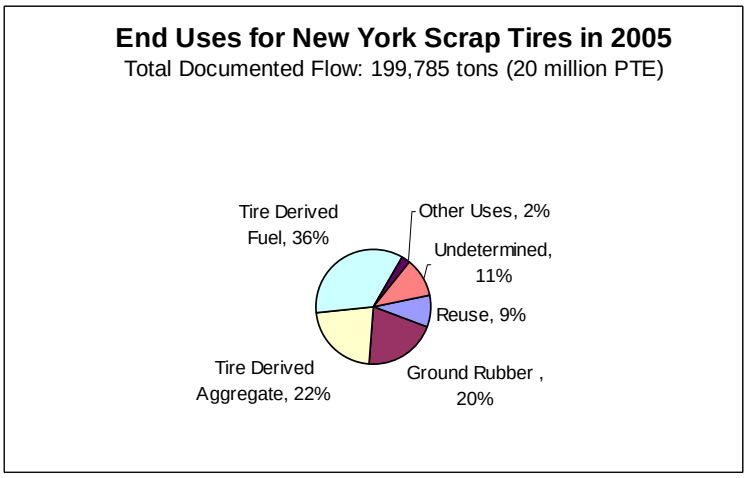
Analysis of New York Scrap Tire Markets: 2007 Update

Prepared for:
New York State Department of Economic Development



2007

R·W·BECK

Analysis of New York Scrap Tire Markets: 2007 Update

Table of Contents

R·W·BECK

APPENDICES:

List of Tables

List of Figures

EXECUTIVE SUMMARY

This is the third in a series of annual reports analyzing markets for scrap tires[1] generated in New York State. In 2005 markets for New York generated scrap tires continued to diversify and expand, as they have regionally and nationally in recent years. R.W. Beck documented the flows of 199,785 tons (20.0 million PTE) of scrap tires generated in New York in 2005. These scrap tires flowed into five broad use categories, as shown in Figure ES-1.

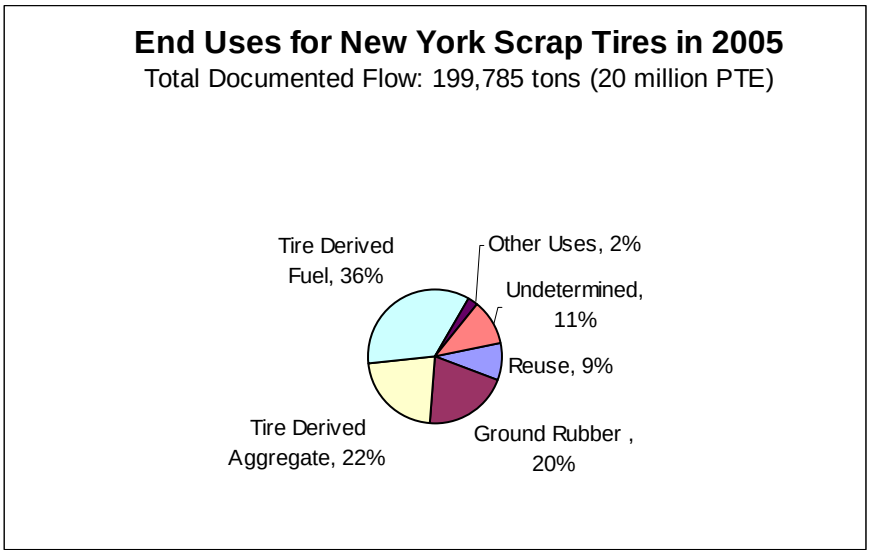


Figure ES-1: End-Uses for Annually Generated New York State Scrap Tires in 2005 (Annual Generation = 199,785 tons, 20 million tires)

Key market trends include:

- The tire derived fuel (TDF) category[2] experienced strong growth in 2005. This trend continued in 2006 with an approximately 25 percent increase over 2005 levels. Total use in this category of 71,801 tons (7.2 million PTE) represents more than 11 percent growth over 2004 and more than 44 percent growth over 2003. Growth in this category was driven by high costs for conventional power generation fuels, resulting in substantial increases in scrap tire use by two New York utilities and the dedicated tire-derived fuel facility in Exeter, CT. In

[1] Unless otherwise noted, in this report the term "tire" is equated to a Passenger Tire Equivalent (PTE). This report adheres to an assumed 20 pounds per PTE for consistency with previous reports. However, current research indicates a typical scrap passenger tire weighs closer to 22.5 pounds.

[2] In this year's annual update, use of scrap tires in electric arc furnaces at steel mills has been reclassified as "other recycling." Formerly, this use was classified along with TDF as "raw materials and fuel."

addition to the use of New York generated scrap tires, an increasing number of scrap tires are being imported into New York for use as TDF.

- Markets for ground rubber remained strong, with total use of New York generated scrap tires estimated at 39,800 tons (3.9 million PTE), led by the Athletic Surfacing and Horticultural category, and driven by continued growth in sports turf, mulch and playground products. While total use declined somewhat in 2005 compared to 2004, demand in this category is expected to significantly rebound in the coming year due to continued strong markets, planned expansions and the start-up of a new production facility in late 2006.
- Use of tire-derived aggregate in landfill engineering applications, at 43,954 tons (4.4 million PTE) declined by 23 percent compared to 2004, but remained a very significant use -- accounting for 22 percent of total flow. Moreover, the number of landfills using TDA in engineering applications appears to be growing.
- Estimates of scrap tires flowing to the reuse category in 2005 indicated a slight increase over 2004 at 17,507 tons (1.7 million PTE). About 4,600 tons of scrap tires flowed into the "other recycling" category in 2005. This is a slight decrease from 2004, even though this year the "other recycling" category was redefined to also include a new use – electric arc furnaces – that had previously been classified with TDF in the "raw materials and fuel" category (no longer used in this report).
- Just over 70 percent of all New York generated scrap tires flowed to in-state end-use markets, with the remainder flowing to other states and to Canada. Additionally, just under 50,000 tons of scrap tires (5 million PTE) were imported to the state, primarily from neighboring states.

Use of tires abated from noncompliant waste tire stockpiles was just getting underway in Study Year 2005. However, by December 2006 over 75,000 tons (7.5 million PTE) had been processed and/or shipped from noncompliant waste tire stockpiles, with approximately 156,000 tons (15.6 million tires) remaining. These processed waste tires are being used primarily in DOT road construction projects, although some have also found their way into landfill TDA projects and in raw material applications.

Section 1
INTRODUCTION

This is the third in a series of annual reports analyzing markets for scrap tires generated in New York State. Scrap tires are a potentially valuable material that can serve as feedstock for reuse and recycling businesses, provide a low-cost fuel alternative to manufacturers and utilities, and provide other beneficial uses. Although the economic value of recovered scrap tires is generally low relative to processing and transportation costs, scrap tire markets are several years into a period of significant expansion and diversification in New York and throughout the Northeast. In contrast to recycling, disposing of tires wastes their value and presents important environmental challenges. Stockpiled tires, in particular, present a substantial environmental and public health hazard. They are a persistent breeding ground for mosquitoes and rodents, and can fuel dangerous and difficult-to-extinguish fires. Tire fires can result in contamination of surrounding surface and ground water; and air contamination from tire fires can be widespread, substantially affecting human and environmental health as well as commercial activities.

The State of New York is aggressively working to strengthen scrap tire markets and to clean up noncompliant waste tire stockpiles. The New York Waste Tire Management and Recycling Act of 2003 instituted a $2.50 fee on each new tire purchased, to be placed in a Waste Tire Management and Recycling Fund. The Act requires the New York State Department of Environmental Conservation (DEC) to work in concert with the Department of Transportation (DOT) and other agencies in the abatement and beneficial reuse of non-compliant waste[3] tire stockpiles. Also, the Act requires the New York State Department of Economic Development (DED) to prepare an annual analysis of scrap tire markets and to implement a comprehensive program to expand markets in support of the following priorities:

1. Reduce the number of waste tires generated;
2. Remediate waste tire stockpiles in noncompliance;
3. Recycle waste tires into value-added products;
4. Beneficially use waste tires in an environmentally acceptable manner, including beneficial use in civil engineering applications; and
5. Recover, in an environmentally acceptable manner consistent with the purpose of the Act, energy from waste tires that cannot be economically recycled or otherwise beneficially used.

[3] In this report the terms *waste tire* and *scrap tire* are used synonymously. The Act defines *waste tire* as "any solid waste which consists of whole tires or portions of tires [including] tire casings separated for retreading and tires with sufficient tread for resale…"

To assist DED in complying with these requirements, in Fall 2004, DED contracted with R.W. Beck, Inc. to prepare a comprehensive analysis of New York scrap tire markets, including detailed background information on each market. The comprehensive market analysis was completed in 2005. Two annual updates to the market analysis have been prepared, the second of which is represented by this report.

Summarized in the following sections of this report is information on:

- Markets for annually generated scrap tires in Study Year 2005 (along with trends in 2006 and a comparison with 2003 and 2004 findings);
- Progress towards abating stockpiled waste tires;
- Inter-state scrap tire flows;
- New York State efforts involving the use of ground rubber in asphalt paving; and
- Overall findings and conclusions.

Additionally, Appendix A summarizes the methodology used and discusses sources of uncertainty and the degree of confidence in results; Appendix B lists DED's investments in market expansion through the Waste Tire Management and Recycling Fund to date; Appendix C lists examples of New York State tire-derived aggregate applications; and Appendix D summarizes the results of a scrap tire market forum sponsored by DED and held on December 11-12, 2006.

The report is limited to a presentation of aggregated statistics. To protect confidentiality, no company-specific information or data are presented.

