

Scrap Tire Management

A Case Study of Vermont

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Prepared by:

Marie Choi
Kevin Hudak
Danielle Penabad

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Contact:

Nelson A. Rockefeller Center, 6082 Rockefeller Hall, Dartmouth College, Hanover, NH 03755
<http://policyresearch.dartmouth.edu> • Email: Policy.Research@Dartmouth.edu

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EXECUTIVE SUMMARY

In 1990, the Environmental Protection Agency estimated that there were nearly one billion scrap tires in stockpiles across the nation. The most recent data of Vermont, reported by the Environmental Protection Agency in 2001, indicates that as many as 200,000 scrap tires are stored in stockpiles. Such stockpiles pose serious environmental and health threats which could have severe long term effects if not properly addressed. To confront those threats appropriately, the state should consider developing more effective strategies for the collection and use of scrap tires. The rubber from scrap tires has a variety of constructive uses, such as a physical resource in civil engineering, thus stockpiling scrap tires is a problem not only due to the pollution it represents, but also because of the productivity waste it involves.

This brief summarizes the threat posed by scrap tire stock piles, describes the status quo for scrap tires processing, and discusses policy options the state may wish to consider in order to improve the current status of scrap tire management in Vermont. The information presented in this report is synthesized from reports on scrap tires and drawn from conversations with professionals involved in different stages of scrap tire processing in both the private and the public sector.

Currently in Vermont, scrap tires that are legally stockpiled are collected at public drop-off centers or at private tire and auto dealerships. In both cases, the fees are charged to consumers for disposing their tires, which serves as a disincentive for people to properly dispose of their tires. Despite readily available scrap tire disposal methods, illegal stockpiling continues to be a problem. The long term ramifications can be serious, thus improvements in scrap tire management can potentially help alleviate illegal stockpile dumping.

After the collection process, scrap tires are commonly converted to Tire-Derived Fuel, and, less frequently, used in civil engineering projects. In evaluating the potential uses of scrap tires, policy makers could consider the costs, public health and safety concerns, environmental implications, and labor issues associated with each application. With attention focused on those concerns, this paper discusses the costs and benefits of Tire Derived Fuel and various civil engineering uses of scrap tires.

Ultimately, three policies the state could institute to attempt to collect a greater percentage of the scrap tires produced are:

- Creation of "Tire Round-Up Day" – once every year where residents can drop off their tires free of charge in various waste facilities
- A tire deposit system similar to that put in place for glass bottles
- The institution of a tire tax on new tires to pay for the disposal of scrap tires

1. STATUS QUO

1.1 Threats Posed by Improperly Stored Tires

In 2001, Vermont reported that 200,000 scrap tires were being stockpiled within state boundaries (the number is presumed to have since decreased).¹ This significant amount of scrap tires doesn't include the large number of scrap tires that are illegally dumped. Chittenden County, for example, widely considered being remarkably efficient in terms of solid waste procedures, found 1,334 scrap tires during their roadside cleanup in the spring of 2005.²

In Vermont, scrap tires are considered solid waste and are subject to the provisions of state-level Solid Waste Rules, which set forth regulations on "collecting, storing, transferring, processing, treating, and land filling" tires. For example, no more than three hundred tires can be left outside, uncovered, and tire landfills are prohibited.³ The number of tires found in Chittenden County's spring cleanup suggests that the law continues to be implemented imperfectly, meaning that many tires continue to be improperly stored.

Improper storage of scrap tires can pose serious health and environmental threats to Vermont residents. Stockpiles can ignite, "creating tire fires that are difficult to extinguish and can burn for months, generating unhealthy smoke and toxic oils."⁴ In October of 1983, tires in storage at the Rhinehart, West Virginia tire dump ignited and burned for nearly nine months.⁵ The smoke from the fire, containing toxic smoke and air pollutants, spread for fifty miles and across the border into four different states.⁶ Such drastic consequences are incentives to implement efficient scrap tire storage and disposal laws.

In addition, by collecting rainwater, scrap tires create ideal environments for rodents and mosquitoes.⁷ Both pests can harm human health, and the interaction of scrap tires and their rainwater pools with other elements of an ecosystem has the potential to create an equally harmful situation.

1.2 Current Disposal Channels

Scrap tire disposal in Vermont takes place through both public and private facilities. In each, residents depositing tires are charged a small fee to cover the costs of hauling the tires away. Tires can be deposited either at district drop-off centers or at private tire- and auto dealerships. In both cases, the tires enter the export market after being transported to facilities out of state by hauler and storage companies, as Vermont currently has no means to properly dispose of tires within the state boundaries.

