers. The mission of the Chelsea Center is to develop an infrastructure for a sustainable materials economy in Massachusetts, where businesses will thrive that rely on locally discarded goods as their feedstock and that minimize pressure on the environment by reducing waste, pollution, dependence on virgin materials, and dependence on disposal facilities. Further information can be obtained by writing the Chelsea Center for Recycling and Economic Development, 180 Second Street, Chelsea, MA 02150.

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Figures and Tables

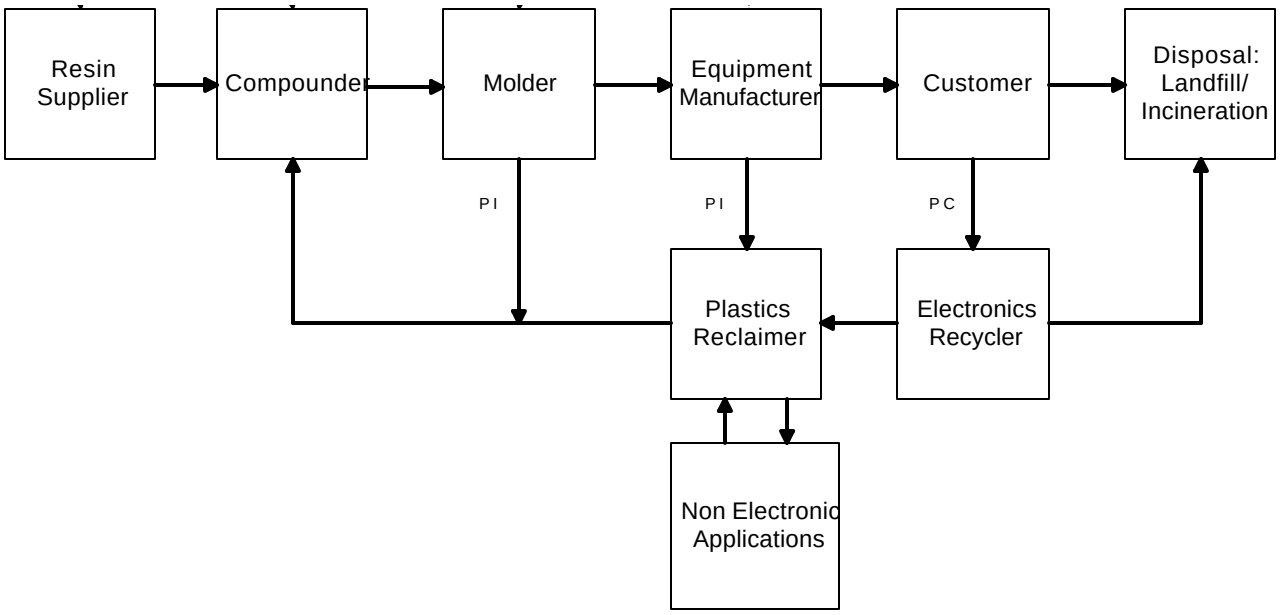
1. Introduction

The Gordon Institute (TGI) at Tufts University initiated a Stakeholder Dialogue process in the Spring of 1999 to bring together the plastics supply chain to discuss barriers and opportunities in the recycling and reuse of engineering thermoplastics (ETP) derived from used electronic equipment. The goal of the Dialogue process is to stimulate cooperation within the supply chain to collect and process the growing volume of discarded plastics from electronics, and utilize these recycled materials in new markets and applications. Figure 1 depicts the supply chain.

This report summarizes the outcome of the first two Stakeholder Dialogues, held on May 10, 1999 at Tufts University in Medford, Massachusetts and June 22, 1999 at Nypro Inc. in Clinton, Massachusetts. This summary should be viewed as a "work in progress". The Stakeholder Dialogues are just beginning to unravel the complexity of the issues, develop recommendations, and work towards supply chain collaboration.

