

Incentives for solving the scrap tire problem through existing markets

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Abstract

The nature and causes of the scrap tire problem are examined from the viewpoint of the discipline of economics rather than a technological perspective. State governmental responses to the problem and commonly proposed remedies are briefly reviewed and the nature of the tire market's failure to prevent the scrap tire problem is examined in order to gain insight into effective and efficient corrections, without involving direct governmental participation in funding of recycling, market development and technology selection. Those functions remain in the private sector. The role of government suggested is the traditional one: that of setting the market "rules of the game". A completely market-based mechanism involving a tire disposal fee that remains wholly in the private sector is developed for dealing with new scrappage and a method is suggested by which to calculate a cost-effective disposal fee. This article will be of interest to state and local environmental officials concerned with the tire problem and who wish an understanding of the fundamental causes of the problem.

Introduction

In contrast to many years of inattention, the scrap tire problem in the United States seems to have finally commanded the serious attention of the nation's lawmakers and environmental protection officials. In recent years there have been several major tire fires, most notably in the states of Virginia, New Hampshire and Washington. In addition, the arrival of the Asian Tiger mosquito and the dengue fever which it spreads has state health officials throughout the nation very concerned, as this mosquito can winter over and therefore is likely to spread to the entire continent. This mosquito, like its encephalitis bearing cousins, finds scrap tires a congenial breeding habitat; consequently, the widespread dumping and littering of scrap tires means that the mosquito will find appropriate habitats throughout the nation.

Even a cursory examination of the current and potential uses for scrap tires under existing economic and market conditions indicates that the scrap tire problem is going to get worse before it gets better. Rubber reclaiming has been

in secular decline because of the rise of less expensive plastics based substitute products and because of the shift to radial tires which use little to no reclaimed rubber in their formulation. Other technologically feasible and/or promising uses of scrap tires are in large measure not widely utilized because production cost conditions are unfavorable; these principally are asphalt rubber and energy recovery. In short, cost savings or profit opportunities associated with scrap tire reuse are too small or nonexistent for private markets autonomously to recycle the percentage of tires they once did.

It is important for policy makers and legislators to recognize that the barrier to increased scrap tire recycling and reuse is not the lack of technology, since in addition to the currently used technologies, there are a number of technologies "on the shelf" that are technically (but not economically) feasible. Rather, economic conditions have been controlling. Furthermore, the problem cannot be easily solved simply through governmental participation in market development. Rather, the scrap tire problem is the consequence of an absence of correct institutional "rules of the game": market incentives are lacking or inappropriate. A consequence of inadequate incentives in private markets to manage scrap tires properly has, as in the case hazardous wastes, given rise to unscrupulous "tire jockeys" who are implicated in illicit tire dumping along roadside and in riverbeds, creeks and ravines throughout rural America. In addition, the seemingly ever elusive promise of future riches has led to market speculation in which landowners accumulate enormous piles of tires—it is these that are primarily implicated in the recurrent fires. If proper market incentives were instituted, appropriate technological and market development would follow with little or no direct assistance from government, simply because technology is readily available and new attempts to recycle tires are continuously being made.

Genesis of the scrap tire problem

The scrap tire problem in the United States as we know it: fires, dumping, littering, extensive habitat for disease vectors, has been in the making for at least the last 25 years and is due to two principal factors. First, the large increase in the automobile population and the increased flow of scrap tires has been coupled simultaneously with the introduction of radial tire technology in tire fabrication, greatly reducing the use of rubber reclaim in the formulations of sidewall compounds. Secondly, prices of petroleum based substitutes for reclaimed rubber (e.g. plastic instead of rubber mats) have declined relative to the price rubber reclaim, a function of the declining relative cost of energy, further diminishing the market for rubber reclaim. Real energy prices are today at the level they were in the 1960's. Both have made tire recycling today only marginally profitable at best.

These two facts have provided the motivation for the current state-level

policy approaches to the scrap tire problem: (1) the raising of funds through taxation to provide a subsidized offset to the lack of profit opportunities in private tire reuse and recycling markets, and (2) development of new markets for tire derived materials. A method does need to be found by which to restore profitability in the scrap tire industry, but we argue here that tax based approaches are both inefficient and ineffective, and governments are almost never well positioned to develop new markets. Both approaches represent fairly direct interventions in the scrap material markets, but are misdirected because government simply does not have a good track record with these interventions.