Section 2
ANNUALLY GENERATED SCRAP TIRES

This section summarizes markets for annually generated scrap tires. First, a brief market overview and description of scrap tire generation are provided, followed by findings for each broad market category.

Market Overview and Key Trends

Table 2-1 details the end uses to which annually generated New York scrap tires flowed in 2005, along with key trends. Accurately estimating scrap tire supply and demand is complicated by numerous sources of uncertainty, including the need to deal with incomplete, inconsistent, inaccurate, and sometimes conflicting data and information. Because overcoming these data barriers is time consuming and challenging, these supply and demand estimates should be viewed as the best available approximations. R.W. Beck will continue to seek to refine these estimates in the annual updates to be prepared under contract to DED through 2008. (See Appendix A for additional discussion of methodology and sources of uncertainty.)

Table 2-1
2005 Markets for NY Scrap Tires and Key Trends

Market Category	Submarket	2005 Use of NY Scrap Tires (Tons)	2005 Use of NY Scrap Tires (PTEs)	Percent of Total	Key Trends
Reuse	Partially Worn Reuse	13,829	1,382,901	6.9%	Expected to remain stable
	Retread and Remanufactured	3,678	367,846	1.8%	Expected to remain stable
	Subtotal – Reuse	17,507	1,750,747	8.8%	
Ground Rubber	Roads	1,310	130,980	0.7%	Expanded demonstrating in NY in 2006. Expected steady but very slow growth in near term
	New Tires	1,445	144,480	0.7%	Likely to remain negligible. No direct NY suppliers to new tire industry
	Athletic Surfacing and Horticultural	26,598	2,659,805	13.3%	Sustained growth in 2006; sharp growth in 2007 due to new supplier and expansions
	Molded Products	1,508	150,808	0.8%	Likely to remain stable with moderate growth in 2007 potential due to anticipated new capacity
	Rubber-Plastic Compounds	353	35,280	0.2%	Potential for growth, will likely remain negligible in near term
	Misc. Ground Rubber	8,586	858,644	4.3%	Most likely sold into sports surfacing and horticultural market, but could not be documented
	Subtotal - Ground Rubber	39,800	3,979,997	19.9%	

Market Category	Submarket	2005 Use of NY Scrap Tires (Tons)	2005 Use of NY Scrap Tires (PTEs)	Percent of Total	Key Trends
Tire Derived Aggregate	Roads	108	10,800	0.1%	Use of annually generated scrap tires (as opposed to stockpiled waste tires) likely to remain negligible
	Landfill	43,954	4,395,399	22.0%	Slight decline in use in 2006 with continued decline expected in 2007 due to competition for scrap tires and reduced demand at some landfills
	Septic	0	0	0.0%	Potential for growth remains unproven
	Subtotal - TDA	44,062	4,406,199	22.1%	
Tire Derived Fuel	Utilities, Dedicated Tire-Derived Fuel, Waste-to-Energy Facilities	71,801	7,180,138	35.9%	Sustained strong demand. In-state demand grew by 25% in 2006, with further growth expected in 2007. Increasing % of NY demand met via imports.
	Subtotal - TDF	71,801	7,180,138	35.9%	
Other Recycling		4,607	460,716	2.3%	Likely to remain stable
Other Unspecified		22,007	2,200,711	11.0%	
	Subtotal - Other	26,614	2,661,427	13.3%	
Total Documented Flow[4]		199,785	19,978,508	100.0%	

Source: R.W. Beck, Inc.

[4] Column totals may not be exact due to rounding.

Table 2-2 compares the results by broad market category for 2003, 2004 and 2005. The findings for 2003 and 2004 have been recalculated to adjust for two changes in the categorization system used. The use of scrap tires in electric arc furnaces at steel mills was removed from the former "raw materials and fuel" category. That category was re-titled "tire derived fuel" (TDF) with its remaining two subcategories combined. Following Table 2-2, a market overview and key trends are presented. Subsequent portions of this chapter summarize trends in each market category.

Table 2-2
Comparison of 2003, 2004 and 2005 New York Scrap Tire Markets

Market Category	2003 Use of NY Scrap Tires (Tons)	2003 Percent of Total	2004 Use of NY Scrap Tires (Tons)	2004 Percent of Total	2005 Use of NY Scrap Tires (Tons)	2005 Percent of Total
Reuse	8,140	3.9%	15,441	7.5%	17,507	8.8%
Ground Rubber	23,938	11.5%	46,485	22.5%	39,800	19.9%
Tire Derived Aggregate	67,883	32.5%	57,302	27.7%	44,062	22.1%
Tire Derived Fuel	49,834	23.9%	64,737	31.3%	71,801	35.9%
Other Recycling	7617	3.7%	10,085	4.9%	4,607	2.3%
Other Unspecified	52,143	25.0%	12,566	6.1%	22,007	11.0%
Total Documented Flow[4]	208,580	100.0%	206,617	100.0%	199,785	100.0%

Source: R.W. Beck, Inc.

In 2005, markets for New York generated scrap tires continued to diversify and expand, as they have regionally and nationally in recent years. R.W. Beck documented the flow of 199,785 tons (20.0 million PTE) of New York generated scrap tires, with about 70 percent of these tires flowing to in-state end-uses.

Key market trends include:

- Overall, scrap tire demand has increased substantially in the Northeast, and especially in New York State, in recent years. This increase in demand has been driven largely by TDF users (including two New York utilities that together used over 53,000 tons or 5.3 million PTE, with about 25 percent being imported into the state). These two facilities showed a further 25 percent increase in total demand in 2006. Despite a drop between 2004 and 2005, scrap tire demand by ground rubber producers is also increasing, especially with the opening of a major new producer in December 2006. Increased demand is tightening the supply of scrap tires and putting downward pressure on tip fees in some areas, especially the Albany and Buffalo areas, with one firm reporting tip fees of as low as $25-50 per

ton. Tightening scrap tire supplies may have contributed to a reduction in the use of TDA in civil engineering applications at New York landfills, as well as to the decision of one cement producer not to begin use of scrap tires as fuel, even though they had secured permits to do so.

- The tire derived fuel (TDF) category[5] experienced strong growth in 2005, and this trend continued in 2006 with an approximately 25 percent increase over 2005 levels. Total use in this category of 71,801 tons (7.2 million PTE) represents more than 11 percent growth over 2004 and more than 44 percent growth over 2003. Growth in this category was driven by high costs for conventional power generation fuels, resulting in substantial increases in scrap tire use by two New York utilities and the dedicated tire-derived fuel facility in Exeter, CT. In addition to the use of New York generated scrap tires, an increasing number of scrap tires are being imported into New York for use as TDF.
- Markets for ground rubber remained strong, with total use of New York generated scrap tires estimated at 39,800 tons (3.9 million PTE), lead by the Athletic Surfacing and Horticultural category, and driven by continued growth in sports turf, mulch and playground products. While total use declined somewhat in 2005 compared to 2004, demand in this category is expected to significantly rebound in the coming year due to continued strong markets, planned expansions and the start-up of a new production facility in late 2006.
- Use of tire-derived aggregate in landfill engineering applications, at 43,954 tons (4.4 million PTE), declined by 23 percent compared to 2004, but remained a very significant use -- accounting for 22 percent of total flow. Moreover, the number of landfills using TDA in engineering applications appears to be growing. (Additionally, a relatively small amount of annually generated scrap tires, 108 tons, were reported to be used as TDA in private road projects.)
- Estimates of scrap tires flowing to the reuse category in 2005 indicated a slight increase over 2004 at 17,507 tons (1.7 million PTE). About 4,600 tons of scrap tires flowed into the "other recycling" category in 2005. This is a slight decrease from 2004, even though this year the "other recycling" category was redefined to also include a new use – electric arc furnaces – that had previously been classified with TDF in the "raw materials and fuel" category (no longer used in this report).
- Just over 70 percent of all New York generated scrap tires flowed to in-state end-use markets, with the remainder flowing to other states and to Canada. Additionally, just under 50,000 tons of scrap tires (5 million PTE) were imported to the state, primarily from neighboring states.

[5] In this year's annual update, use of scrap tires in electric arc furnaces at steel mills has been reclassified as "other recycling." Formerly, this use was classified along with TDF as "raw materials and fuel."

Total Documented Flow

This report does not attempt to estimate total scrap tire generation in New York. Rather, as described in Appendix A the report's findings are based on information provided by New York scrap tire management firms and the New York State Department of Environmental Conservation (DEC). In 2005, flows of 199,785 tons (20.0 million PTE) were documented – down slightly from the 206,617 tons (20.6 million PTE) documented in 2004. R.W. Beck's analysis is based on the number of scrap tires handled by specific facilities, as reported by the facilities themselves directly to the research team, and through waste transporter reports submitted to the DEC. (See detailed methodology description in Appendix A.) These flow estimates are dependent on the reporting rate and accuracy of firms providing information, and is subject to variability from year to year. Beginning with the 2006 reporting year, the DEC is requesting additional information in waste transporter forms, including both the source and destination of scrap tire shipments. This newly available information is expected to greatly facilitate analyses of New York scrap tire flows, beginning with next year's report covering the study year 2006.

Methods of estimating scrap tire generation have received scrutiny in the past two years. In its most recent national markets report covering 2005, the Rubber Manufacturers Association (RMA) for the first time based its report on weight rather than the number of tires. RMA also adjusted its estimated weight of a typical light duty tire (based on passenger and light truck tires) at 22.5 pounds -- up from the commonly estimated 20 pounds per passenger tire equivalent, used in this report to present results for consistency with prior years. RMA estimates the average commercial tire (based on medium, wide base, and heavy truck tires) weighs 110 pounds. The overall weighted average "scrap tire" is 32.8 pounds.