Nypro, a molder of high-precision parts headquartered in Clinton, Massachusetts, was TGI's industry partner on this project. The Massachusetts Chelsea Center for Recycling and Economic Development provided funding for the initial Dialogues. The Stakeholder Dialogue process will continue in 1999/2000 with funding from the US Environmental Protection Agency Office of Solid Waste.

Figure 1: ETP Supply Chain



PI = Post industrial resin
PC = Post consumer resin

2. Agenda and Participation

Over 40 people, representing the diverse stakeholders in the ETP supply chain -- including resin suppliers, original equipment manufacturers, molders, plastics processors, and electronics recyclers, as well as representatives of government, academia and non-profit organizations -- attended each of the first two Stakeholder Dialogues. The overall objectives of these meetings were:

- to share experiences, case histories and performance results in use of recycled ETPs;
- to develop material and processing specifications for EPS that take into account the capabilities and needs of the supply chain;
- to identify barriers to the use of recycled content and brainstorm possible solutions that address identified limitations and opportunities;
- to identify potential applications and end markets for recycled ETPs and requirements of these markets; and
- to stimulate new collaborations and linkages in the supply chain that live beyond the project.

Each Stakeholder Dialogue was a combination of presentations, designed to showcase different perspectives and capabilities of the supply chain, and facilitated discussions in breakout groups. The agenda for the first meeting on May 10th was broad, covering the entire "reverse-logistics" plastics supply chain -- from electronics demanufacturing to plastics processing and reutilization for both high performance and low end applications. Multi-stakeholder breakout groups were asked to address:

- **barriers and issues** in recycling engineering thermoplastics throughout the supply chain and recommended actions to overcome these barriers;
- potential **applications and markets** for recycled engineering thermoplastics and recommended actions to enable these markets to utilize recycled resins; and
- **supply chain protocols** to enhance recycling of engineering thermoplastics.

The June 22nd Dialogue focused on the use of recycled ETPs in new applications, and leveraging the supply chain to "make it happen". The task of the breakout groups was:

- to explore the feasibility, successes and challenges in **using recycled-content resins** in injection-molded applications; and
- to develop strategies to increase the use of recycled-content resins by leveraging the supply chain.

Appendix A contains detailed agendas from each meeting and participant lists.

3. Presentations

Presentations were chosen to help participants become familiar with the activities, issues and challenges confronting diverse stakeholders, and to learn about the successes of some companies in processing and in the use of recyclate. Table 1 summarizes key points made by presenters at the May 10th and June 22nd meetings, organized by stakeholder groups. Table 2 outlines the steps in recycling ETPs, from demanufacture to reutilization, as outlined by IBM.

Table 1: Summary of Stakeholder Activities & Challenges

Stakeholders (by group)	Activities	Challenges
Resin Suppliers		

Allied Signal	❖ Offers several recycled content product lines, including post-consumer nylon resins
	❖ Evergreen Nylon Recycling, a chemical recycling process, converts "end of life" nylon 6 carpet to its base material, caprolactam
	  ❖ Performance same as virgin
	  ❖ Established collection method
	  ❖ Near infrared sorting devices pre-sort N6 carpet in field
	❖ Key drivers: product stewardship, customer demand, regulatory issues
		❖ Building performance into recycled product
		❖ Assuring quality feedstreams
		❖ Collection and sorting

GE Plastics (GEP)	❖ Currently offers some recycled product lines and is developing new products to meet customers' requests for “green” products and to guard against lower cost competition
	  ❖ 75 million lbs of recycled product sold last year
	  ❖ 20% growth rate expected
	❖ Utilizes post industrial and post-consumer feedstreams for recycled products lines
	  ❖ RC Lexan, a polycarbonate (PC) product, contains post-consumer compact discs & water bottles, manufacture off-spec resin, & obsolete inventory
	  ❖ GEP buysback water bottles and CDs from customers
	  ❖ The new Valox (PET-based resin) recycled product will combine reclaimed post-consumer PET bottles & post-industrial scrap from GE customers
	❖ Established control process to ensure quality and traceability of recycle feedstreams
		❖ Products with recycled content (RC) not necessarily less expensive after purchasing feedstream and processing
		❖ Reliable and consistent feedstream is critical and requires tie in to both post consumer and post industrial feedstreams