States should direct their efforts to correcting the defects in the institutional structure within which scrap materials markets operate: the price and market system. While states normally do not intervene directly in markets, governments everywhere set the “rules of the game” for market transactions by providing the legal framework within which transactions may occur and are regulated; ensuring competition and preventing price discrimination are two examples. Some new but simple rules of the game for the scrap tire problem are explained in the following pages. There are several reasons to believe that correction of defects of the tire market will eliminate the scrap tire problem as we know it.

The economics of the scrap tire problem

The set of problems associated with scrap tires has ample precedent in many other sectors of the economy; a typical scenario starts with a shift in demand conditions leaving a formerly vibrant sector of the economy in decline. The affected communities demand that the government assist them in dealing with the new adversity, frequently in ways in which governments do not perform well. Usually governmental programs are developed to assist impacted communities through various kinds of programs to make under- or unemployed resources productive again. For the usual market good or service, the negative effects of the original shift in the economic base eventually diminish or disappear altogether through industrial change and/or labor migration. The case of the shift from textiles to electronics in New England is a case in point. Such change, however, often takes decades.

Because of the changes in the demand for scrap tires, tires now also go “unemployed”, and this unemployed or underemployed resource is capable of causing social problems, just as is unemployed labor. The question is how to “reemploy” the tires effectively and efficiently. To do this we must first have an appropriate conception of the cause of the problem and that will in turn suggest appropriate kinds of solutions. For that purpose we made use of the substantially well developed body of economic thought on waste problems and solutions to them.

Why a focus on economics instead of technology? Wastes are after all pro-

duction and consumption residuals, and so the body of economic thought known as “environmental economics” and “externality theory” can provide us with the guidance for devising effective and efficient public policies for solve this problem. Technology, of course, will always remain part of the solution.

Scrap tires and externalities

Materials used in production and consumption that are unwanted become wastes. As prices and technologies change and structural economic change ensues, materials may go from being wastes to becoming valuable products and *vice versa*. Asphalt was once a refinery waste; now it is quite valuable. Tires were once virtually completely recycled; now they are nearly worthless in today’s markets. In this sense, tires are like virtually another waste, such as air and water residuals, wherein the potential market value of a transformed waste determines the effort exerted and expenses incurred to recover it.

Tires are solid wastes, however, and there are some important technical or physical differences peculiar to solid wastes (as opposed to air and water pollutants) that suggest different policies for their control. That is, it is not appropriate simply to adapt some of the control mechanisms developed for air and water pollutants directly to tires or solid wastes.

The basic difference lies in the relative size and immobility of solid wastes—they are not as easily dispersible as air and water pollutants. Tires require more handling for “disposal” whereas air and water contaminants are fairly easily released to the environment. This has always meant that the assimilative capacity of the local environment (i.e., the microenvironment immediately contiguous to the location of the discharger), to the extent that it exists at all, has been much less for solid wastes than for air and water pollutants, and the majority of communities have had to organize proper solid waste collection and “disposal” long ago. In contrast, this is a relatively recent phenomenon for air and water pollutants, beginning in earnest a little more than twenty years ago, with some exceptions, e.g., Pittsburgh’s former steel plant emissions.

The implication of the foregoing is that market mechanisms and/or governmentally supplied solid waste management services are already in place and well established, although not necessarily well managed. This means that tires are already collected by dealers who contract with haulers for “disposal”—proper or improper. In addition, a tire recycling industry exists, although not in the greatest of economic health: rubber reclaiming, rubberized asphalt, energy recovery and a few other relatively minor uses. Thus, the important elements for recycling these wastes already exist—the problem is that the incentives (profitability) are inadequate to make recycling a significant use of waste tires.

For all wastes, an externality exists whenever each handling or emission of wastes inflicts costs or damages on other parties; when that damage is greater than the costs of control, then pollution control is economically warranted. Of

course, pollution control is often instituted in circumstances where the benefits to the community are less than the costs of control; in those cases the justification must be based on equity or fairness grounds.

It is increasingly understood that externalities in which damages are greater than the cost of control exist because the assimilative capacity of the environment is exceeded and because unregulated or free markets fail ration this scarce assimilative capacity so that it is not exceeded or overused. If environment services (assimilative capacity) were properly priced, waste generators would take the environmental costs into account in business and consumption decision and would be forced to pay a price to use this capacity in production and consumption, just as business must pay for labor services and consumers for goods and services.