The number of scrap tires generated in New York State can be estimated based on fees received through the New York Waste Tire Management and Recycling Act of 2003. This, combined with RMA's weighted average estimate, provides some corroboration for R.W. Beck's total generation estimate. According to NYS DEC, approximately $27 million in fees under the Act were received in 2005, which at $2.25 per tire, equates to some 12 million tires. Multiplying by RMA's weighted average of 33 pounds per tire yields an estimate of 198,000 tons, extremely close to this report's total documented flow in 2005 of 199,785 tons.

Reuse

Reuse markets include retreading and remanufacturing, and the use of partially worn tires domestically or internationally. Reuse is a relatively high value market compared to other options, especially considering that processors need only sort and grade used tires destined for reuse, without the additional costs of processing. R.W. Beck estimates that reuse accounted for about 8.8 percent of New York's annually generated scrap tires in 2005 (17,507 tons or 1.7 million PTE), with the majority comprising reuse of partially worn tires, mainly via exports to other countries.

Based on discussions with processors and other sources, reuse as a percentage of overall scrap tire supply consumed is expected to remain relatively flat or even decline in coming years. According to the Tire Retread Information Bureau, New York is home to at least 22 operating retread facilities, including one that includes retreading, or remanufacturing, of passenger tires through an innovative process. Other than this facility, retreading in New York, as elsewhere, is largely limited to truck tires. Retreading of passenger tires has essentially collapsed and remaining growth opportunities related to truck tires appear limited. While reuse of partially worn tires may have some room for growth, given sustained demand in some developing countries, the ability of New York processors to increase the number of tires sorted, graded and exported into these markets is not expected to increase. Barriers include the need for specialized knowledge and skilled laborers, and market relationships and savvy required to access international markets. Domestic reuse markets are hampered by relatively low cost new tires and concerns regarding safety and liability. Furthermore, as small tire jockeys and resellers exit the market, larger processors with commitments to supply ground rubber, TDF and other domestic markets for processed tires may have less of an incentive to tap reuse markets.

Ground Rubber

Ground rubber markets accounted for about 19.9 percent of New York's annually generated scrap tires in 2005 (39,800 tons or 3.9 million PTE). Ground rubber is a relatively high value market, with a price range of 9 cents per pound (for ¼ inch material) to upwards of 29 cents per pound (for 40 mesh material).[6] New York ground rubber producers noted that prices have increased in the past year. In 2005, New York scrap tires were shipped to three in-state as well as several out-of-state ground rubber producers, the latter of which were located in Massachusetts, Pennsylvania, New Jersey and Quebec. Additionally, one New York firm deals exclusively with buffings from retread operations. These ground rubber producers sold their products to a wide range of customers, both inside and outside New York, including: molded product producers, schools, sports stadiums, landscape firms, road construction firms and new tire manufacturers. Use of New York scrap tires by ground rubber producers declined somewhat in 2005 compared to 2004, reportedly due to a two-month shut down at one of the state's major producers. However, ground rubber is still very much a strong and growing market for New York generated scrap tires. DED has made investment in ground rubber production and markets a priority, as illustrated by the projects described in Appendix B. Demand got a boost in late 2006 with the opening of a large new producer in the Albany region and total use in this category is expected to substantially increase in 2006.

Despite the short-term, modest drop in New York ground rubber production in 2005, ground rubber markets growing both nationally and in New York, and this is expected to be reflected in next year's annual update. Growth in ground rubber production is largely centered on sports turf, mulch products and playground materials, all classified in this report to be in the Athletic Surfacing and Horticultural category. Indications

[6] Scrap Tire News, Scrap Tire and Rubber Users Directory, 2006.

are that these markets will continue to grow in the short-term. Growth in some relatively high-value markets, such as asphalt rubber, remain elusive but hold the promise of even greater demand and associated growth in production capacity. (See detailed discussion of asphalt rubber in Chapter 5 of this report.)

Tire-Derived Aggregate

Tire-derived aggregate (TDA) markets accounted for about 22 percent of New York's annually generated scrap tires (44,062 tons or 4.4 million PTE) in 2005. This is down about 23 percent from the amount used in 2004, due to a combination of reduced landfill cell expansion activity plus the very strong demand within the TDF market category (discussed below). The TDA category was the second largest market niche and, as in the past two years, was dominated by TDA engineering applications at a two New York landfills. In 2006, use of scrap tires in TDA applications apparently dropped moderately, though it is expected to remain relatively flat in 2007 as some new landfill cell expansions begin. TDA is a relatively low value market, with typical prices in the range of $27 per ton (for a 1-2 inch chip) or $17.50 per ton for a 3-4 inch chip.[7] In 2005, the number of landfills using TDA in engineering applications grew, with one additional landfill using a significant amount and the top two landfills accounting for over two-thirds of the total use in the category. There was virtually no flow of annually generated scrap tires to the other two TDA markets (roads and septic applications) in 2005. However, in 2005 stockpiled tires from the abatement of noncompliant waste tire stockpiles began to flow to several identified Department of Transportation (DOT) and New York State Thruway road construction projects. This activity further increased in 2006. (See discussion of stockpiled tire market disposition in Chapter Three below.)

In addition, the NYS Department of Health (DOH) is revising its regulations to allow the use of TDA in septic system leachfields. DED has been working with DOH and the DEC to promote this use. DED is funding technical and economic research and promotion of TDA septic system applications. DED is actively pursuing investment opportunities for other TDA applications. The potential for growth in this market has yet to be determined, but success depends on the supply and price of competing materials.

Tire Derived Fuel

The tire derived fuel (TDF) market accounted for about 36 percent of New York's annually generated scrap tires (71,801 tons or 7.2 million PTE) -- the single largest market niche for New York generated tires. This is up over 11 percent compared to the amount of New York generated scrap tires used in this category in 2004, and up over 44 percent since 2003. In addition to the use of New York generated scrap tires, approximately 25 percent of total in-state TDF demand in 2005 was met through imported scrap tires. In 2006, demand in New York for TDF increased by an

[7] Scrap Tire News, Scrap Tire and Rubber Users Directory, 2006.

additional 25 percent, though a detailed analysis of 2006 flows will not be available until next year's report is prepared. TDF prices vary from tip fees of perhaps $100 per ton for whole tires to typical prices of approximately $25.00 for a 2 inch nominal chip.[8] The main growth driver is the increasing price of conventional fuel used at power generation facilities, which resulted in large increases in scrap tire use at two New York utilities that had begun scrap tire use only two years previously. Approximately 67,960 tons (6.8 million PTE) were used as fuel to generate electricity. About 39,203 tons (3.9 million PTE) of this amount were used at New York power generation facilities, and an estimated 28,342 tons (2.8 PTE) of New York generated scrap tires were consumed by the dedicated tire-derived fuel power generation facility located in Sterling, CT. Relatively small amounts (about 450 tons) of New York generated scrap tires were used in cement kilns, the primary one being located in Quebec, Canada. Additionally, about 415 tons were consumed in municipal solid waste (MSW) waste-to-energy facilities located mainly in New York State.

Strong demand for scrap tires by electricity generation facilities may have contributed to the decision by two potential scrap tire users not to begin use of scrap tires at this time. These two firms, which have the potential to significantly increase demand still further, including a large cement mill that had received all needed permits, and a pulp and paper mill that had conducted test runs with scrap tires and also had received strong, vocal opposition opposed to their use of scrap tires as combustion fuel.

Other Recycling Uses

Other scrap tire recycling uses are estimated at 2.3 percent (4,607 tons or 460,700 PTE) of total scrap tires flow in. In 2005, documented "other" recycling activities included use of scrap tire bales as road base in Chautauqua County, and use of scrap tires at a steel mill with electric arc furnaces (Use of scrap tires in electric arc furnaces at steel mills was reclassified in this year's report from the former "raw material and fuel" category used in the previous two annual reports. This change was made to emphasize that this process makes use of the carbon contained in the tire in addition to the fuel value.) Other uses in this category that had been documented in previous years are likely continuing, including a wide range of projects involving whole, baled, and cut scrap tires. Some of these uses (such as production of cut, punched, and stamped products, production of rubber highway safety cones, or use of tire strips in railroad ties) are value-added markets that could grow modestly in coming years. Many other low or no-value uses are dependent on sponsorship (e.g., by local government agencies) and are not expected to grow. The portion of overall flow moving to these uses is expected to remain low in the foreseeable future.

Other Unspecified Flows

In 2005, R.W. Beck documented approximately 22,007 tons of scrap tires (2.2 million PTE) generated in New York, but for which a specific end use could not be confirmed.

[8] Scrap Tire News, Scrap Tire and Rubber Users Directory, 2006.

Much of this unspecified flow was associated with two relatively large processors that changed ownership, one in late 2005 and one in 2006. These changes complicated verification of 2005 flows. Additional unspecified flows are the result of reporting inconsistencies and/or gaps that could not be addressed within the time and budget available for the project.

Section 3
INTERSTATE SCRAP TIRE FLOWS

This chapter analyzes the flow of scrap tires into and out of New York State. First, an analysis of in-state markets for New York generated scrap tires is provided. Next, an analysis of scrap tires exported from New York is provided, and the final subsection analyzes scrap tires imported.