1.2.1 Public Disposal Sites

According to Buzz Surwilo, an Environmental Analyst for the Vermont Department of Environmental Conservation, solid waste districts at the county level are in charge of managing solid waste in accordance with a statewide plan through which the state ensures compliance and grants state funds. The solid waste districts are funded by state grants and locally arranged trash collection taxes. The state program operates on a \$6 per ton tax on solid waste moving to landfills. Part of the revenue goes to solid waste districts and grants can range from \$10,000 to \$50,000 based on district size.⁸

In the past few years, prices at district drop off centers have been on the rise. For example, Chittenden Solid Waste District's prices have increased from \$1.75 to \$2.25. Fees at most solid waste districts have increased even more to \$2.75 per tire less than 16 inches in diameter. This increase in price can be attributed to an increase in end market fees.⁹ The Environmental Analyst for the Vermont DEC suggests that the fees on scrap tires may act as a disincentive that discourages residents from properly disposing tires at appropriate collection stations.¹⁰

1.2.2 Private Disposal Sites

Tire and auto dealerships take spare tires for a small fee. Three private enterprises that collect tires were surveyed for this paper.¹¹ The fee charged per tire ranges from \$.90 to \$5 for tires of roughly normal size, reflecting in part the differing costs of hauling the tires away. The frequency with which tires are picked up by the hauler likewise varied, as did the appropriateness of tire storage strategies employed by the collectors.

1.2.3 Tire Exports

The tire export market in Vermont consists of haulers working for private companies in Canada, Maine, and Massachusetts that specialize in tire storage and shredding. The JP Routhier & Sons Company of Massachusetts and BDS Waste Disposal of Maine are the largest tire collectors.¹² Hauler and storage companies shred the tires when they arrive in the out-of-state facility. The majority of Vermont's spare tires end up as Tire Derived Fuel, which is used in paper mills and other manufacturing facilities, especially Maine's tree paper and pulp mills that use tire-derived fuel for electrical energy.¹³

1.3 End Markets for Scrap Tires

In 2003, the civil engineering market in the United States consumed over 56 million tires, accounting for over 19 percent of the scrap tire market.¹⁴ Within this market, the most popular applications for scrap tires are: landfill construction and operation, septic system drain fields, sub-grade fill and embankments, backfill for walls and bridge abutments, sub-grade insulation for roads, and rubberized asphalt and lightweight concrete. The Vermont Agency of Transportation (VTTrans) continues to plan pilot programs to explore the costs and benefits of these civil engineering applications.

All of these applications, except for Rubberized Asphalt and Concrete (RAC), require Tire Derived Aggregate (TDA), tire shreds ranging from two to 12 inches depending on the specific application. The beneficial properties of TDA include its light weight, high permeability, ability to attenuate vibrations, and good thermal insulating properties. The table below demonstrates some of the benefits of TDA in comparison to materials that scrap tire often replaces in civil engineering projects.

In addition to the practical benefits of using TDA, the light weight of tire shreds compared to other materials could potentially lower transportation and labor costs during construction.

Table 1.3.1: Properties of Tire Rubber Used in Civil Engineering Applications:¹⁵

Size	2 to 12 inches
Weight	1/3-1/2 weight of soil
Volume	1 cubic yard = 75 tires
Drainage	10 times better than well graded soil
Insulation	8 times better than gravel
Lateral Foundation Wall Pressure	1/2 that of soil
Septic System Drain Fields	Holds 1.5 times more water than stone

1.3.1 Landfill Construction and Operation

Landfill construction and operation is the fastest growing market application for tire shreds. This application utilizes scrap tires for various functions, including: leachate collection systems, gas venting systems, in cap closures, operational liners, and material for daily landfill cover. In January 2005, Vermont was in the process of designing a new landfill cell for a central Vermont facility that could potentially utilize up to 18,000 cubic yards of tire chips – approximately 1.35 million tires or two years waste tire generation for the state of Vermont.¹⁶ This landfill cell design is called a “bioreactor”, incorporating layers of tire shred in combination with piping systems and geotextile at intervals between layers of landfill. If properly implemented, a bioreactor should provide better flow of leachate through the collection system, reduce clogging potential, prevent shifting or damage to the gas venting system, and prevent birds or rodents from entering. (See Appendix A, Chart A.1)

Alternate daily covers (ADC) would be one potential use for tire shreds in landfill operation that is not currently being implemented in Vermont. ADCs consist of six inches of material spread across the work area of an active landfill cell at the end of each day. Tire shreds are valuable for this function because: 1) their material flexibility accommodates differential settlement within landfills, 2) they lack of nutrient source for animals, 3) they have high permeability to facilitate leachate and gas migration, and 3) they are resistant to adverse weather conditions.¹⁷ However, tire shreds also have undesirable characteristics such as combustibility, which is a potential fire hazard, and high permeability, which allows for water infiltration. Most states that currently utilize this material for ADC mix tire shreds with 30-50 percent soil by weight. This significantly reduces the undesirable characteristics of tire shred. Using tire shreds as ADC material has been found to be generally cost effective compared to soil because it extends landfill capacity and decreases the amount of soil.¹⁸ However, costs vary on a site-by-site basis as availability of scrap tires and cost of soil varies.