For air and water pollution control, in contrast to solid waste management, because of the fact that air and water borne wastes are not voluntarily received by any economic agent in the normal course of market exchange, and because of their properties of easy dispersion, finding methods to "close" the market system for these residuals is more difficult, but possible, through marketable pollution permits, for example.

However, in the case of solid wastes and tires in particular, all of the elements of exchange are in place. The only problem preventing greater use of recycling mechanisms is the economic one: a profit cannot be made in tire recycling, mainly because of the cost of tire preparation: collection, shredding and grinding. It is to this problem that much of recent state scrap tire policy has been directed. However, this policy has not been directed to closing the market system, but has been more focused on direct interventions and subsidies as methods of offsetting the effects of the tire market failure.

In the economic analysis of externalities, it is not enough to assert that there is market failure and therefore conclude that whatever measure is required to correct the problem is economically justified. For it could occur, and frequently does, that the cost of control is much greater than the benefit, and that the proper action is no action. For example, this situation occurs very frequently over the addition of stop lights at intersections. More accidents could be prevented if there were far more stop lights installed, but it is expensive and if overdone, may in fact create disrespect for stop lights in general, leading to a more serious problem. The short of the story is that the perceived benefits have to be at least as great as the costs of control for the action to be justified economically.

In the case of scrap tires, there is no empirical information available in whether the benefits of control are in fact greater than the costs of control. An initial attempt by the U.S. EPA in the early 1980's to assess the benefits of control suffered from lack of data in general. The best we can do at present is to note that state governments have and most probably will continue to act to control scrap tire problems: we might infer from this "revealed preference"

for control that the benefits must be greater than the costs. This is a weak inference at best, since the state actions could be inadequately founded. While mechanisms to assess willingness to pay for non-market benefits are under development, they have not yet been applied to the tire problem.

Thus, of the two ever present questions for environmental control that each society must answer in one way or another: (1) do the benefits outweigh the costs?, and (2) what is the cost effective method of control?, we cannot provide a definite answer for the first with presently available information. We can be more definite about the second, and that is the focus of this analysis.

This analysis then is a contribution to the search for the most efficient way to "close" the tire market, but not for the optimal level of tire recycling.

Commonly proposed remedies and state responses

Common remedies

Although the U.S. Environmental Protection Agency has researched a number of technologies to promote increased recycling of tires over the years, it has not developed programs to increase scrap tire utilization. Beginning in 1980, solid waste management problems were declared to be "local problems" by the federal government and were essentially left to the states, counties and municipalities to resolve and after several years lag, several states have begun to act.

State and local governments are frequently handicapped in dealing with environmental problems in that they typically have little in-house analytical and research expertise for policy analysis, and as a consequence, they frequently turn to engineering consulting firms for studies and suggested solutions. This is on the surface a quite logical choice as some form of technology is nearly always involved in one way or another in environmental control. Perhaps more controlling is the fact that engineers usually play a quite prominent role in environmental protection agencies. It is, then, a source of little surprise to find that environmental consultants tend to propose "end-of-the-pipe" methods for environmental protection, to borrow an analogy from the water pollution field. This is what they know best.

End-of-the-pipe controls are frequently warranted, and will play an important role in resolving the scrap tire problem, but such a focus, some would say a bias, leads to a failure to consider the pollution problem systemically. Usually neglected is the economic behavioral context in which decisions about waste handling are made and why the unregulated marketplace seems to be biased toward pollution. This is a serious error of omission only gradually being appreciated today.

As mentioned, the typical result of the study process is that technological solutions are recommended, which in the case of tires means energy recovery, shredding, asphalt rubber, etc. Since state study commissions nearly always recognize early that these cannot be profit making activities in today's market

conditions, it is usually recommended that the state raise revenues to subsidize the technology (ies). To be sure, as we shall argue, tire recycling activities are indeed only marginally profitable today, and so some additional source of revenue to support tire recycling needs to be found. We will argue, however, that states should not be in the business of choosing which technologies to support because they tend not to choose well, nor should the usual subsidy process be followed.

State responses

Several U.S. states have enacted or are considering tire legislation: Minnesota, Oregon, Wisconsin, Texas, North Carolina, California and Maine, among others. The typical state program involves the "tax and subsidy" approach to public provision of services by raising funds through a fee or tax on vehicles on or another vehicle related tax base, such as vehicle transfers, and using these revenues to fund activities designed to reduce the problem: mostly energy recovery or shredding with landfilling.