In-State Markets for New York Generated Scrap Tires

The New York scrap tire market is continuing a period of transition that began in 2003, with in-state demand growing and diversifying steadily. Throughout the 1990s, New York scrap tire demand was limited to traditional retread and reuse markets, along with a fledgling ground rubber production industry. However, as shown in Table 3-1, in 2005 in-state demand for scrap tires and intermediate products exceeded 141,000 tons (14.1 million PTE or nearly 71 percent of total documented flow) -- about the same percentage as in 2004. These uses include approximately:

- 17,298 tons (1.7 million PTE) of graded, sorted tires sent to New York retreaders and reused tire distribution firms, many of which were subsequently shipped to wholesalers and retreaders out of state;
- 35,633 tons (3.5 million PTE) of New York scrap tires shipped to New York-based ground rubber producers report using approximately 34,515 tons (3.4 million PTE) of New York generated scrap tires, the bulk of which was used to produce sports surfacing and horticultural market products such as mulch, playground material and sports turf products. Ground rubber products produced in New York were shipped to a wide range of customers and value-added manufacturing markets, largely outside New York State;
- 44,051 tons (4.4 million PTE) of tire chips used as tire derived aggregate in engineering applications (almost exclusively at New York landfills);
- 4,607 tons (460,700 PTE) used in miscellaneous recycling uses classified in the “other recycling” category;
- 39,203 tons (3.9 million PTE) used at New York utilities as fuel for electricity generation; and
- 415 tons (41,500 PTE) burned at New York Waste-to-Energy facilities.

Table 3-1
In-State Uses for New York Generated Scrap Tires (2005)

Market Category	2005 Total Use of NY Scrap Tires (Tons)	In-State Use (Tons)	Definition of In-State Use	Percent of Category Total Used In-State
Reuse	17,507	17,298	Sorted for Reuse at NY Facilities; tires sold to retreaders and wholesalers in and out of NY	99.9%
Ground Rubber	39,800	35,633	Ground Rubber Produced or Consumed in NY (much of which was sold to out of state customers)	89.5%
Tire Derived Aggregate	44,062	44,051	TDA Used in NY landfills	99.9%
Tire Derived Fuel	71,801	39,618	Tires Consumed in NY to generate electricity	55.2%
Other Recycling	4,607	4,607	Products Produced in NY	100.0%
Undetermined	22,007	NA	NA	NA
Total Documented Flow4[4]	199,785	141,207	N/A	70.7%

Source: R.W. Beck, Inc.

There are signs that New York's scrap tire market expansion and diversification trend may be intensifying. In 2005 and 2006, two new ground rubber producers began operations. Use of TDF has increased substantially within New York, and one large cement producer that had obtained permits and was anticipating making the necessary investments to begin use of scrap tires decided not to do so at this time, in part due to concerns over the cost and supply of scrap tires. Several additional ventures are under development that could further enhance value-added demand for scrap tires within New York State. Demand for tire-derived aggregate (TDA) in septic and road construction applications (in addition to already substantial landfill applications) has the potential to increase, although such growth (for annually generated tires, as opposed to stockpiled tires) is probably still a few years off. Use of ground rubber in asphalt products in New York has large potential, as demonstrated in the following chapter, but may require several more years of research and development before increasing substantially.

Scrap Tires Exported from New York State

Table 3-2 summarizes estimated exports of whole, unsorted and un-graded scrap tires from New York State. (These estimates do not include exports of sorted, graded tires intended for reuse or retreading, or exports of ground rubber or products made from

ground rubber.) R.W. Beck estimates that a total of approximately 38,380 tons (3.8 million PTE) were exported to out-of-state destinations in 2005. The single largest destination by far was the Exeter tire-derived fuel electricity generation facility located in Sterling, CT. Additionally, relatively small amounts of New York generated scrap tires flowed to three ground rubber producers in Quebec, Canada and also to three ground rubber producers located in Pennsylvania, Massachusetts and New Jersey. Based on waste transporter reports submitted to NYS DEC, an additional 2,094 tons (2.1 million PTE) flowed to other US destinations, but the specific use of these tires could not be determined.

Table 3-2
Scrap Tires Exported From New York State (2005)

Category	Other US States	Canada	Total
Ground Rubber	3,191	976	4,167
Tire Derived Fuel	31,745	374	32,119
Other	2,094	NA	2,094
Total	37,030	1,350	38,380

Source: R.W. Beck, Inc.

Scrap Tires Imported Into New York State

As shown in Table 3-3, R.W. Beck estimates that 49,271 tons (4.9 million PTE) of unprocessed, ungraded scrap tires were imported into New York State in 2005. The largest single use of these tires was at New York's two utilities that combust scrap tires to generate electricity. The next highest-quantity use was processors, who sorted, chipped and shredded the tires for delivery to a variety of end uses. New York's ground rubber producers imported approximately 7,382 tons (0.7 million PTE); one landfill imported approximately 5,238 tons (0.5 million PTE); and two firms involved in remanufacture and reuse imported an additional 770 tons (77,000 PTE). The majority of these imported tires were sourced from neighboring US states; however, at least 11,000 tons (1.1 million PTE) were sourced in Canada and flowed to New York utilities generating power from combusted scrap tires.

Table 3-3
Scrap Tires Imported into New York State (2005)

Category	Scrap Tires Imported (Tons)
Processors (Various End-Uses)	11,964
Reuse	7,211
Ground Rubber	10,960
Tire-Derived Aggregate	5,238
Tire-Derived Fuel	13,897
Total	49,271

Source: R.W. Beck, Inc.

Section 4
RUBBERIZED ASPHALT APPLICATIONS

This Section provides an update on the use of rubberized asphalt in New York State. The first subsection briefly describes the range of potential applications, including key advantages and challenges. The second subsection summarizes efforts in New York to demonstration and use rubberized asphalt in New York. The third subsection discusses select experience in North America and the final subsection presents broad conclusions.

This section is focused exclusively on rubberized asphalt products made from ground rubber. Another road construction application involving scrap tires is the use of chips (e.g., tire-derived aggregate) in road base and in other lightweight fill applications. In New York State, these uses currently involve exclusively scrap tires recovered and processed from noncompliant waste tire stockpiles, and are described in Section 5 below.

Overview

Ground rubber can be used in a wide variety of paving applications in state and federal highway projects, municipal roads projects and private sector roads and parking lot projects. Experience in other states indicates there are clear, documented advantages to rubberized asphalt compared to conventional products. However, most of this experience is in warm weather states like Arizona and California, and transportation officials in New York indicate that there are significant challenges which must be overcome in order for rubberized asphalt to play a significant role in the state's paving projects which are designed for a harsh, cold winter environment.

Rubberized asphalt products include: hot mix asphalt (HMA), crack fillers, stress absorbing membranes (SAM, also known as rubberized chip seals) and stress absorbing membrane interlayers (SAMI), all of which play a role in paving and maintaining highways, roads, parking lots and other surfaces. Three basic approaches have been taken to preparing and applying rubberized asphalt products:

- In the *wet process*, ground rubber is blended with the asphalt cement before incorporating the resulting binder in an asphalt paving or surfacing project. According to standardized specifications for asphalt rubber (ASTM D 6114), ground rubber must comprise at least 15 percent of the total asphalt mix, but in practice 18-20 percent rubber is common. The term "asphalt rubber" is defined as material made and applied according to this specification. The wet process has become the most commonly used approach for rubberized asphalt, and is the industry standard in California and Arizona, and has been used, among many other locations, in demonstrations for five years in Alberta, Canada.

- In the *dry process*, ground rubber is mixed with aggregate material before the mixture is charged with the asphalt cement. This method only applies to hot-mix asphalt production. The dry process was the focus of early experimentation. It is still used, but not as commonly as the wet process. In the dry process, ground rubber may comprise about 1.5 to 3 percent of the asphalt mix.
- In the *terminal blend process*, ground rubber is blended into the asphalt at the refinery and then shipped directly to the asphalt plant, just like regular asphalt or other raw materials used in pavement mixes. Highway departments or contractors then buy the asphalt rubber pre-mixed. Historically, the terminal blend process uses from 3 to10 percent rubber.

Potential advantages to asphalt rubber cited in a wide range of literature include:

- Reduction in road noise and other sound mitigation measures.
- Increased durability.
- Less splash and spray/better drainage.
- Reduction in overlay thickness by up to 50 percent compared to conventional HMA mixes.
- Maintains a smooth surface longer, with safety, fuel efficiency and construction advantages
- Improved performance leading to decreased maintenance costs and increased longevity.
- Improved resistance to rutting.
- Reduction in reflective cracking in new overlays.
- Increased skid resistance.
- Lower life-cycle paving and maintenance costs (notwithstanding higher initial costs).
- Resistance to bleeding or softening in summer weather.

Transportation officials and advocates of rubberized asphalt point to a number of key obstacles to use of rubberized asphalt, including:

- Infrastructure – The need for local contractors with the equipment and experience needed to bid projects, mix and apply rubberized asphalt products.
- Initial Cost – Initial construction costs are generally higher than for conventional paving products.
- Unproven in Local Conditions – Only limited demonstrations have been conducted in New York State, and experience in other cold weather regions is not as widespread as in warm weather states.
- Familiarity with Conventional Approaches – Several people interviewed for this report indicated that a major obstacle is the inertia of currently used

products, with which government and private sector organizations involved in asphalt projects are very familiar and comfortable.

- Consistency with Established Specifications – In New York in particular, the state's reliance on performance grade modifiers poses an obstacle to increasing rubberized asphalt use. While ground rubber may be used to achieve the performance modifier standards, it must compete against other modifiers that are better known and with lower initial costs. The State of New York rarely uses open graded paving mixtures due to previous problems with maintenance and performance.