RC Plastics	❖ Division of LNP, focused on recycled content engineering plastics ❖ Offer several recycled resins (PC/ABS, PC, glass reinforced PC) in custom colors, flame retardant and non-flame retardant grades ❖ Processing steps for quality assurance	❖ Procurement of recycled-content plastics needs to be priority of OEMs ❖ Complexity of electronics stream necessitates automated sorting and identification technologies ❖ “Homes” needed for waste plastic

Table 1 (cont.)

Stakeholders (by group)	Activities	Challenges
Molders		
Nypro	❖ Experience using internal regrind in variety of applications, even medical applications ❖ Typical usage 25% by weight ❖ Quality assurance tracking system for regrind ❖ Several methods to reintroduce regrind, incl. closed loop systems ❖ Greater cost reductions with internal use of regrind than if sold on secondary market ❖ Cost savings depend on the amount of resin in the product and process waste generated	❖ Regrind has heat history, potentially limiting reuse applications ❖ Continuing, reliable source of material of known purity and origins ❖ Processing variations with use of recycled material ❖ Variability of recycled feedstock can lead to quality variations in finished product ❖ Identification of market applications
Moldflow Corporation	❖ Mold design analysis to determine optimum mold and part design prior to investing in tooling and to avoid "trial and error" ❖ Analysis requires material property data	❖ Currently little/no material data on recycled resins ❖ Need grade specific data for analysis ❖ Material characterization costs time and money
Equipment Manufacturer		
IBM	❖ Environmentally Conscious Products (ECP) Program drives plastics recycling efforts ❖ Design objectives for "use of recycled materials" & "recyclability" ❖ Recycled-content plastic usage metrics: "net" poundage of and no. of parts using recycled content ❖ Progress in qualification and use of recycled content plastics ❖ Over 2 million pounds of recyclate used since 1995 ❖ Recycled content resins in 6 major product lines, both internal and decorative parts ❖ Qualified PVC, PC/ABS, PC and PPO in standard and other grades ❖ No significant difference in properties 13-100% post consumer and post industrial ❖ IBM IntelliStation E Pro Desktop ❖ 100% recycled PC/ABS from pre and post consumer sources; all parts equal to or less than prime cost	❖ Fragmented ETP supply chain ❖ Need to collaborate to accomplish the key elements of the process (see Table 2) ❖ Lengthy qualification process for each part using recycled resin ❖ Availability of recycled resins for molding trials and parts production in required colors ❖ Worldwide availability of recycled grades satisfying price targets, processing and functional requirements. ❖ Adequate feedstock given mixed electronics waste stream and current processing capabilities ❖ Dynamics of prime resins and products (e.g., shift in resin use and product cycles) ❖ Lack of perceived benefits ❖ Environmental benefits insufficient without economics

Table 1 (cont.)

Stakeholders (by group)	Activities	Challenges
Customers State of MA	❖ New computer procurement initiative lists "recycled content in plastic housings and other parts" as a desirable criteria	
Electronics Recyclers Metech	❖ Some recovery of single and mixed resins from electronic waste ❖ segregated engineering plastics (e.g., TPO) for compounding applications ❖ mixed plastics for pavement and other applications	❖ Resin identification ❖ Plastics contamination affecting marketability (e.g., metals, EMI coatings, flame retardants, fillers) ❖ Price competition for off-spec & post industrial materials ❖ Limited use of styrenics in mixed plastics applications ❖ Need more markets for post consumer plastics from electronics
Plastics Processors MBA Polymers	❖ Processing and sale of ETPs from durable goods, including automotive and electronics ❖ Extensive R&D over past several years to develop processing technology with support of industry and government ❖ Over 3 million pounds processed as of 6/99 ❖ Currently mostly toll processing ❖ Primary resins targeted for recovery: ABS, HIPS, PC, PC/ABS	❖ Numerous types and grades of plastics and products ❖ Wide range of well-adhered contaminants ❖ Cost-effective collection ❖ Marketing recycled material
RST	❖ Processing facility with technology to sort and clean ETPs, including paint and coatings removal	❖ Fast identification equipment for presorting ❖ Markets for "waste" and low end plastics (e.g., ABS, HIPS, brominated plastics) ❖ Difficult to put value into processing when low market value ❖ Investment of OEM, compounder and processor ❖ High volumes of material