For example, the recently enacted North Carolina program operates with a one percent sales tax on new tire sales, requires the counties to establish places for proper disposal and distributes the tax revenues to the counties to fund the expense. If the sales tax generates insufficient revenue to cover county costs, then the counties are authorized to levy tipping fees at the disposal sites.

Another is the California program. Legislation there authorizes a \$0.25 disposal fee per tire to be levied on new tires; tire retailers retain 10% of the fee to cover their fee collection costs and the balance goes to the state treasury to be deposited in the California Tire Recycling Management Fund. These revenues will be used to clean up tire piles, fund research, subsidize shredding and landfills and transfer stations and to subsidize the purchase of materials manufactured from recycled tires.

Still another variant is that of Maine, where tire consumers will pay a \$1.00 disposal fee upon a new tire purchase to be used to clean up tire piles and to make grants and loans for tire recycling. Oregon was perhaps the first in the nation to deal with its scrap tire problem and has levied a \$1.00 fee on new tire sales. Eighty-five percent of the revenue collected from tire dealers is deposited in a Waste Tire Recycling Account to be distributed to recyclers for partial reimbursement of recycling costs and for clean-up of some existing tire piles.

To the extent that such legislation is designed to deal with past accumulations of tire piles, there really are no alternatives but to using state revenues to subsidize the clean-up, although as we will see below, such programs need to be integrated with programs designed to handle the flow of "new" or recently scrapped tires.

A shortcoming common in these responses to the tire problem is that they do not develop effective responses to deal with the continuing flow of tires (new scrappage) and to the tire market failure that is the continuing source of

the problem. In part, this is due to the circumstance that state and local governments typically possess limited ability to undertake good diagnostic analysis of (a) the economics of environmental problems (benefits, costs and institutional arrangements), and (b) why private markets create these problems. Furthermore, they have been hampered by the lack of conceptual frameworks in the published literature on the problem within which to formulate and on which to predicate appropriate policies to deal with the problem. States are usually poorly equipped to make independent assessments of the feasibility of new technologies, and neither are they good at identifying and evaluating good business risks. Further, state bureaucracies find it much more comfortable and convenient to employ traditional tax and subsidy approaches to the provision of public services. It is for these reasons that the tax and subsidy approach is usually chosen.

Nonetheless, there have been difficulties with some of these programs; the most notorious has been Minnesota's venture with "TireCycle", which declared bankruptcy. Economists generally indicate that an important effect of such tax and subsidy approaches is that whatever the level of recycling is stimulated by them, it will tend to be at a higher cost than necessary, which in turn may lead to less recycling than is economically warranted if legislatures and the public balk at the costs. Also, taxation and subsidy schemes, requiring periodic legislative and continual administrative attention, tended to become heavily politicized, leading to program distortions and ineffectiveness.

Our purpose here is emphasize that while it is true that state action is required to "close" the tire cycle, direct state involvement in the funding of tire reuse and recycling activities for the continuing flow of tires is *not* necessary, although it is for past tire accumulations. In fact, there are good reasons to indicate that direct state involvement should be avoided because of the inefficiencies and perverse incentives that typically characterize public production of services. What is recommended here instead is that state governmental efforts be focused on setting the correct "rules of the game" for the tire market and letting the set of economically efficient technologies and solutions be generated by the marketplace. The role of the federal government in resolving the scrap tire problem should be directed to providing the states with appropriate incentives to act and to underwrite the needed background analyses for proper state actions.

Fortunately for the tire problem, it is relatively simple for state governments to "close" these open ended markets and internalize the costs in a manner that is more efficient and effective than thorough direct subsidies and market development.

A market based solution

Making a market for scrap tires: a proposal

Virtually all of the components of the market system required to increase levels of tire recycling are already in place, and those that have fallen into

disuse can be easily resuscitated. Existing tire dealers provide the point of collection of used tires; tire haulers already exist (but need to be licensed), and there are a number of reduction and reuse technologies already in use, albeit at modest levels: rubber reclaiming, energy recovery, asphalt rubber, etc.

The lack of incentives to deal with the scrap tire problem caused by the new flow of tires can be easily eliminated by a simple change in the rules that govern the operation of this market: a legislative mandate that all used tires shall be returned to dealers upon a new tire purchase and that for each tire purchased, the consumer shall pay a non-refundable environmental disposal fee of, say, \$1.00 to \$2.00 per tire or another appropriate amount, to cover the cost of transport, size reduction if needed and any "tipping fee" required to restore profitability in the using industries: rubber reclaiming, highway construction using asphalt rubber, energy generation, etc. The dealer would be obligated to accept tires from the purchaser of new, retreaded or used tires only, not from others. How this amount should be calculated is discussed below. This much of the proposal appears in existing legislation, in that of California, e.g.