Rubberized Asphalt Use in New York State

To date, use of rubberized asphalt in New York has been limited to a small number of projects. While the rubberized asphalt market consumed approximately 1,310 tons of New York generated scrap tires in 2005, this use was outside of the state. However, with the funding and leadership of the New York State Department of Economic Development, a public-private partnership is emerging in which the New York State Department of Transportation, asphalt contractors and ground rubber producers are actively investing in the demonstrating, infrastructure and market relationships needed to allow use of asphalt rubber to increase significantly in coming years. Asphalt rubber has the potential to become a major new, high value market for ground rubber produced from New York's scrap tires; however, the extent to which this potential is achieved will depend on the ability of this public-private partnership to collectively overcome the challenges described above.

New York State Department of Economic Development (DED)

The DED has invested in, or is actively considering, several projects that would assist in laying the ground work for increased rubberized asphalt use. The DED encouraged and provided funding to a DOT project to demonstrate in New York a proven technology that incorporates recycled tire rubber to create an improved asphalt chip seal (described below). The DED has provided support to four ground rubber producers with an interest in supplying ground rubber to asphalt rubber users. Additionally, the DED is considering funding a proposal for a university-based technical information center to promote rubberized asphalt applications, and is considering a funding proposal to assist a private asphalt supplier in purchasing blending equipment required to begin use of rubber in asphalt paving and maintenance projects.

New York State Department of Transportation (DOT)

The DOT has partnered with DED, other states and private firms to undertake a variety of activities over several years with the objective of investigating and demonstrating rubberized asphalt products. DOT representatives say the agency is committed to actively participating in demonstrations with DED and private sector

partners, including establishment of a proposed research and technical assistance center at a university in New York. The DOT is tracking the use of rubberized asphalt in other states. Representatives have expressed a strong commitment to continued dialog and partnering in further investigation and use of rubberized asphalt products. Following is a brief summary of DOT activities to date.

Between 1989 and 1994, the DOT experimented with five rubberized asphalt applications. Four of these were dry process installations, all of which failed. One was a wet process installation constructed with 10 percent recycled rubber in the base, intermediate and top course, and was considered to be a success.

DOT has adopted standard specifications that allow the use of recycled tire rubber in any of the performance grade binders used in the state. DOT representatives state that using rubber in performance grade binders does provide benefits; however, it is considerably more expensive than using performance grade binders made with polymers. Moreover, the need for specialized equipment and other challenges discussed above have so far limited use of performance grade binders made with rubber to the one wet process installation mentioned above.

The DOT is watching closely a project of the National Cooperative Highway Research Program within the US Transportation Research Board. This project has the objective of recommending design, construction and maintenance guidelines that will maximize the advantages and minimize the disadvantages associated with permeable friction course use. A permeable friction course mix can contain polymer modified asphalt or asphalt-rubber and fibers, alone or in combination, thereby holding the potential to open a new avenue for the use of recycled rubber in paving applications.

The DOT is a partner with other Northeast States in a research project examining the use of thin lift mixes, including at least one rubberized mix. The DOT has also participated in an Accelerated Load Facility (ALF) Pooled Fund Study Test, in which one roadway section includes asphalt rubber

The DOT is evaluating the use of terminal blend rubber modified binders. Previously, DOT has been concerned about the potential for oversized rubber particles to inhibit compliance with the binder performance grading specification (AASHTO M320). The DOT is contacting others that have used the binder to investigate how this challenge can be overcome. DOT representatives are actively looking for a possible interim solution, while waiting for the results of a proposed research study.

The DOT is also engaged in ongoing discussions with asphalt industry groups regarding the use of asphalt rubber products, including the Northeast Asphalt User Producer Group (NEAUPG) and New York Construction Materials Association Binder sub-committee.

In 2006, DOT participated in a project jointly funded with DED to demonstrate Rubberized Chip Seal applications. Four projects were constructed in August 2006, with additional projects set for construction in 2007. DOT will be conducting a follow-up evaluation of these demonstrations. These recent demonstrations used a rubber asphalt surface treatment (RAST) different than the conventional surface treatment chip seal. The finished product is a membrane type layer that is often

referred to as a SAM due to the amount of binder applied and tenacity of the residue present. This type of product is made with about 18-22 percent rubber added to the asphalt binder, and uses about 1,350 tires per mile treated with RAST.

Finally, the DOT is looking to construct terminal blend rubber modified binder HMA pilot sections in future years.

Asphalt Pavement Contractors and Suppliers

At least two Northeast asphalt suppliers that are active in New York State have made, or expect to make, investments in equipment that will allow their use of recycled rubber in paving applications. One supplier based in New York has purchased equipment to enable them to begin use of terminal blend rubberized asphalt products. The other producer purchased a portable blending facility, and was a partner in the DOT-DED funded chip seal project described above using wet process asphalt rubber. Representatives of both of these asphalt suppliers stated that they anticipate their firms will be actively marketing rubber asphalt products to state, local and private customers in New York State in coming years, among customers in other Northeastern states. Both also expressed optimism that the products will enjoy strong demand, given the advantages of the product. Many asphalt suppliers are not enthusiastic about rubberized asphalt, largely due to the obstacles described above.

Ground Rubber Producers

New York's ground rubber producers have expressed a strong desire to supply ground rubber to the rubberized asphalt applications, and are strongly encouraging expansion of this market. One ground rubber producer in New York previously established facilities in California and Arizona, and is already a major supplier to asphalt rubber producers in those states. While demand for ground rubber is currently strong, asphalt rubber holds the promise of a relatively high value market with well-established, strong customers, making potential growth in this arena highly attractive to the state's ground rubber producers.

Rubberized Asphalt Use Outside of New York State

Based on statistics from the Rubber Manufacturers Association,[9] asphalt rubber consumed about 108 million pounds of ground rubber in 2005, accounting for the recycling of approximately 6 million PTE, or 2 percent of all scrap tires generated nationally. The vast majority of this use occurred in five states: California, Arizona, Texas, Florida and South Carolina. However, several other states have experimented with, or are actively investigating the demonstrating of asphalt rubber, including (in addition to New York): Michigan, Washington, Nevada, Rhode Island, Nebraska, Tennessee, Pennsylvania, Illinois, Delaware, Massachusetts and New Jersey.

Following below are brief descriptions of three locations that may provide useful lessons as New York continues to explore and expand use of rubberized asphalt.

[9] "Scrap Tire Markets in the United States." Rubber Manufacturers Association. November 2006.

Alberta, Canada

Alberta is an example of an area that is systematically investigating and documenting the use of asphalt rubber in a cold weather region. This systematic approach will provide a wealth of information relevant to New York in coming years.

Through a public private partnership, Alberta is five years into a systematic strategy designed to test, expand infrastructure and ultimately trigger market-based demand for asphalt rubber concrete (ARC). The initiative was launched in 2002, with funding provided by the Alberta Recycling Management Authority, Tire Recycling Division, and with active involvement by several municipalities and private sector engineering, asphalt and paving firms. EBA Engineering Consultants was retained to provide technical advice and project management services.

The ARC produced in Alberta is based on the wet process and ASTM specification as used in Arizona. The asphalt cements used in the projects were 80-100A, 150-200A and 200-300-A penetration grade asphalt cement – softer than those generally used in the warm weather US states that make extensive use of ARC. This is needed to retard against cracking during Alberta's harsh winters.

According to representatives involved in the program, results have been positive but lessons are still being learned. Pavements placed in the first year performed well. There were some concerns about pavements placed in the program's second year, but the specifications and application procedures were adjusted in subsequent years and the pavements are performing well so far. One issue is the availability of fine grind ground rubber. The program is moving to a finer grind in the range of 10-20 mesh, which appears to be performing better than the courser grinds used previously.

Alberta's experience confirms the sound reduction benefits, and their data show that ARC could potentially be considered as an alternate noise abatement measure. This could reduce the cost of other measures such as walls, enhancing the overall economics of ARC use. Alberta representatives anticipate that the use of ARC will continue and expand once the five-year investment strategy comes to an end this year, in both municipalities and at the province level. The basic strategy, involving investment in equipment, training of local asphalt firms and documentation of performance, appears so far to be sound.

Grey County, Ontario

Grey County is an example of a municipality that has successfully demonstrated the use of a variety of asphalt rubber products in very harsh winter weather conditions over several years. Grey County's experience demonstrates that asphalt rubber products can be used in cold weather regions at the local level, even in the absence of the systematic testing and evaluation conducted by states and provinces. Use of rubberized asphalt products has been driven in large part by the County's public works director, with strong support from the public and elected officials.

Grey County has used a wide variety of applications over the course of several years, including both wet and dry processes, as well as hybrids and other innovative approaches. The County successfully manages a closed loop system in which waste

tires generated locally are shipped to processors, then shipped back as ground rubber for use in paving projects.

Grey County representatives say they have documented the benefits associated with rubberized asphalt in other areas, including increased skid resistance, reduced noise, increased performance life, reduced wheel rutting and reduced reflective cracking. County representatives further note that in their experience, rubber asphalt applied with the wet process per ASTM standards has shown the best performance in their cold winter environment. Costs for rubberized asphalt have run about 15 to 20 percent higher than conventional asphalt. The County has recycled rubberized pavements without difficulty.

California

California is an example of a state that has systematically built the foundation for rubberized asphalt use over many years, termed rubberized asphalt concrete in the state. As with Arizona, some state that the specific paving technologies employed are not be relevant to New York's cold climate. However, California is a laboratory for innovative approaches to promoting asphalt rubber.