Table 1 (cont.)

Stakeholders (by group)	**Activities**	**Challenges**
Alternative End Markets		

SelecTech	❖ Injection molded products from mixed and contaminated plastics
	❖ Focus on big, heavy products with few tolerance requirements and low aesthetic requirements
	  ❖ E.g., planters, landscape timbers, speed bumps, industrial floor tiles
	  ❖ Often plastic replaces other materials (e.g., clay, concrete) and adds value
	❖ Unique processing technology tolerates contaminants and mixed plastics, eliminating the need for conventional processing steps, (e.g., sorting, washing, pelletizing) and lowers feedstock and processing cost
	❖ Does not currently use ETPs from electronic waste, but would like to consider
	  ❖ Current feedstocks include waste carpet, wire insulation, PE films	

Table 2
Key Elements of the Process from Demanufacture to Reuse

*1. **Generating** plastic waste through demanufacturing and scrap processing
2. **Sorting** by color, type and quality
3. **Densification** by shredding and/or grinding
4. **Purification** for contaminant removal
5. **Compounding** with additives and pelletizing
*6. **Qualification** to meet material specifications
*7. **Identify Application** matched to material
*8. **Part Qualification** to meet processing and functional requirements
*9. **Specify Recycled Material** on part drawing
*10. **Molding Production Parts:** quality & price

* Process steps that IBM is directly involved in.
Source: Dewey Pitts, IBM, June 22, 1999.

4. Breakout Group Discussions

Brainstorming in the breakout groups at both meetings surfaced many important issues, although there was little time for in-depth discussion or the generation of action plans. The summaries below should be viewed as "works in progress", documenting the key issues discussed within the multi-stakeholder breakout groups. The issues are not prioritized (unless otherwise noted), and do not necessarily represent a consensus among participants. These summaries will be used as a starting point for future Stakeholder Dialogues.

May 10 Breakout Group Discussions

Barriers

Two breakout groups discussed barriers to recycling of engineering thermoplastics. Following an initial brainstorm session, each group prioritized the barriers, as summarized in Table 3, using a multi-voting process. Although given the same assignment, the results were very different. One group's discussion primarily focused on supply issues, while the other concentrated on product design issues. Time permitting, participants developed recommendations for overcoming barriers.

The dominant barriers emerging from the discussions can be consolidated into several key, yet overlapping, themes useful for framing future Dialogues.

- **Product recovery.** There is a need for more efficient collection systems for electronic equipment in order to accumulate and aggregate like resins and achieve the volumes of plastics needed for cost-effective processing and market development. Participants voiced a role for equipment manufacturers and resin suppliers in such a system.

- **Economics of sorting and processing mixed resin streams**. Currently the economics of recycling ETPs are marginal. After collection and processing, the price of recycled-content resin may exceed the price of prime resin. This is a disincentive for OEMs who are looking for cost reductions, or cost parity at a minimum. Increasing the volume of material processed should result in greater efficiencies and cost reductions (i.e., economy of scale).

- **Continuity of supply.** Equipment manufacturers are reluctant to specify recycled resin without supply assurances, and resin suppliers are reluctant to make available recycled product without consistent, quality feedstreams.

- **Lack of design protocols and material specifications.** Given time to market pressures, the use of recycled content is often hindered by a lack of readily available protocols and material specifications for recycled resins, compared to virgin resins.