The new aspect of this proposal is contained in the requirement that the dealer will in turn be required to contract directly with licensed haulers and/or with scrap tire processors (retreaders, rubber reclaimers, asphalt rubber processors, energy recovery firms, etc.) or with approved landfills for recycling. The tire dealer will have to negotiate with these "end" users over what portion of the environmental disposal fee is to be paid by the dealer to them in order to ensure subsequent proper disposal or recycling of the tires and how much of the fee he is allowed to keep to cover his processing and paperwork costs, as some form of manifesting will be required to ensure that "midnight dumping" does not occur. While such manifesting of scrap tires would be a new practice for the dealers, it is a simple extension of the manifesting that applies to all tire shipments prior to the retail stage; indeed it applies to all products in the economy. Tire manufacturers are not involved in this process.

A major advantage of this system is that the financing of the mechanism stays wholly within the private sector—no taxes are levied, no state collection of revenues is involved, no continuous lobbying influence is involved in legislative or administrative rule making as new technologies appear—in short, none of the usual and often substantial governmental inefficiencies will impinge upon the recycling. All that is required is for the state environmental authorities to calculate the cost of the least-cost reuse option or disposal and set the disposal fee at that level. This charge could conceivably vary regionally within a state. Periodic inflation adjustments could be avoided if the fee were tied to an appropriate cost index. This actually is important in order to avoid the "regulatory lag" that always results with governmental fee setting (as with public utility commissions), avoiding periodic politicization of the process.

A further important advantage of this mechanism is that by restoring the needed profitability to recycling and reuse technologies, it will then be possible

for existing and prospective recyclers to negotiate equity or debt financing for their projects directly from the financial sector of the economy; state recycling grants are unnecessary. The leaves the evaluation and financing of business proposals wholly within the private sector, where it is done best. This was a serious problem in the Minnesota experience.

It should be noted again, that this proposal applies to the new flow of scrap tires, not to accumulated backlogs, which are indeed a serious problem in many areas. This accumulation reflects the results of past market failure and the failure of government to deal with the problem. This problem can best be dealt with through general appropriations until the problem is resolved and/or through a temporary fund created by revenues from a surcharge on landfills which would expire once the backlog is eliminated. This is of course what has been proposed in a number of states.

Policing and enforcement

All markets, to function properly, have to be policed, and environmental "markets" are no different. Certainly licensing of haulers and perhaps end users must be required to avoid fraud. Fraud can still be a potential problem in which those managing the scrap tire flow might collude to retain the environmental disposal fee and still dump the tires illicitly. Further, there is the question of how the enforcement will be financed. License fees could help to cover this cost. A better solution is to integrate this enforcement activity with that for all environmental problems. It is clear to this observer that there will have to be environmental police with arrest powers, and this police function is best funded out of general revenues, much as are current state police functions. Landfill surcharges are another potential source of revenue for this function.

Setting the disposal charge

Because the tire and secondary materials markets will continue to fail to set a market clearing price for scrap tires, due to insufficient demand, an approximation to that price must be calculated by environmental authorities in each state. The question then is how to do this.

The exercise is rather straightforward. While the relevant economic theory tells us that the charge should be set to reflect the damages improperly managed tires cause, as indicated above, present knowledge does not enable us to set the disposal charge based on tire caused damages or external costs. Thus, we cannot calculate the optimal level of recycling for tires, although we can be sure that the current level of recycling is below the optimal quantity. The best we can do at present is to base the disposal charge on cost-effectiveness considerations, as follows.

The available technologies for scrap tire use must be identified and the cost of employing them over the full range of potential output for each technology needs to be calculated. These technologies then need to be ranked along the

cost dimension for all the relevant levels of scrap tire utilization. The normal case is that one technology will be the least cost or dominant technology over a low level of output, another over the next range of output, still another over the third range of output and so on. This exercise will ensure identification of the cost-effective methods of scrap tire disposal and reuse at all levels of scrap tire flow.

Each state could commission a study to determine what represents the lowest cost alternative for that state. Alternatively, the U.S. EPA could develop a decision maker's guide (guidance manual) which could provide for quick determination of the likely least cost alternative in a given jurisdiction. Using this information, each state then could determine the charge necessary within its borders to solve its scrap tire problem, which may or may not be complete utilization of the current flow, depending on state preferences. With this information, each state can be sure that with whatever level of scrap tire reuse that state sets as its objective, the incentive offered (the environmental disposal charge) will be the minimum required to solve the problem.