Efforts to increase use of rubberized asphalt in California go back to limited use of rubberized chip seals in the early 1970s. In the early 1990s, the California Integrated Waste Management Board began to aggressively promote rubberized asphalt use. These efforts were stepped up in 2000. Related state activities have included:

- Technical information provided through two centers, one in northern and one in southern California;
- Demonstration and research projects involving a range of different applications and conditions;
- Two separate grant programs targeted to local government agencies designed to cover the incremental cost of using RAC; and
- Funding staff positions within the state transportation agency, Caltrans, specifically focused on evaluating and promoting RAC.

While use of RAC by Caltrans had steadily increased, state legislation was recently signed into law requiring increased use over time. The agency is now required to increase its use of RAC to 35 percent of all paving projects by 2013 and to 50 percent of all projects by 2015.

These efforts have shown substantial results. Caltrans nearly met the 35 percent goal early in 2005, with 1.8 million PTE being used in 967,000 tons of rubberized asphalt concrete used in 34.5 percent of total asphalt placements. Between 2000 and 2005, the agency used a total of nearly 9 million PTE in projects that used over 4.5 million tons of RAC.

Arizona

More than any other state, in Arizona, asphalt rubber is a standard component of state paving practices. While the wet process employed in warm weather states like

Arizona is often perceived to be incompatible with asphalt needs in cold weather states like New York, Arizona still provides a wealth of experience. Between 1995 and 2005, Arizona used between 29,000 and 36,000 tons of rubber asphalt per year, in 41 to 54 paving projects. Between 1988 and 2005, over 20 million PTE had been used in rubber asphalt paving projects involving over 19,500 lane miles.

Next Steps for Rubberized Asphalt in New York State

While challenges remain, public and private entities in New York are in the early stages of building a foundation that could well lead to substantial use of rubberized asphalt in coming years. Based on experience in other states, even the most optimistic scenario probably involves a very slow but steady increase in the amount of ground rubber used in paving applications for the foreseeable future.

In the immediate short-term, it appears that rubberized asphalt installations will probably be limited largely to chip seal projects and terminal blend paving projects, and will probably use a relatively small amount of ground rubber. Experience with these installations and recognition of the product's advantages will be needed to spur greater use in coming years.

Section 5
STOCKPILED WASTE TIRES

In late 2004, as required under the Act, DEC prepared a *New York State Waste Tire Stockpile Abatement Plan*. The plan details a partnership among the DEC, DOT, the Thruway Authority, and the Office of General Services (OGS) to implement the DEC's *Plan* in which tires in noncompliant waste tire stockpiles in New York will be used in civil engineering highway projects, with all noncompliant stockpiles expected to be abated over the next six years.

Use of tires abated from noncompliant waste tire stockpiles was just getting underway in Study Year 2005. However, by December 2006, as shown in Table 5-1, significant progress had been made. Over 75,000 tons (7.5 million PTE) of scrap tires in stockpiles had been cleaned and processed. Of this amount, 33,505 tons (3.3 million PTE) have been processed to meet DOT specifications and are being stored on site awaiting use. About 20,304 tons (20.3 million PTE) were processed to meet DOT specifications and used in DOT road projects. And, about 22,106 tons (22.1 million PTE) have been processed to meet specifications other than those of DOT and shipped to various beneficial uses (primarily involving civil engineering applications at landfills). According to DEC, about 16,700 tons of this material were shipped in the study year 2005. Approximately 156,000 tons (15.6 million PTE) remain on site, unprocessed, at the largest noncompliant waste tire stockpiles.

Table 5-1
Status of Largest NYS Noncompliant Waste Tire Stockpile Abatement Efforts
(as of December 2006)

Waste Tire Stockpile	Location	Current Estimate (Tires)	DOT Spec Shred on Site (Tons)	DOT Spec Shred Shipped (Tons)	Non-DOT Spec Shred Shipped (Tons)
Cycletech	Greenport (Columbia County)	2,297,000	0	11,250	11,720
Southern Tier Tire	Persia (Cattaraugus Co.)	219,600	0	1,977	219
Hutchings	Plymouth (Chenango Co.)	250,300	1,663	0	840
Clarence	Newstead (Erie Co.)	612,000	4,664	964	492
Hornburg	Sinclairville (Chautauqua Co.)	1,645,700	10,874	0	5,583
Tire Recycling	Saugerties (Ulster Co.)	375,000	1,186	0	453
Fortino	West Monroe (Oswego Co.)	8,100,000	15,118	6,113	1,588
Mohawk	Waterford (Saratoga Co.)	6,800,000	0	0	0
Ben Maglio	Perry (Wyoming Co.)	315,000	0	0	1,211
Totals	NA	20,614,600	33,505	20,304	22,106

Source: NY State Department of Environmental Conservation

Section 6
CONCLUSIONS

Given the continuing growth and diversification of New York scrap tire markets, as well as the funding and mandate provided by the Act, the New York State Department of Economic Development ("DED") is well positioned to continue to successfully execute its legislative mandate to strengthen New York scrap tire markets by increasing the value of, and demand for, New York generated scrap tires. DED has used Scrap Tire Management Funds to invest in several scrap tire processing and manufacturing ventures that have expanded capacity to produce higher-value tire material. In addition, DED has funded research and supported efforts targeting, for example, increased use of scrap tires in engineering applications and for use as rubber in asphalt products. These efforts are expected to help expand New York's scrap tire market infrastructure and capacity in future years.

Although growing, New York's scrap tire market infrastructure continues to suffer from the inherently poor economics of scrap tire processing and transportation. This situation means that the industry will likely remain fragile to a degree; and disruptions such as an oversupply caused by too many producers, or newly-revealed issues that impede a particular market (e.g., cement kilns or playground products) could have a very detrimental impact on the industry. DED's continued annual market analyses and investments provide useful tools that can be used to both anticipate and respond to any such negative trends, should they occur.

Appendix A
METHODOLOGY AND SOURCES OF UNCERTAINTY

Methodology

R.W. Beck undertook the following steps to estimate the supply and demand of New York generated scrap tires in 2005:

1. Obtained and compiled data from Part 364 waste transporter annual reports from the Department of Environmental Conservation (DEC) for calendar year 2005. Each form shows the waste transporter, amount shipped, and "disposal facility" (often a recycling facility). These data were entered into an Excel spreadsheet and sorted separately by transporter and by disposal facility. Beginning September 2005, revisions to the 364 program were made that will enhance the tracking of all regulated waste, including waste tires, to destination facilities. The more-complete data will first become evident on a full year basis with the 2006 annual report data that will be available at the end of 2007.
2. A survey form was mailed to 141 firms identified as having some involvement with New York scrap tire management. Of these, 45 firms were targeted for follow-up by phone, due to their large operations or other factors of interest. From these efforts, detailed responses and/or qualitative interviews from 25 firms were secured.
3. Data were obtained from the Connecticut Department of Environmental Protection providing estimates of New York generated scrap tires managed by three large Connecticut processors and the amount flowing to a large tire-derived-fuel facility in Connecticut.
4. New York State representatives at DED and DEC were interviewed to obtain additional information on stockpiled tire management, Beneficial Use Determinations (BUDs), market trends and State activities.
5. A spreadsheet was developed listing separately suppliers and end-users of scrap tires, defined strictly according to the system used throughout this report. Each identified facility for which flow data were available was assigned either as supply, demand, or both (if they both supply and use material on site). Suppliers include any facility producing a whole tire, tire shred or chip; ground rubber for sale directly to an end-use market; or that engaged in end-use activities on site.
6. Suppliers and end use facilities were scrutinized in an effort to eliminate double-counting, to list only those suppliers shipping directly to an end-use market, and to document final disposition of New York generated scrap tires.

7. Information from the waste transporter reports was combined with survey and interview responses and analyzed in order to generate the assessment of interstate scrap tire flows presented in Section 4.

Potential Sources of Error

Following are the major potential sources of error in this analysis and the steps R.W. Beck took in an attempt to reduce error:

- The potential exists to double-count tires flowing between New York facilities. R.W. Beck worked to mitigate this impact by cross checking flows wherever possible using information obtained from interviews. This factor may result in an overestimate of some categories such as TDA use at landfills.
- Throughput to retreaders was estimated based on shipments from major processors. It is likely that some quantities of scrap tires flowing to these facilities were not counted. This factor may cause R.W. Beck's estimate of total flow to be under estimated somewhat.
- New York State law exempts waste transporters hauling less than 500 pounds (25 passenger tires) of non-hazardous waste in any single shipment from having to be permitted. Additionally, those transporting via rail, water, and air are exempt from waste transporter permitting. Although R.W. Beck does not believe these exemptions are a large source of error, it is impossible to document this with certainty.
- The potential exists for waste transporters, located both in-state and out-of-state, to not obtain a permit. According to ECL 27-0303, Chapter 226, "Waste Tires shall mean waste tires transported for a fee for the purpose of reuse, recycling or disposal, except those tires collected and transported incidental to the collection and transportation of solid waste." Some haulers have indicated that they are not transporting for a fee, therefore they do not have to be permitted. The extent to which this is occurring, or what impact this would have on overall market numbers is unknown.
- Some waste transporters/processors receive stockpiled tires from smaller, locally-managed cleanup projects. R.W. Beck attempted to identify the number of stockpiled tires received vs. annually generated through the interview process; however some respondents did not know the portion, and some smaller entities were not interviewed.
- It is impossible to know the final disposition of some tires. Some resellers, for example, indicate that a portion of their tires go to Canada, but they can only speculate what is done with them there. Similarly, some respondents were unwilling or unable to share information regarding final disposition and not every processor and producer in the State was interviewed.
- In some cases, waste transporter data may be reported incorrectly due to waste transporter errors in completing the form, or data entry errors by DEC or R.W. Beck staff.