Table 3
Barriers to Recycling ETPs

* Scored highest in multi-voting process

BARRIERS	RECOMMENDATIONS
Group 1	
* Economics ♦ Processing is marginal ♦ Cost of collection and transport given immature infrastructure ♦ Lack of perceived benefits in using recycled content	♦ Develop cost-benefit analysis for use of RC, e.g., reject ratio, material cost, cycle time
* Continuity of supply and [lack of] product take back ♦ Consistent supply volume and composition ♦ Identification of additives in recyclate ♦ [Lack of] extended producer responsibility (EPR) ♦ Customer/supplier relationships ♦ Information sharing on materials supply	♦ Build consortium of electronics recyclers to pool resources for access to larger quantities of 1material ♦ Need economically viable identification technologies for materials and additives ♦ Need for increased product recovery and EPR starting with resin supplier ♦ Build relationships and communication among suppliers, customers, recyclers, & manufacturers to develop materials supply ♦ Establish clearinghouse for information on material supply
* Regulatory issues ♦ FR certification for products sold in Germany ♦ UL specifications	♦ Clarification and education about additives (e.g., bromines) ♦ Clarification about regulatory issues & restrictions
♦ Lack of incentives for using recycled content (e.g., regulation)	
Group 2	
* Lack of design for recycling information at the product level * Lack of material specifications for RC resins ♦ chemical composition ♦ thermal history ♦ material processability & variability ♦ Lack of corporate/industry/trade association demand or commitment to recycled ♦ Lack of alternative markets ♦ Lack of understanding of the economics of recycled resin compared to prime ♦ Transportation and storage costs	

Markets and Applications
One breakout group was assigned the task of identifying potential markets and applications for recycled ETP and the requirements of these markets. The group brainstormed an extensive list of potential markets and applications for recycled ETPs, as outlined in Table 4. One application, computers, was selected for a more detailed look at product requirements, challenges and recommendations (Table 5).

June 22 Breakout Group Discussions

Designing Products with Recycled Content
Designing products with recycled content was the task assigned to the breakout groups on June 22, including:

- the feasibility, successes and challenges in using recycled-content resins in injection molded applications;
- how to accomplish the goal of incorporating recycled content into product; and,
- strategies to increase the use of recycled content resins by leveraging the supply chain.

Tables 6, 7 and 8 outline some of the key results of the brainstorming and discussion sessions on use of recycled-content resins. One group validated the key elements in the ETP recycling process presented in Table 2 above and elaborated on the key steps to incorporate recycled content into new applications (see Table 6). They noted that the process for qualifying recycled-content resin is no different than the introduction of any new material into the manufacturing process.

Roles and Responsibilities of the ETP Supply Chain
Table 9 highlights one group's thoughts on how the supply chain must work together to accomplish ETP recycling objectives.

****Recommendation****
Increased communication is needed to "spread the word" about current successes, processing capabilities and feasibility of using recycled content. See Table 9 for examples.

5. Next Steps

The initial Stakeholder Dialogues brought together key representatives of the ETP supply chain, and began to lay some essential groundwork for further development. The Gordon Institute at Tufts University has received funding from the US EPA Office of Solid Waste to continue the Stakeholder Dialogue process. Future meetings will predominantly focus on flushing out priority issues, such as addressing key barriers, and the generation of action plans. A multi-stakeholder Advisory Committee will be formed to assist in the planning for future Dialogues. The Gordon Institute will also explore possibilities for creating an on-line communication mechanism to provide an on-going Dialogue and possibly reach a broader network of stakeholders.

