End of life tyres
A valuable resource with growing potential
2007 edition
ETRMA is the Voice of European tyre and rubber manufacturers, representing 4200 companies in EU27, employing 360,000 individuals, with an industry turnover exceeding € 49 b.

In 1989, a Used Tyres Group dedicated to the management of end of life tyres was set up under the strategic guidance of the Tyre Steering Committee. This Group is composed of experts from all tyre manufacturers producing in Europe, which are Bridgestone Europe, Continental, Cooper Tires, Goodyear Dunlop Tires Europe, Marangoni, Michelin, Nokian Tyres, Pirelli Tyre, Trelleborg Wheel Systems and Vredestein.

The Used Tyres Group mission is to:

- Promote the environmentally and economically sound management (elimination) and use of end of life tyres, and proactively pursue Producer Responsibility with a dedicated financing scheme;
- Provide the necessary assistance in EU Member States in anticipating the implementation of the provisions of landfill Directive for end of life tyres from 2006;
- Promote that end of life tyres are a resource that can be used in a wide array of applications;
- Propose a “downstream management” for tyres coming from end of life vehicles;
- Develop procedures to ensure that end of life tyres exported do not go into illegal reuse.

The activity of the Used Tyres Group covers all the Member States of the EU, plus Candidate Countries such as Turkey.

The European tyre industry is committed to assist in promoting environmentally and economically sound end of life management practices for its products. The industry continues to promote the development of appropriate markets for end of life tyres, provides technical and policy information regarding end of life tyres management, and advocates a legislative and regulatory framework that contributes to the achievement of these goals.

ETRMA undertakes action to host European, international and national conferences for authorities and advocates for sound EU programs to address end of life tyre issues.

ETRMA does not represent and does not have any vested interest in the processing of end of life tyres or in any product made from end of life tyres.

ETRMA promotes the principle that end of life tyres are a valuable resource with growing potential.

This edition is the 2nd report on end of life tyres management in Europe published by ETRMA as part of the tyre manufacturers’ continued commitment to promote the best available techniques in the effective recycling and recovery of end of life tyres.

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This ETRMA report presents the situation of end of life tyres (ELTs) in Europe for 2007 and sets out to demonstrate the progress that has been made over the last decade by the European tyre manufacturers to address, in a responsible manner, the challenges posed by the end of life tyres, which include:

- No landfill option as from 16 July 2006;
- Guaranteeing an ecological treatment along the process chain;
- Promoting efficient and sustainable economical solutions.

### 1. Tremendous Progress ... in the Face of Growing Arisings

#### A) Increasing Volumes to be Treated Worldwide

Over 1 billion tyres are sold worldwide each year and subsequently just as many fall into the category of end of life tyres. Despite an increase in the service life of tyres, these volumes are constantly on the increase because of the growing number of vehicles and increasing worldwide traffic.

<table>
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<th>Recovery rates for 2006</th>
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<tr>
<td>EU 15</td>
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<td>The US (2005)²</td>
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In 2006 the enlarged Europe was faced with the challenge of managing, in an environmentally sound manner, more than 3.23 million tons of used tyres. For the EU15 the annual arisings have progressed from 2.10 million tons in 1994 to 2.78 million tons in 2006, representing an average annual increase of 2.6%.

These are significant increases and it is therefore essential that we promote an efficient, sustainable and responsible attitude to the management of end of life tyres. The estimated annual cost for the management of ELTs is estimated at € 600 million.

In addition the EU has millions of used tyres that have been illegally dumped or stockpiled. These historic stockpiles can, in some cases, pose a potential threat to human health (fire risk, haven for rodents or other pests such as mosquitoes...). The current estimate for these historic stockpiles throughout the enlarged EU stands at 5.5 million tons (1.73 times the 2004 annual arising).

Ultimately, the improved economic performance of the end of life tyre business should mitigate in favour of an earlier and more effective approach to tackling historic stockpiles.

The annual estimate for used tyres from end of life vehicles (ELV) amounts to 50 million tyres, which represents 10% of the annual arising.