Despite the above data limitations and other sources of error, R.W. Beck believes these supply and demand estimates are the best available covering New York, and the best possible, given the study's available time and resources. R.W. Beck believes that they accurately indicate the relative flow of scrap tires in 2005 to broad market categories. However, the breakdown of flows to narrow sub-markets within broad market categories may be less accurate.

R.W. Beck will continue to seek to refine these estimates in future annual updates. As noted previously, beginning September of 2005, the DEC made revisions to the 364 program that will enhance the tracking of all regulated waste, including waste tires, to destination facilities. The more complete data will first become evident on a full year basis with the 2006 annual report data which will be available at the end of 2007.

Appendix B
NYS DED INVESTMENTS IN SCRAP TIRE MARKET EXPANSION

Following is a summary of investments designed to strengthen and expand markets for scrap tires generated in New York State, as awarded to firms by New York State Department of Economic Development, Environmental Services Unit.[10]

New York State Dept. of Transportation

Award: $200,000 Total Project: $400,000

This project is demonstrating the use of an innovative new technology that incorporates recycled tire rubber to create an improved asphalt chip seal. The project involved placing the improved chip seal on four stretches of road within New York State. If adopted as regular practice, this technology would create additional demand for finely ground rubber from New York State. (Summer 2006)

University at Buffalo Center for Integrated Waste Management (Research Foundation of the State University of New York)

Award: $1.8 million

This is a five-year effort to form the New York State Tire Derived Aggregate Program at the University at Buffalo Center for Integrated Waste Management. The program will work to expand the acceptance of recycled tire derived aggregate (TDA) in civil engineering applications in New York State. Civil engineering applications for TDA include septic system leach fields, insulating layers for road base, lightweight fill behind bridge embankments, backfill for building foundations and similar uses. A Technical Advisory Board, comprised of state and national stakeholders and experts, will oversee the program activities which will include developing a centralized information clearinghouse on the worldwide web and conducting targeted research. (January 2006)

Niagara County Industrial Development Agency

Award: $485,000 Total Project: $1,004,991

This is a capital project to assist RubberForm Recycled Products, LLC, Lockport, in purchasing machinery and equipment necessary to manufacture molded rubber products out of crumb rubber (processed from scrap passenger tires). Success of this project will result in the manufacture of new products made from 625 tons of crumb annually and the creation of eight full time jobs. (Oct. 2005)

[10] Prepared by NYS DED staff.

An-Cor Industrial Plastics, Inc.

Award: $200,000 Total Project: $249,094

This research, development and demonstration project is to assist An-Cor Industrial Plastics, Inc. to evaluate the manufacture and testing of a new "tire log" from scrap tires. The project will determine the cost to manufacture as well as demonstrate its use in a retaining wall application. Success of this project will enable An-Cor Industrial Plastics, Inc. to manufacture this new product using scrap tires. (Mar. 2005)

Town of Colonie, Industrial Development Agency

Award: $750,000 Total Project: $5,000,000

This is a capital project to assist CRM, LLC in the purchase of equipment to establish a cryogenic ground rubber production facility in Colonie, NY. The plant opened in December 2006. Success of this project will result in additional tire recycling capacity of 2.5 million tires per year, producing 30 million pounds of ground rubber per year with a sales value of $6 million annually. (Dec. 2005)

Schenectady Metroplex Development Authority

Award: $500,000 Total Project: $1,744,000

This is a capital project to assist New York Rubber Recycling (formerly RTG - New York) with the purchase and installation of a cryogenic grinding system to increase the volume and quality of their ground rubber production. Success of this project will increase throughput by 1.5 million tires per year. (April 2005)

Niagara County Industrial Development Agency

Award: $265,500 Total Project: $531,500

This is a capital project to assist High Tread International of Lockport in purchasing equipment that will increase their passenger tire recycling capacity and significantly increase the value of their product. This project will increase passenger tire recycling by 1,800 tons per year, realize an annual economic benefit of $975,000, and create three new jobs. (Sept. 2005)

Research Foundation of State University of New York

Award: $200,000 Total Project: $297,080

This research, development and demonstration project is to assist the University at Buffalo Center for Integrated Waste Management complete research needed to identify ways to overcome the remaining barriers (technical, practical and economic) to the utilization of tire chip aggregate (TCA) in septic system leachfield applications. (Mar. 2005).

Auburn Industrial Development Authority

Award: $32,411 Total Project: $64,822

This is a capital project to assist Nucor Steel Auburn, Inc. to purchase a grapple to feed waste tires into its steel making system. Success of this project was projected to result in an additional 1,120 tons of tires recycled annually and over $200,000 in economic benefits from operating savings and revenue from sales of additional steel. (Nov. 2004)

NP&G Innovations

Award: $194,310 Total Project: $616,310

This is a research, development and demonstration project to assist this Cazenovia-based company in the completion of engineering design, process development and construction, testing and certifications required by the American Railway Engineering and Maintenance of Way Association for its innovative railroad cross ties made from recycled tire strips and steel. (Nov. 2004)

Appendix C
EXAMPLES OF TDA APPLICATIONS IN NEW YORK STATE

Table C-1 on the following pages summarizes a partial list of civil engineering projects in New York State that utilized tire-derived aggregate. The list was compiled by the New York State Department of Environmental Economic Development as part of an effort spearheaded by the US Environmental Protection Agency's Resource Conservation Challenge, Scrap Tire Working Group.

Table C-1
Partial List of Tire-Derived Aggregate Civil Engineering Applications in New York State

Project	Location	Year(s)	Description	Tire Source	Comments	Photo
NYSDOT – Rte. 17 (now I-86)	Exit 79, near Binghamton	1999	Standard Fill. Embankment. New exit ramp on interstate highway. 250,000 tires	Local Abatements	Design input -D. Humphrey. Basis of DOT's future acceptance of TDA from the Act abatement projects.	
Delaware County	CR-20 near Broome Co. border	2000	Insulation drainage. Solved a frost-heave problem. 499,000 tires	Local Abatements, annual flow	D. Humphrey involved in design.	
NYS Thruway Authority	Between interchanges 53 & 54, near Buffalo	2002(?)	Lightweight fill. Embankment. Solved a problem with poor soils. 100,000 tires.	Annual flow	Engineers used TDA to solve problem without any fanfare!	
I-87	South of Plattsburgh	2004-05	Standard fill. Filled in former railroad overpass 1,100,000 tires	Act Abatement	First project to use TDA from Act abatements.	

Project	Location	Year(s)	Description	Tire Source	Comments	Photo
I-87 north of Albany	Between Exits 15 & 16	2006 (start)	Standard fill. Traffic cross-over for bridge reconstruction project. 902,000 tires	Act Abatements		
SR-240X	Cattaraugus County	2006	Standard fill. Fill behind bridge approaches 266,813 tires	Act Abatements		
Modern	Lewiston	1996(?) to present	Drainage. Liner layer in new landfill cells.	Annual flow		
Seneca Meadows	Seneca Falls	1997(?) to present	Drainage layer in liner of new landfill cells.	Annual flow, private & local abatements		
Madison County	Wampsville	2001	Drainage and frost protecting. Drainage layer in liner of new landfill cell.	Annual flow		

Project	Location	Year(s)	Description	Tire Source	Comments	Photo
Modern Tire Recycling	Lewiston	1999(?)	Drainage and lightweight fill. Replace natural aggregate	Annual flow	In conjunction with UB. Constructed test installation side-by-side with natural aggregate.	
Chautauqua County		2001-2004(?)	Lightweight boulders replace native soils in 3 roads that traverse swampy areas	Local Abatements	EPA funded project	
Washington County		2003(?)	Lightweight boulders, drainage	Local Abatement	EPA funded project	
Aquaterra Systems	Bolton Landing	2004(?) to present	Forest road construction	Annual flow		
Private Residence	Ulster County	2005(?)	Used in construction of newly poured basement walls	Annual flow		

Appendix D
SUMMARY OF A NYS DED FORUM ON SCRAP TIRE MARKETS

Summary
2006 NY Scrap Tire Recycling Forum
Albany, NY
December 11-12, 2006

OVERVIEW

Background

On December 11-12, 2006, Empire State Development sponsored the New York Scrap Tires Recycling Forum held in Albany, N.Y. The purpose of the forum was to:

- Provide a progress report on New York State scrap tire management efforts;
- Provide status reports on national and regional tire recycling markets and market trends;
- Obtain feedback to guide future scrap tire recycling market development efforts; and
- Provide a venue for discussion and information sharing among NY scrap tire industry stakeholders.

In attendance were over 115 individuals with an interest in scrap tire management in New York as well as speakers and forum sponsors. Participants included representatives from tire dealers, scrap tire processors, manufacturers of scrap tire-derived products, trade associations and publications, and government agencies. An abbreviated version of the agenda is provided below. Selected PowerPoint presentations from the presenters, the **Forum attendance list**, and **this summary** can be accessed via **the Internet**.

Two technical sessions were held on Day 1, followed by a tour of a local tire recycling facility. Day 2 opened with a panel session on markets. Following this session, forum participants broke into three groups focusing on civil engineering applications, asphalt rubber applications, and manufactured products. Each group was asked to brainstorm on two guiding questions:

1. What are the opportunities and remaining barriers in the marketplace?
2. What strategies could New York employ to overcome the barriers and pursue the opportunities?

Following the agenda below are notes summarizing the results of these brainstorming sessions.