Table 4
Potential Markets for Recycled ETPs

- Telecommunications
  - spools
  - novelty phones
  - fax machines
  - modems, hubs for networks
- Automotive
  - bumpers, mirror housings
  - liners on pickup trucks
  - low temperature engine parts
- Electrical
  - fuse boxes, enclosures, connectors
  - wire nuts
  - wire coating
- Construction
  - flooring, counter tops
  - artificial lumber
  - concrete additives, insulation
  - supplies (e.g., scaffolding)
  - vinyl siding/windows, roofing
- Materials Handling
  - pallets, shipping containers
  - recyclable totes
- Computer/Data Processing
  - internal parts such as stiffeners, fan housings
  - external parts such as housings, pedestals, handles, painted parts
- Household Appliances
  - vacuum cleaners, coffee machines
  - power tools
  - TVs, radios, VCRs
- Yard & Garden
  - handles for rakes and tools
- Traffic Control
  - speed bumps, parking stops
  - guardrail posts

Table 5
Computer Applications

Product Requirements
- Cost of recycled content equivalent to prime
- Comparable engineering properties
- Cosmetic needs

Market Requirements
- Sufficient & consistent supply
- Consistent color
- Competitive cost

Challenges
- Bromine/toxic contaminants
- Inconsistent supply stream
- Lack of national standards
- New material qualification process adds time & cost

Recommendations
- Focus on non-visible parts and parts with secondary finish
- Promote design for plastics disassembly and recycling
- Create demand and incentives for RC
- Develop a "seamless" process (i.e., parity with prime) for designers to incorporate recycled content
- Develop industry standard for color of internal parts based on composition of recovered material.
- Use recyclate as middle layer in layered, co-injection molded application.
- Develop industry collaboration to build infrastructure and quality, consistent supply
- Develop government procurement specifications
- Communicate success stories

Table 6
Steps to Incorporate Recycled Content into Product

This process is no different than the steps needed to use any new material in a product, although participants noted that the use of recycled content comes under more scrutiny.

Material Qualification	Need representative material for testing After material is approved for use, this step can be skipped for subsequent applications.
Identify Application	Some applications are easier to start with, for example: ♦ parts where color not an issue; ♦ internal parts; ♦ parts with no major performance criteria; ♦ parts with thick walls to avoid concerns about rigidity, flow, strength; ♦ textured finish. More difficult applications to introduce recyclate include: ♦ cosmetic parts; ♦ critical performance features such as color, Class A finish.
Parts Qualification	Similar to molding trials for any new resin: ♦ Need adequate material supply; an existing tool; critical functions/companies present at trial, including resin supplier for technical support ♦ Change processing parameters as needed to accommodate new material ♦ Check parts for critical dimensions and appearance

*****Recommendation*****
Consider recycled-content grades or internal regrind in initial qualification and validation process along side prime resin.

Table 7
Drivers Influencing Use of Recyclate

Positive
- Corporate directive
- Corporate direction or policy
- Internal champion
- Country restrictions
- Government regulations
- Customer requirements
- Manufacturing incentives (e.g., inventory reductions, cost reductions, available scrap)

Negative
- Recycled material costs more
- Perceived risk of using recycle
- Some loss of properties depending on application

Table 8
Critical Success Factors for Increasing Use of Recyclate

- Enhance separation technology
- Design for de-manufacturing
- Improved collection infrastructure
- OEM's have to "want it"
- Overcome negative attitude -- "it didn't work then, it won't work now"
- Flexibility in material specifications
- Economies of scale (e.g., transportation to recycler)
- Economic balancer
- Tangible savings in using recyclate (e.g., energy)
- Identify and clarify roles of supply chain (e.g., OEM's, suppliers, consumers)
- Market development

Table 9
ETP Supply Chain - Roles and Responsibilities

Supply Chain	*Role & Responsibility*	*Communication Needs*
OEMs	Take the initiative and ask for/specify recycled content.	Give them credit for accomplishments to date; publish data documenting success.
Molders	Push OEMs, pull suppliers	Let supply chain know that recyclate is feasible from molders perspective.
Mold Designers & Academia	Provide design data	
Resin Suppliers/ Compounders	Product stewardship Provide consistent supply	Publicize availability of recycled-content supply.
Plastics Recyclers	Provide consistent quality and volumes	Equipment and processes
OEM/Communities/ Electronic Recyclers	Collection	Document best practices, economics and volumes.