The market based incentive mechanism here described will lead to efficient (cost-effective) tire recycling. The bidding and negotiating process that results with this mechanism will ensure that tires will go to the recycler with the lowest costs. It will also ensure the appropriate allocation among competing recycling alternatives, and when all of these are too costly to compete with landfilling in remote areas, it will provide the means by which proper landfilling can be financed.

An additional important factor favoring this approach is that it involves an important element of fairness for the business community, in that, to use a popular phrase, it establishes a "level playing field". That is, it involves no prior state selection of the favored technology to employ and thus eliminates state involvement in business decisions, something at which governments are notoriously inefficient and ineffective—again the experience in Minnesota is an example. It also eliminates the perpetual lobbying by would-be tire recyclers for state grants to fund their proposed technology.

With this approach, there is no presumption that the technologies will necessarily be constructed within the borders of any particular state, but simply that the charge to set high enough to resolve its problem which many simply mean transporting the material to a facility in another state.

An alternative proposal

A different proposal that is promoted by the National Tire Dealers and Retreaders Association and that has been widely followed in new state legislative around the country is to levy a fee on new tire purchases and distribute the revenues to local solid waste management authorities. They would make available disposal facilities to which the tire can be brought without charge. The

local authorities would contract for further processing and/or recycling if warranted.

The apparent advantage of this program is that removes the incentive for fraudulent behavior on the part of tire jockeys, i.e. illicit dumping. It would also avoid post-return manifesting. The economic advantage then would be apparently reduced cost of enforcement and reduced transactions costs.

There are disadvantages also. Government operation of disposal facilities and/or contracting to removal tends to be inefficient as argued above. This raises costs and will make the fee to the consumer higher than it would otherwise be. Governments are generally inattentive to efficiency because they tend to be few to no penalties associated with failure to control costs—governments never go out of business.

Further, governments have a poor showing in choosing technologies; they are prey to proverbial “snake oil” salesmen, which in this context has tended to be engineers bearing tire pyrolysis plants. Additionally, providing “free” disposal does not guarantee that fraud will not be committed—contracts with recycling firms still need to be monitored and enforced, since the incentive is still present to remove the tires for a fee and dump them illicitly. Manifesting would probably still be required and therefore so will enforcement. There have already been cases of exaggerated promises which when unfilled have left communities owning large stocks of unwanted tires.

Is the “free disposal” alternative in fact superior? In the final analysis, it is an empirical question which we do not attempt to resolve here; but it can be said that the theoretical advantages are probably not as great as they might appear.

Tire piles

As was mentioned earlier, this proposal deals with the new flow of scrap tires, not the accumulated backlogs. Separate financial provisions need to be made to deal with this cost. It would probably be best to use some other mechanism than a tax on tire sales, in order not to confuse the tire consumer. Perhaps a tax on vehicle transfers or annual license renewal would be best in states without constitutional provisions against it or a surcharge on landfills as was suggested above.

If a state moves aggressively against tire accumulations, the resultant flow of material will compete with that being generated by the annual flow being handled under the environmental disposal fee mechanism. It would seem that without proper coordination of the two flows, the market mechanism could be upset.

Fortunately, the presence of the environmental disposal charge mechanism will facilitate rather than impede the elimination of the tire accumulations. This is because that mechanism will provide the needed market incentives

(prices) for increased recycling and then lead to an expansion of processing facilities. State governments need only to offer the same price as is being generated by the market mechanism to provide the needed incentive to reduce the tire piles. As in the case of the current flow of scrap tires, once a price is clear and long term contracts have been written, it is a simple business proposition to obtain long term financing from the financial sector of the economy, avoiding the use of public monies for capital equipment acquisition as was done in Minnesota.

Conclusions

We have examined the economic basis of the scrap tire problem and our diagnosis has led us to suggest a market based incentive system that should solve the problem generated by new scrappage and avoid the difficulties and inefficiencies inherent in governmentally sponsored recycling, market development and technology selection. Since all of the elements save the suggested changes in the rules of the market game are in place, once that change is made, there is reason to believe that the market will respond quickly to the new profit opportunities. It would be necessary to have the usual legal provisions to prevent fraud: licensing of all participants if not already licensed and manifesting of the tires to ensure that they remain in the disposal and recycling loop.

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