1.3.2 Septic System Drain Fields

Arkansas, Delaware, Florida, Georgia, New Jersey, South Carolina, Pennsylvania, and Virginia already use tire shreds to construct drain fields for septic systems. The number of tires used per septic system in various states ranges from 800 to 1,800 per system. Tire shreds are equal in performance to traditional stone backfill material. Furthermore, tire shreds are lighter than stone, facilitating transport during construction.¹⁹ In 1990, Vermont’s Agency of Natural Resources (ANR) commissioned a bench study on substituting tire shreds for stone in the construction of on-site wastewater systems. Favorable results from this study resulted in the 1999 construction of a septic system at Little River State Park in

Waterbury. The ANR's Waterbury construction used tire shreds for half of the leach field and conventional stone for the other half. No problems were encountered during construction and the system remains fully functional.²⁰

1.3.3 Sub-grade Fill and Embankments

TDA has been used in Maine, Minnesota, California, North Carolina, New Jersey, Oregon, Pennsylvania, South Carolina, Vermont, Washington, Wisconsin, Wyoming, and Virginia to retain forest roads, protect coastal roads from erosion, and enhance the stability of steep slopes and shoulder areas along roadways.²¹ The largest known use is that of 580,000 scrap tires for a landslide correction project in Oregon. Overall, more than 70 successful projects have been constructed throughout the U.S.²² The major benefit of using TDA for sub-grade fill and embankments is that TDA is significantly lighter than soil fill, allowing for construction of embankments on weak, compressible foundations. Additionally, TDA is significantly cheaper than alternatives such as shale aggregate or polystyrene insulation blocks.²³ In Maine, TDA was used to strengthen the embankment on the Portland Jetport Interchange. By using two layers of TDA for the core of the embankment, the Maine Turnpike Authority saved \$300,000 on this embankment alone.²⁴

However, using TDA for embankments and lightweight fill also poses several risks. In the past, there have been concerns about the puncturing of rubber tires on haul vehicles during construction by the exposed steel in tire chips or shreds. Other concerns include whether compaction will be adequate since some consolidation will occur and long-term differential settlement could result in some cracking of the roadway above tire shred embankments.²⁵ Although all scrap tire embankments constructed so far have remained structurally stable, three shredded tire projects had combustion problems within six months of completion in 1995.²⁶ Following these incidents, the Ad Hoc Civil Engineering Committee, in partnership with government and industry, developed design guidelines for the reuse of scrap tires for civil engineering purposes in 1997. TDA embankments that have been built since have been closely monitored for temperature changes.

From 1990-1995, VTTrans used TDA as lightweight fill for several projects. As of January 2005, VTTrans had a policy to use recycled tires in project situations that make sense, such as projects that require lightweight fill. However, VTTrans had not committed to any such projects for FY 2006.

1.3.4 Backfill for Walls and Bridge Abutments

The use of tire shreds as backfill for walls and bridge abutments has caught the attention of many engineers. Studies in Maine and South Dakota have demonstrated the engineering advantages of using tire shreds as backfill.^{27,28}

- The weight of tire shreds produces lower horizontal pressure on the wall, allowing for construction of thinner, less expensive walls;
- Tire shreds are free-draining and provide good thermal insulation, eliminating water and frost buildup problems behind walls;
- Compressibility provided by a thin layer of tire shreds placed directly against a bridge abutment can significantly reduce horizontal pressures.

In the “Uses for Discarded Tires” report, VTrans examines the cost effectiveness of using TDA as fill material for walls and bridges. VTrans used estimates provided by JP Routhier and Sons to show that the expected cost of using TDA will be similar to the costs of using granular backfill—approximately \$25 per cubic yard.²⁹ VTrans will be conducting two pilot projects in FY 2007, Cabot BRO 01446(27) and Chittenden TH 3 9617, in order to assess the costs and benefits of using shredded tire backfill on two bridges.³⁰ Combined, these two pilot projects will require approximately 79,350 scrap tires, or approximately 13 percent of the total generated in Vermont over one year. VTrans also estimates that if it were feasible to use recycled tire material in every bridge project proposed for FY 2006-2007, 189,000 tires (31 percent of the annual waste stream) would be recycled.³¹

1.3.5 Sub-grade Insulation for Roads

Given Vermont’s cold climate, using TDA as sub-grade insulation for roads is a particularly relevant option. Frost penetration beneath roads causes water to be drawn up, creating layers of ice that can be more than an inch thick. This pressure on the road can produce uneven driving surfaces and possibly crack the pavement. When the water melts in the spring, the excess water weakens the sub-base, leading to ruts in gravel roads and cracked pavement. TDA is a possible solution to this problem. A six-inch to 12-inch layer of tire shred keeps sub-grade soils from freezing in the water and prevents the problem of excess water that is released when sub-grade soils thaw in the spring. High permeability of tire shreds also allows excess water to drain from beneath the roads, preventing damage to road surfaces.