6. Appendix

- **Meeting Agendas**
- **Participant Lists**

Recycling Market Development for Engineering Thermoplastics from Used Electronic Equipment

Stakeholder Dialogue 1: Exploring Barriers and Market Opportunities

Tufts University
May 10, 1999

AGENDA

8:00 - 8:45 **Coffee and Pastries**

8:45 - 9:00 **Welcome & Dialogue Overview**
Patty Dillon, The Gordon Institute at Tufts University
Brian Jones, President, Nypro

9:00 - 9:30 ***Recycling Successes and Challenges at IBM**
Dewey Pitts, IBM

9:30 - 10:15 **State of the Art in Plastics Recycling and Identification**
Cesar Castro, MBA Polymers
*Ed Grant, Purdue University and SpectraCode

10:15 -10:45 **BREAK**

10:45 -12:15 **Panel Discussion**
Experience, Feasibility, and Opportunities in Recycling Engineering Thermoplastics: Supply Chain Perspectives
Moderator: Ed Aqua, The Gordon Institute
1. *Electronic recycler (Chris Ryan, Metech International)
2. Plastic processor (Ron Roberto, RST)
3. *Resin supplier (Don Edens, RC Plastics)
4. *Molder (Joe Rizzo, Nypro)
5. Manufacturer (Tom Ricciardelli, SelecTech)
6. *Government procurement (Eric Friedman, Mass Procurement Office)

12:15 - 1:30 **LUNCH**

1:30 - 3:30 **Key Issues, Barriers and Opportunities**
Breakout discussion groups to address the following issues, working towards specific recommendations and action plans.
1. Barriers in recycling engineering thermoplastics throughout the supply chain and recommended actions to overcome these barriers;
2. Potential applications and markets for recycled engineering thermoplastics and recommended actions to enable these markets to utilize recycled resins; and
3. Supply chain protocols to enhance recycling of engineering thermoplastics.

3:30 - 4:30 **Recommendations/Next Steps**

***** Copy of presentation available

Participant List
Stakeholder Dialogue 1
May 10, 1999

Mark Abare	Plastics Distributors and Fabricators
Edward Aqua	The Gordon Institute at Tufts University
Chris Beling	US Environmental Protection Agency
Cesar Castro	MBA Polymers
Mark Corbett	Pitney Bowes
Patricia Dillon	The Gordon Institute at Tufts University
David Dodds	RC Plastics
Dennis Doran	Pharr Yarns Trading Co.
Don Edens	RC Plastics
Michael Fisher	American Plastics Council
Eric Friedman	Commonwealth of Massachusetts
Peter Glekas	Injectronics Inc.
Ed Grant	Purdue University/SpectraCode
Stephen Greene	Polaroid Corporation
Liz Harriman	Toxic Use Reduction Institute
Dick Hermann	Nypro Inc.
Matthew Hoyt	BASF Corporation
Brian Jones	Nypro Inc.
Michael King	SelecTech Inc.
Jim Kinsella	Domino Enterprises Inc.
J. Ray Kirby	IBM
Gloria Labovitz	Nypro Inc.
Frank Liberti	GE Plastics
Steve Long	Commonwealth of Massachusetts
Lorenzo Macaluso`	University of Massachusetts
Cindy Murphy	MCC
Barry Parker	University of Massachusetts
Dick Peloquin	ElectronicCycle Inc.
David Pierce	BASF Corporation
Dewey Pitts	IBM
John Quentilian	Allied Computer Brokers, Inc.
Steve Quigley	Hi-Tech Hose
Tom Ricciardelli	SelecTech Inc.
Joseph Rizzo	Nypro Inc.
Ronald Roberto	Recycling Separation Technologies, Inc.
Chris Ryan	Metech International
Lauren Sharfman	WasteCap of Massachusetts
Jodie Siegel	Chelsea Center for Recycling and Economic Development
Robert Smetana	Nypro Inc.
Julie Ann Stuart	Ohio State University
Pat Trudeau	Nypro Inc.
Amy Ullman	Wiltec, Inc.