FORUM AGENDA

Day 1:
Background and Context

Session 1: Welcome and New York Progress Reports

- **Analysis of New York Waste Tire Markets – 2006 Update**
  R.W. Beck, Steve R. Stein, Senior Consultant
- **Dept. of Environmental Conservation Update**
  Steve Hammond, Division Director
- **Dept. of Economic Development Update**
  Amy Schoch, Deputy Commissioner

Session 2: New York Scrap Tire Markets in a National & Regional Context

- **Mr. Michael Blumenthal, Rubber Manufacturers Association – U.S. Market**
- **Mr. Glenn Maidment, Canadian Rubber Association – Ontario and Quebec**
- Ms. Carey Hurlburt, Connecticut DEP

Tour of CRM's new cryogenic facility (24 hour operation)

Day 2:
Moving Forward

Session 3: Market Experts Panel

- **Rubber Modified Asphalt**
  Serji Amirkhanian, Asphalt Rubber Technology Service, Clemson Univ.
- **Manufactured Products**
  Alan Moreland, Rubber Consultant, Charleston, SC
- **Athletic Surfaces**
  Ron VanGelderan, Synthetic Turf Council, Georgia
- **Civil Engineering**
  Lou Zicari, Univ. at Buffalo

- Brainstorming #1 – What are the opportunities and remaining barriers in the marketplace?
- Brainstorming #2 – What strategies should NY employ to overcome the barriers?

Session 4: Closing and Next Steps

Brainstorming Session – Civil Engineering Applications

Market Opportunities

- Tire derived aggregates:
  - GCP-19 for DOT
  - Wastewater treatment/septic
  - Aggregates for use in radon mitigation and construction of radon resistant homes and as general fill around foundations
  - Landfills: Leachate liner protection; gas collection, landfill cell construction
  - Sea walls and lake shore erosion protection
  - Erosion control/sediment catch
  - Animal bedding
- Railroad tie manufacture (whole tires application)
- Opportunities aimed specifically at consuming available stockpiled tires and consuming tires delivered to landfill sites that are intermittently available when on-site applications are not available.

Obstacles to Realizing Opportunities	Strategies for Overcoming Obstacles
SUPPLY	
Contaminants/dirt associated with stockpiled tires (causes damage to equipment and limits beneficial uses; varies depending on variability of soils)	(Temporary problem that will end when stockpiles are eliminated)
Size of OTR tires makes them difficult to process/use	
Availability of supply may become limited as stockpiled tires get consumed	Option: recovery of single-use material for future supply
Global competition for supply affecting pricing and supply availability.	
Lack of guaranteed flow/supply of tires limits ability to invest in capitalizing facilities	Design for recyclability

Obstacles to Realizing Opportunities	Strategies for Overcoming Obstacles
Large volume applications tend to be intermittent in nature and require stockpiles of tires. Storage can be expensive.	
REGULATORY/INSTITUTIONAL	
Regulatory layers are complex; obtaining permits is time consuming and challenging.	Facilitate access to appropriate personnel and resources Coordinate agency activities and roles with respect to permitting as well as other areas. Involve public in rulemaking process Define more uses/ applications/ products that do not need to be regulated as waste Reduce regulatory requirements for industry crossover.
Dept of Health's lack of research permitting process limits ability to demonstrate new applications when DOH permitting is required.	DOH has proposed changes to the existing regulations to incorporate TDA. The specific waiver policy will also be revised to allow for more flexibility in trying new processes and/or applications.
Specification development and gaining approval is lengthy process and results in delays	Fund and convene stakeholders to develop specifications Standardize material properties Develop specifications in advance and anticipation of use NYS - accept specs and research from other states Build partnerships between state government, local government, and trade organizations to streamline process and cut costs
State contracting/bidding process limits market access.	
ECONOMIC	
Low cost of competing feedstock materials limits price to be paid for tire derived feedstocks	Tax credits or other economic incentives for green purchases/products.
Cost associated with transporting supply from stockpiles to processors and end users.	Locate business opportunities near significant sources of supply
Concern over state subsidization of costs associated with moving tires to market and impact on the market when these	

Obstacles to Realizing Opportunities	Strategies for Overcoming Obstacles
subsidies end.	
Competition with other market applications for tire supply.	Vertical integration to capture supply as well as to make products
Economies of scale – concern over getting enough supply to support investment in equipment and facilities	Revive Scrap Tire Council or similar entity to engage stakeholders and to coordinate efforts to assure key issues are identified and attended to
Fluctuating market conditions	Improved ability to diversify processing/product manufacturing capabilities to produce various products to meet changing market opportunities Support for processes that provide maximum market potential and not just limited applications Better price forecasting; tracking of key market indicators Support NYS TDA program and establish mechanisms for sharing information
INFORMATION	
Availability of technical information, specification, results of R&D and demonstration projects.	Improved and coordinated technology transfer and case studies information Focused tech transfer of concepts – identify benefits (cost savings, etc.)
Lack of technical expertise and understanding of how to access state resources to receive technical and financial assistance	Better promotion of State financial and technical assistance and provision of more assistance
Lack of consumer awareness of benefits of using tire derived aggregates and other tire products	Targeted promotion/media attention to projects and successes

Brainstorming Session – Asphalt rubber Applications

Market Opportunities

- SAM/SAMI
- Asphalt modifier
- Open graded, gap graded: friction courses
- Crack seal
- Noise reduction materials
- Structure waterproofing
- Skid resistance

- Splash reduction
- Pavement thickness reduction
- Increased rubber modifier infiltration into PG asphalt
- Long term applications that realize life cycled cost benefits

Obstacles to Realizing Opportunities	Strategies for Overcoming Obstacles
TECHNICAL	
Particles are an obstacle to PG grading system Currently too costly to make particle size very small	SCDOT has made an exception to PG grading/particle size issue – NY needs to determine if they can do this too
Concerns over use of RMA (Rubber Modified Asphalt) in northern climates: Effects of salt Insulating benefit of rubber Lack of R&D program to overcome technical barriers and lack of standardization of specs across states in the region Aromas/human health/environmental/GHG emissions	Obtain information on work already done elsewhere in areas with similar climates Reliable non-biased R&D of technical issues: PG, etc. Regional Level (Northeast – to develop standardization of specs across states) More involvement by AASHTO
RMA means higher temps and higher energy to produce	Warm mix asphalt – new technology promising to address many other issues BUT: is still in development – not ready yet to be tried introducing rubber modifier to it adds one too many variables
REGULATORY/INSTITUTIONAL	
NYSDOT reluctance to specify RMA	NYSDOT needs to do homework to be comfortable with specs DOT review of elastic recovery spec. (short term)
No champion of this issue within DOT. DOT has many priorities; this needs to rise to the surface	Multi-tiered approach: DOT commissioner – build support at top (No one knew if DOT commissioner is aware of the issues) Grassroots work in DOT to get local acceptance (i.e. regional DOT's) "PR" campaign to locals to get info out For example, the demonstration projects in Phoenix got the attention of the mayor and the city council that saw no cracks and low noise. (a project on the Bronx River Parkway would have likely had the same effect)

Obstacles to Realizing Opportunities	Strategies for Overcoming Obstacles
ECONOMIC	
High initial cost is barrier to local highway departments	Need to get product out there for users to see in use: Demonstration projects in Northeast to provide real-life experience with it for locals Get demos done NOW before tire fee goes away in 2011
	State pay differential between polymer asphalt and asphalt rubber for trial projects. DED funding for DOT to buy higher cost product for demos
FHWA funding	National R&D needed to get buy-in by rethinking PG-grading specs
INFORMATION	
No consistent terminology Lack of clear guidance on when and how to use Lack of knowledge of key players that need to be involved in moving process forward	Training – not conferences, in conjunction with demonstration projects works better to build comfort in product use
Lack of ability of highway spec agencies to consider life-cycle costs and full environmental impact when developing specifications	DOT would benefit from seeing life cycle costing data from other states who are farther along

Other Players

1. Northeast Asphalt Users Producer Group
2. NE State Materials Engineers Association
3. NY Construction Materials Association
4. FHWA
5. Cornell Local Roads Program

Brainstorming Session – Manufactured Products Applications

Market Opportunities

- Mats, cones
- Rubber sidewalks
- Logs
- Molded products

- Shingles
- TDF
- Cryogenic

Obstacles to Realizing Opportunities	Strategies for Overcoming Obstacles
DEMAND	
Insufficient demand for finished products; demand pull needed	NYS to “make the case” for using our products Align with construction industry State procurement OGS should be involved
SUPPLY	
Need to increase supply of cryogenic	Lower cost of production
Concern over access to supply may limit investment	Become a net importer of tires
Pallet – strength issues with existing technologies	Investment in research: colleges & industry
Create more higher value products	Lower cost of production; invest in research Separate into components Rubber-modified plastic
Quality	Develop certification programs Work with testing labs
ECONOMICS	
Price constraints	Green purchases – set-asides Local subsidies (e.g. Germany) Forum for manufacturers and processors Find end-users and connect with producers of feedstock Base any assistance on use of NYS tires
Need to lower production costs	Re-evaluate use of money from tire fees Fund education R&D tax credits
Anti-dumping efforts are too slow	Be like California governor – aggressive
INFORMATION	
Product acceptance	Educate the public Technical assistance for end users Find “champions” Facilitate the creation of a database of NYS firms and markets involved with tires

Obstacles to Realizing Opportunities	Strategies for Overcoming Obstacles
Credibility of industry information	Use state as a credible source of information in a way that industry is not Provide link to a state web page that has good information Defining quality specs Overcome urban myths Convene industry Address learning curves

Note: The content of this document is a compilation of the notes from the 2006 forum. The opinions expressed do not necessarily represent the opinion of either the NYS Dept. of Economic Development or R.W. Beck.