Vermont has conducted studies that experiment with various methods of preventing muddy roads caused by seasonal freezing and thawing. However, these studies have not tested tire scraps as a possible means of alleviating the problem of muddy roads. Muddy roads continue to be a problem for Vermont, resulting in high costs for road maintenance.³²

1.3.6 Rubberized Asphalt and Lightweight Concrete

Rubberized asphalt and concrete (RAC) currently accounts for 20 percent of the U.S. ground rubber market. States including California, Arizona, Florida, South Carolina, and Nebraska have continued to use rubberized asphalt for both intermediate (overlay of badly worn road surfaces) and long-term road repair. RAC has the benefits of longer lasting roads, better stopping distances, skid-resistance, and quieter roads. In California, RAC has been used extensively because of its cost savings. The Rubberized Asphalt Concrete Technology Center has estimated that a two-inch thick rubberized asphalt concrete resurfacing uses over 2,000 waste tires and can save up to \$22,000 per lane mile over conventional asphalt.³³

However, RAC technology is relatively new and expensive. Crumb rubber processing is an expensive process; thus, RAC provides long-term cost savings, but requires large initial investments. (See Appendix A, Figure A1) Furthermore, environmental groups have raised concerns about the safety of RAC for motorists who are allergic to rubber, as well as potential safety risks to workers mixing and installing RAC.

1.4 Barriers to the Use of Scrap Tires in Civil Engineering Applications

To succeed in using scrap tires for civil engineering applications, the state must overcome several barriers. Currently, Vermont ships most scrap tires to other states for use in Tire Derived Fuel plants, and there are no in-state tire processing facilities. In order to buy scrap

tires for civil engineering projects, Vermont must buy tires back from neighboring states through hauling companies like JP Routhier and Sons. However, if the market for scrap tires in Vermont grew, this could potentially entice a tire processor to build a fixed or mobile tire shredding site in Vermont. This would reduce some transportation costs currently accrued from the disposal of scrap tires.

If Vermont were to engage in civil engineering projects that utilized large quantities of scrap tires, and were interested in reducing costs associated with buying scrap tires from other states, a temporary storage site would be necessary to house shredded tires for future use in civil engineering applications. However, temporary storage requires the establishment of a monofill that meets current Solid Waste Management standards.

Finally, careful planning would be required to ensure that scrap tire processors could meet the demand and timeline for planned civil engineering projects. This requires a high level of coordination and advance planning on the part of both VTrans and various contractors. To illustrate: In the past, the Vermont Agency of Transportation has joined the Agency of Natural Resources in using shredded tires for civil engineering projects, including drainage layers, gravel road bases, and paving. One problem past projects have encountered is the lack of available spare tires amongst different regions in Vermont. A dedicated civil engineering project has the prospects of using a majority of locally-stored tires and those dropped off at Solid Waste Districts. In 1990, while building a park septic field with shredded tires versus stone beds, the contractors ran out of locally-stored tires during construction.³⁴

1.5 Tire-Derived Fuel and Its Problems

Nationally, the most prevalent end-use market (with 44.7 percent of the total consumption) for scrap tires was Tire-Derived Fuel (TDF). Tire-Derived Fuel is produced by shredding tires and separating them into components for combustible fuel to generate electricity. Aside from TDF, 19.4 percent of scrap tire consumption is devoted to other civil engineering uses.³⁵ The use of TDF has increased by approximately 400 percent since its inception in the 1980s, while substitution of TDF for other fuels has risen 12 percent since 2001. The substitution of TDF continues to be adopted nation-wide in 43 cement factories, 17 paper mills, and 29 industrial/utility boilers.³⁶

Tire-Derived Fuel production poses a health threat to employees in paper, cement, and industrial plants. A California Integrated Waste advisory to waste management employees reports, “Epidemiological studies of the cancer mortality rates among those workers that have high PAH [Polycyclic aromatic hydrocarbons, a class of compounds emitted in tire burning] exposure show an association with increased mortality from lung cancer.”³⁷

Tire-Derived Fuel became a political issue in Vermont when an International Paper plant in Ticonderoga, New York announced plans for a test burn using TDF to replace ten percent of their oil in the generators running the factory. This substitution, according to plant officials, would save \$1.5 million a year.³⁸ The two-week test burn is part of a growing trend towards TDF across the company for these very same cost-cutting factors.