Stakeholder Dialogue 2:
Moving Recycled Engineering Thermoplastics into High Performance Applications

hosted by Nypro Inc.
Clinton, Massachusetts

June 22, 1999

7:30 am	**Continental Breakfast**
8:00am - 8:30 am	**Welcome & Introductions** *Brian Jones, Nypro Ed Aqua, The Gordon Institute at Tufts University
8:30am - 12:00 am	**Making It Happen: Case Studies and Perspectives from the Supply Chain** Moderator: Bob Smetana, Nypro **Processing Recyclate in Medical Applications at Nypro** (Doug Thorpe, Nymedex) ***Recycling Engineering Thermoplastics from Durable Goods** (Michael Biddle, MBA Polymers) ***GE Plastic: A Supplier Perspective** (Dick Smith) ***Allied Signal: Successes and Opportunities** (Joe Barnes) *"Mold Analysis" Perspective on Designing with Recycled Material (Glenn Longwell, Moldflow Corporation) ***Recycling Plastics in Computer Applications** (Dewey Pitts, IBM)
12:00 pm - 1:00 pm	**LUNCH** **Demonstration of Nypro Institute's Online Training Program** Dick Hermann, Nypro
1:00 pm - 3:30 pm	**Leveraging the Supply Chain to Make It Happen** Breakout discussion groups will discuss roles, what's needed, and requirements of the supply chain to achieve recycled content objectives for selected applications
3:30 pm - 4:00 pm	**Reports from Breakout Groups**
4:00 pm - 4:30 pm	**Recommendations and Next Steps** Patty Dillon, The Gordon Institute at Tufts University

* Copy of presentation available.

Participant List
Stakeholder Dialogue 2
June 22, 1999

Edward Aqua	The Gordon Institute at Tufts University
Joseph Barnes	Allied Signal
Chris Beling	US Environmental Protection Agency
Lawrence Bell	Nypro, Inc.
Michael Biddle	MBA Polymers
Jay Celorie	Hewlett Packard Company
Al Cochran	Carbon Polymers
Greg Conigliaro	Conigliaro Industries
Mark Corbett	Pitney Bowes
Myfanwy DeVoe	Hewlett Packard Company
Patricia Dillon	The Gordon Institute at Tufts University
Mark Dinnie	Nypro Clinton
Don Edens	RC Plastics Inc.
Michael Fisher	American Plastics Council
Gary Foreman	RC Plastics Inc.
Robert Hall	Association for Manufacturing Excellence
Dick Hermann	Nypro Inc.
Cathie Hess	GE Plastics
Carol Jacobson	Nypro Clinton
Brian Jones	Nypro Inc.
Michael King	SelecTech Inc.
Tony Kingsbury	Dow Chemical
Jim Kinsella	Domino Enterprises, Inc.
Kelly Florchak	Injectronics Inc.
Michael Foster	Allied Signal
Glenn Longwell	Moldflow Corporation
PJ Murphy	Plasticsnet
Randy Palmer	Nypro Inc.
Deborah Perchart	Allied Signal
Amy Perlmutter	Chelsea Center for Recycling and Economic Development
David Pierce	BASF Corporation
Dewey Pitts	IBM
William Quinn	Polaroid Corporation
Howie Reisdorf	General Polymers
Joseph Rizzo	Nypro Inc.
Ron Roberto	Recycling Separation Technologies Inc.
Chris Ryan	Metech International
Jodie Siegel	Chelsea Center for Recycling and Economic Development
Steve Silver	Civiera & Silver International Inc.
Robert Smetana	Nypro Inc.
Richard Smith	GE Plastics
Doug Thorpe	Nymedex
Pat Trudeau	Nypro Clinton