1.6 Vermont’s Current Plans for Improvement

The Vermont Agency of Transportation in the winter of 2004 adopted an “Environmental Stewardship Policy” to guide their future operations. The policy has a special emphasis on environmental quality of engineering options. The Vermont Agency of Transportation seeks to “minimize agency-generated waste by reducing, reusing, or recycling materials and find substitutes for hazardous materials whenever possible.”³⁹ This policy is partly directed at tire recycling or reuse for civil engineering programs, and the Vermont Agency of Natural Resources approves of the use of shredded scrap tires for civil engineering purposes.⁴⁰

2. POLICY OPTIONS

2.1 Tire Round Up Days

One policy option is promoting the use of drop-off centers located throughout the state, where residents can dispose of their unwanted tires. Illegally dumping tires or improperly storing them can pose serious health and environmental threats to Vermont residents. “The curved shape of a tire allows rainwater to collect and creates an ideal habitat for rodents and mosquitoes. Prone to heat retention, tires in stockpiles also can ignite, creating tire fires that are difficult to extinguish and can burn for months, generating unhealthy smoke and toxic oils.”⁴¹

The fee for dropping off an unwanted tire is based on a tire’s rim size. Unfortunately, prices at drop-off centers have increased due to “higher fees charged by the end market to recycle the tires.”⁴² Vermont residents have little incentive to properly dispose of their tires, especially since the drop-off centers have increased their fees.

Table 2.1.1 Fees for Common Tire Sizes at Most DOCS

Rim Size	Fees at most DOCS
16" or smaller	\$2.75
16" – 19"	\$5
20" – 24.5"	\$14
Larger than 24.5"	\$56
Tires on rims	Add \$1

Source: <http://ccs.burlingtonfreepress.com/fe/HouseandHome/tires.asp>

Chittenden County Waste District Drop-Off Center has offset this problem by promoting “Tire Round-Up Days.” These events take place every year in April and October in centers throughout Chittenden County including: Burlington, Essex, Hinesburg, Milton, Richmond, South Burlington, and Williston. Residents can drop off their tires free of charge, thus giving them the incentive to properly dispose of their unwanted tires. When residents drop off a set of four standard tires from a compact car, they save a total of \$11 on disposal charges.

Chittenden County’s “Tire Round-Up” events have been successful in the past. In April 2005, 1,081 residents of Vermont participated and 4,393 tires were collected. In October 2004, there were 1,017 participants and 2,907 tires were collected.⁴³ Funds for the bi-annual events are included in the budget. The Chittenden Solid Waste District reimburses each

drop-off center what they would have collected had they charged for the disposal of the collected tires. Since they are a municipality, they are not in the business of making profits.

In the spring of 2005, Chittenden Waste Management facility reimbursed drop off centers \$12,198 and in the fall of 2004, the amount was \$8,136.⁴⁴ Chittenden County has one fourth of the population of the state (around 150,000 people); thus, the county has the economies of scale to hold such events. The facility receives most of their funding from the tax on trash collection in the district.

Once the tires are collected at the seven drop-off centers, they are shipped in roll off boxes (rectangular boxes that are 10 to 40 cubic yards) to the center in Williston, Vermont. Chittenden County averages a shipment of two tractor trailer loads of tires per month. The tires are stored in an outdoor bunker before being loaded into tractor trailers and shipped out of state. The state of Vermont requires that each facility obtain certification from the state in order to store tires.

The county uses two markets for their tires, one in Massachusetts (Routhier) and one in Maine (BDS). The Chittenden facility pays Routhier \$137.50 per ton of tires, which includes the new fuel charge of \$12.50 per ton, and \$250 per truck load for loading the tires.⁴⁵ Vermont scrap tires are separated from those of other states and are specifically used for shredding, not TDF. The Chittenden facility pays BDS a flat rate of \$115 per ton of tires.⁴⁶ The tires go to waste management landfills where they are used as drainage layers.

Other counties in Vermont might find it beneficial to model their tire disposal system after Chittenden County, since they have been successful in recycling scrap tires. In order to educate the public about the event, the districts could issue a press release, print ads in local newspapers, display posters at each drop-off center, and make information available on their websites, hotlines and radio stations.

2.2 Deposit System

Another policy option is a deposit system modeled after the bottle bill. “A bottle bill is a law that requires a minimum refundable deposit on beer, soft drink and other beverage containers in order to insure a high rate of recycling or reuse.”⁴⁷ The purpose of the bill is to curtail the amount of solid waste deposited in landfills. According to the Container Recycling Institute, after the enactment of a bill “seven states reported a reduction of beverage container litter ranging from 70 to 83 percent. High recycling rates were also achieved.”⁴⁸

A similar system could be implemented for scrap tires. One alternative would involve including a built-in fee into vehicle registration costs that would cover the disposal of unwanted tires. When the owner of a vehicle delivers their tires to a drop-off center, they can either dispose their tires for free or be reimbursed for the extra fee they paid when they registered their vehicle. This gives car owners an incentive to properly dispose of their tires since the service can be free of charge or the owners can be fully reimbursed.

The state might create a fee based on the following calculation: The life cycle of a tire is five years, and cars generally operate on four tires. Therefore, an annual fee should require a vehicle owner to pay 4/5 of the cost of disposing one tire. If the state divides all the money

spent on tire disposal each year by the number of tires the state disposes of in drop-off centers each year, the figure that results is the cost that the state bears each year for managing each tire in drop-off centers. This figure is then multiplied by 4/5 to establish the total cost that should be added to each vehicle registration fee.

$$\frac{\text{State funds spent on tire disposal (per year)}}{\text{\#of tires state disposes of in tire drop-off centers (per year)}} = \text{Cost to state of managing one tire in drop-off center}$$

$$4/5 \text{ (The total cost to state of each scrap tire)} = \text{cost added on to vehicle registration fees}$$

Table 2.2.1 Motor Vehicle Costs and Fees

Type of Vehicle	Registration Cost	Number of Vehicles Registered in VT in 2001	Rim Size	Fees at most DOCS
Autos	\$50	395,030	Under 19"	\$5
Buses and Trucks	\$50	140,580	20" – 24.5"	\$14
Tractor Trailer	\$30	80,143	Larger than 24.5"	\$56

Sources: Vermont Department of Motor Vehicles <http://www.aot.state.vt.us/dmv/dmvhp.htm> and <http://ccs.burlingtonfreepress.com/fe/HouseandHome/tires.asp>

2.3 Tire Tax

Rhode Island has an innovative program where they charge a \$5 deposit on all replacement vehicle tires. When car owners return their old, unwanted tires within 10 to 14 days after purchasing new tires, their deposits are returned to them.⁴⁹ The reimbursements are kept to one tire for every tire purchased. Currently, Rhode Island is the only to state to enact a deposit-refund system.

“In addition to the deposit, Rhode Island, along with most states, imposes product charges on tires to finance the oversight of scrap tire handling, disposal, and recycling.”⁵⁰ This option, a tire tax, is similar to the deposit system. States can enact a tire tax on the retail sale of new tires and the money collected from the tax can then be deposited into a fund that would be used for scrap tire management. On average, many states have a \$1 per tire tax on the retail sale of new motor vehicle tires. The state of California has a \$1 per tire fee, which generates \$3 million to \$4 million annually for the California Tire Recycling Management Fund.⁵¹ In Illinois “any person offering tires at retail sale...must collect a fee of \$1 per tire sold and delivered in the State. After collection allowances are paid to the retailer and the Illinois Department of Revenue, \$0.80 of each dollar is deposited into the Used Tire Management Fund. Approximately \$7 million is expected to be generated annually.”⁵²

By enacting a tire tax, Vermont could establish a scrap tire management fund that would enable the state to have the funds to properly dispose of unwanted tires.

3. CONCLUSION

Ultimately, the improper disposal of scrap tires not only poses serious health and environmental threats but also decreases the productive capacity of the scrap tire management system. Illegally stockpiled scrap tires can catch fire and be very difficult to extinguish, increasing the amount of toxic smoke in the air. Additionally, abandoned scrap tires create ideal environments for harmful pests such as rodents and mosquitoes. Because of certain disincentives (fees and long distances to a drop off facility), scrap tires are often not properly disposed of in the current scrap tire management system. This prevents maximum use of the civil engineering market, where scrap tires are used in landfill construction and operation, septic system drain fields, walls and bridge abutments, as insulation for roads, and as rubberized asphalt and lightweight concrete. Thus, implementing appropriate policy solutions could create a more efficient scrap tire collection system and increase the productivity of the civil engineering market. The plethora of positive uses for scrap tires makes it imperative to collect the majority of scrap tires, which is done through proper collection strategies.

Of the policy options available, the creation of tire round-up days, a deposit system, and a tire tax are viable solutions to remedy the current management system. Tire round-up days would eliminate fee disincentives because residents will be able to drop off their tires free of charge. Based on past experience in Chittenden County, these days have been very successful and could be relatively easily implemented in other areas within Vermont. However, implementation may require more planning and organization than the other two policy options. As another option, a deposit system could include a fee, built into vehicle registration costs, which would cover the disposal of unwanted tires. When an individual turns in their tires, they would be eligible to receive a refundable deposit, thus increasing the incentive to properly dispose of scrap tires. A final policy option would be to implement a tire tax. This is likely the simplest policy to implement, and it would enable the state to have the proper funds to dispose of scrap tires and to increase the ability to locate illegal stockpiles. The state may wish to consider one or more of these three policy options to improve the current scrap tire management system in Vermont.

4. APPENDIX A

Chart A.1 Civil Engineering Applications⁵³

Application	Tire Shred	Material Replaced	Benefits	Risks
Leachate Collection Systems	Relatively clean-cut 4" square tire shred	Middle layer of three feet of sand typically used in a leachate collection system.	<ul style="list-style-type: none"> ▪ Better flow of leachate through collection system ▪ Compact less than sand, reducing clogging potential of leachate system ▪ No environmental stress or thermal degradation 	<ul style="list-style-type: none"> ▪ Tire shreds should not be used in sections of the system that touch geotextile that separate collection system from solid waste b/c tire wire would puncture the geotextile and cause leakage.
Gas Venting Systems	Clean-cut 4" square tire shred	Conventional fill materials	<ul style="list-style-type: none"> ▪ Lightweight tire shreds exert less pressure against gas venting equipment ▪ Prevents shifting or damage to gas venting system 	
Cap Closures	Rough shreds	Clean fill in three feet of cover material placed between uppermost geotextile layer and geotextile under final cover material.		
Operational Liners		Clean fill or sand separating municipal solid waste from landfill containment systems		<ul style="list-style-type: none"> ▪ Tire shreds are not placed directly against geosynthetic membranes
Alternate Daily Cover	Rough shreds mixed with clean fill	Six inches of cover material landfills spread across work area of active cell at the end of each day	<ul style="list-style-type: none"> ▪ Utilizes large numbers of tires ▪ Keeps municipal waste in landfill and prevents birds or rodents from entering 	<ul style="list-style-type: none"> ▪ More cost effective than using 100% clean fill ▪ No ability to control odor emanating from landfill

Figure A.1: Chart demonstrating risks and benefits of using tire shred for various landfill construction applications. Source: "U.S. Scrap Tire Markets, 2003"⁵³

REFERENCES

- ¹ “U.S. Scrap Tire Markets: 2003 Edition.” Rubber Manufacturer’s Association. July 2004: Washington, D.C. p.50. http://www.rma.org/scrap_tires/
- ² Plunkett, Nancy. Director of “Tire Round-Up Day.” Phone Interview. 1 November 2005.
- ³ “Scrap Tire Management.” Solid Waste Environmental Fact Sheet. New Hampshire Department of Environmental Services. 2000: Concord, NH. <http://www.des.state.nh.us/factsheets/sw/sw-22.htm>
- ⁴ “Management of Scrap Tires: Basic Information.” U.S. Environmental Protection Agency. April 2005: Washington, D.C. <http://www.epa.gov/epaoswer/non-hw/muncpl/tires/basic.htm>
- ⁵ “Evaluation of Employee Health Risk from Open Tire Burning: LEA Advisory #46.” California Integrated Waste Management Board. 6 November 1997. <http://www.ciwmb.ca.gov/LEAAdvisory/46/>
- ⁶ Modena, Thomas D. “Rhinehart Tire Fire Dump.” Winchester, Frederick County, Virginia. Superfund Program Site Fact Sheet. Virginia Department of Environmental Quality. <http://www.deq.virginia.gov/waste/pdf/superfund/rhi.pdf>
- ⁷ “Management of Scrap Tires: Basic Information.” U.S. Environmental Protection Agency. April 2005: Washington, D.C. <http://www.epa.gov/epaoswer/non-hw/muncpl/tires/basic.htm>
- ⁸ Surwilo, Buzz. Phone Interview. 27 October 2005.
- ⁹ “Tired of Tires.” Vermont House & Home. *The Burlington Free Press*. August 2005. <http://ccs.burlingtonfreepress.com/fe/HouseandHome/tires.asp>
- ¹⁰ Surwilo, Buzz. Phone Interview. 27 October 2005.
- ¹¹ Holtz, Eric. Manager, Adirondack Tire Centers. Phone Interview. 1 November 2005; Laird, Ernie. Owner, A Brown Tire and Auto Service Centers. Phone Interview, 1 November 2005; and Bourn. Bourn’s Tire and Auto Center. Phone Interview. 1 November 2005.
- ¹² “Agency of Transportation Uses for Discarded Tires.” Legislative Study Report. Vermont Agency of Transportation. 22 December 2004. p. 2.
- ¹³ “U.S. Scrap Tire Markets: 2003 Edition.” Rubber Manufacturer’s Association. July 2004: Washington, D.C. p.23. http://www.rma.org/scrap_tires/
- ¹⁴ “U.S. Scrap Tire Markets: 2003 Edition.” Rubber Manufacturer’s Association. July 2004: Washington, D.C. http://www.rma.org/scrap_tires/
- ¹⁵ “U.S. Scrap Tire Markets: 2003 Edition.” Rubber Manufacturer’s Association. July 2004: Washington, D.C. p.18. http://www.rma.org/scrap_tires/
- ¹⁶ “Agency of Transportation Uses for Discarded Tires.” Legislative Study Report. Vermont Agency of Transportation. 22 December 2004. p. 9.
- ¹⁷ “Guidance Manual: Shredded Tires as Alternative Daily Cover at Municipal Solid Waste Landfills.” California Integrated Waste Management Board. 30 October 1997: Walnut Creek, CA. p. 17 <http://www.ciwmb.ca.gov/Publications/Tires/21297024.doc>
- ¹⁸ “Guidance Manual: Shredded Tires as Alternative Daily Cover at Municipal Solid Waste Landfills.” p. 18.
- ¹⁹ “U.S. Scrap Tire Markets: 2003 Edition.” Rubber Manufacturer’s Association. July 2004: Washington, D.C. p.20. http://www.rma.org/scrap_tires/
- ²⁰ “Agency of Transportation Uses for Discarded Tires.” Legislative Study Report. Vermont Agency of Transportation. 22 December 2004. p. 5-6.
- ²¹ “Scrap Tires User Guideline—Embankment or Fill.” Turner-Fairbank Highway Research Center. <http://www.tfhrc.gov/hnr20/recycle/waste/st4.htm>
- ²² “Scrap Tires User Guideline—Embankment or Fill.” Turner-Fairbank Highway Research Center. <http://www.tfhrc.gov/hnr20/recycle/waste/st4.htm>
- ²³ “U.S. Scrap Tire Markets: 2003 Edition.” Rubber Manufacturer’s Association. July 2004: Washington, D.C. p.20. http://www.rma.org/scrap_tires/
- ²⁴ Humphrey, Dana N. “Tire Shreds Save Money for Maine.” Maine Department of Transportation. February 2000. p.3. <http://trb.org/publications/trnews/rpo/rpo.tn206.pdf>
- ²⁵ “Scrap Tires User Guideline—Embankment or Fill.” Turner-Fairbank Highway Research Center. <http://www.tfhrc.gov/hnr20/recycle/waste/st4.htm>
- ²⁶ “Scrap Tires User Guideline—Embankment or Fill.” Turner-Fairbank Highway Research Center. <http://www.tfhrc.gov/hnr20/recycle/waste/st4.htm>

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- ²⁷ Humphrey, Dana N. "Civil Engineering Applications of Tire Shreds." Tire Industry Conference. 3 March 1999: Hilton Head, SC. p. 5 <http://www.shercomindustries.com/industries/Hilton%2520Head.pdf>
- ²⁸ "U.S. Scrap Tire Markets: 2003 Edition." Rubber Manufacturer's Association. July 2004: Washington, D.C. p.20. http://www.rma.org/scrap_tires/.
- ²⁹ "Agency of Transportation Uses for Discarded Tires." Legislative Study Report. Vermont Agency of Transportation. 22 December 2004. p. 7.
- ³⁰ Ibid.
- ³¹ Ibid.
- ³² Humphrey, Dana N. "Civil Engineering Applications of Tire Shreds." Tire Industry Conference. 3 March 1999: Hilton Head, SC. p. 7 <http://www.shercomindustries.com/industries/Hilton%2520Head.pdf>
- ³³ "The Advantages of Rubberized Asphalt Concrete." The Rubberized Asphalt Concrete Technology Center. 2004. <http://www.rubberizedasphalt.org/advan.htm>, "Agency of Transportation Uses for Discarded Tires." P. 9.
- ³⁴ "Agency of Transportation Uses for Discarded Tires." Legislative Study Report. Vermont Agency of Transportation. 22 December 2004. p. 5-6.
- ³⁵ "U.S. Scrap Tire Markets: 2003 Edition." Rubber Manufacturer's Association. July 2004: Washington, D.C. p.6. http://www.rma.org/scrap_tires/.
- ³⁶ Esch, Mary. "Burning tires gains momentum nationwide." *The Burlington Free Press*. 21 March 2005. <http://www.burlingtonfreepress.com/apps/pbcs.dll/article?AID=/20050321/NEWS01/51012010&theme=TIRES>
- ³⁷ "Evaluation of Employee Health Risk from Open Tire Burning: LEA Advisory #46."
- ³⁸ Page, Candace. "N.Y. tire-burning permit hits snag." *The Burlington Free Press*. 2 November 2005. <http://www.burlingtonfreepress.com/apps/pbcs.dll/article?AID=/20050317/NEWS01/51012018&theme=TIRES>
- ³⁹ "Agency of Transportation Uses for Discarded Tires." Legislative Study Report. Vermont Agency of Transportation. 22 December 2004. p. 5.
- ⁴⁰ Ibid.
- ⁴¹ "Management of Scrap Tires: Basic Information." U.S. Environmental Protection Agency. April 2005: Washington, D.C. <http://www.epa.gov/epaoswer/non-hw/muncpl/tires/basic.htm>
- ⁴² "Tired of Tires." Vermont House & Home. *The Burlington Free Press*. August 2005. <http://ccs.burlingtonfreepress.com/fe/HouseandHome/tires.asp>
- ⁴³ Plunkett, Nancy. Phone Interview. 1 November 2005
- ⁴⁴ Ibid.
- ⁴⁵ Ibid.
- ⁴⁶ Ibid.
- ⁴⁷ "What is a Bottle Bill?" Container Recycling Institute. http://www.bottlebill.org/about_bb/bottlebill-what4.htm
- ⁴⁸ Ibid.
- ⁴⁹ "Waste Tires Used for Roads." The Vermont Legislative Research Shop. March 2004: Burlington.
- ⁵⁰ Ibid.
- ⁵¹ "State Scrap Tire Programs." Environmental Protection Agency. August 1999: Washington D.C. <http://www.epa.gov/epaoswer/non-hw/muncpl/tires/scrapti.pdf>
- ⁵² Ibid.
- ⁵³ "U.S. Scrap Tire Markets: 2003 Edition." Rubber Manufacturer's Association. July 2004: Washington, D.C. http://www.rma.org/scrap_tires/