#### B) Annual Arisings and Recovery Rates by Country

Not surprisingly the largest volumes of arisings are in the biggest countries (Germany, UK, France, Italy and Spain) where the totals vary between 300 and 600 thousand tons per annum. Except Poland with...
160 thousand tons, all the other countries have arisings under 150 thousand tons per annum and 5 countries have 15 thousand tons or less.

In 2006, 15 of the EU27 countries recovered 90% and more of their annual arising. 12 of the 15 countries recovered 100% while a further 2 attained between 80% and 90%. The remaining countries were under 77% with 4 still between 0% and 25%.

Countries where a producer responsibility system has been operating for over 10 years. (e.g. Nordic countries) have recovery rates of 100% and stockpiles have been eliminated.

Despite the heterogeneous nature of these rates, in 2006 the EU27 had an average recovery rate of 87% while the figure for the EU15 was 89%, which is quite favourable when compared with recovery rate of other sectors: 63.4 % for paper\(^3\), and 47% for plastics\(^4\) in 2005.

\(\text{CEPI (Confederation of European paper industries) Press release of 11 October 2007}\)
\(\text{PlasticsEurope Press release of 9 May 2007}\)

\(c)\) **A TURNAROUND IN MARKET TRENDS OVER THE LAST DECADE**

Over the past decade from 1994 to 2006 there has been a dramatic turnaround in the trend with a decline from 62% landfilling in 1994 to 13% in 2006, while energy recovery, recycling and retreading has risen from 27% in 1994 to 78% in 2006. The major markets in 2006 were energy recovery 32% and recycling 34%.

At present landfilling still accounts for 13% but the prospects are that it will decline as countries such as Spain, which very recently backed Producer Responsibility, will improve their end of life tyre management systems and will actively seek new and innovative ways to expand their treatment capacities.
What are the issues facing the tyre industry in the realm of end of life tyres? EU Member States have to be in compliance with the EU legislation in transposing the Directives into local legislation. They are free to set national initiatives to reach the EU targets. In regard to the development of waste management policies at national level, the landfill of waste Directive has been a major driver during the past decade. Tyre manufacturers are also facing growing environmental pressure from the general public and other stakeholders concerning illegal dumping and historic stockpiles.

For all these reasons it is in the interests of the tyre industry to continue being proactive and take responsibility collectively for end of life tyres treatment.

Today within the EU there are three different systems for managing end of life tyres:
- Producer responsibility
- Tax system
- Free market system
Some countries are currently in the process of moving from one system to another one: in Italy, Producer Responsibility is under legislative development.

**A) PRODUCER RESPONSIBILITY**

The law defines the legal framework and assigns the responsibility to the producers (manufacturers and importers) to organise the management chain of end of life tyres. This led to the setting-up of a not-for-profit company financed by tyre producers aiming at managing collection and recovery of end of life tyres through the most economical solutions. A reporting obligation towards the national authorities provides a good example of clear and reliable traceability. In addition, these companies are able to develop high-level knowledge on technologies and build up additional R&D capacities. The annual investment in R&D is around € 5 million. For the end user, this system guarantees transparency of costs through a visible contribution, clearly indicated on the invoices.

The members of these companies usually include the national manufacturers and the main importers. For example in Finland, Nokian Tyres is the national tyre manufacturer and Bridgestone, Continental, Goodyear, Michelin and Pirelli are the importers.

This system appears to be the most suitable and robust for addressing and resolving end of life tyre arisings, in a sustainable manner for the long term, and to achieve a 100% recovery rate, in the most economical way. On the whole the tyre manufacturers have demonstrated a clear preference for this system and have deployed determination and commitment to take this route. Currently, the network is including 17 countries. Italy and other EU Member States are set to follow in the near future.

Countries: Belgium, Czech Republic, Estonia, Finland, France, Greece, Hungary, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, and Turkey.

**B) TAX SYSTEM**

Under the tax system each country is responsible for the recovery and recycling of the end of life tyres. It is financed by a tax levied on (tyre) production and subsequently passed on to the customer. This is
an intermediate system whereby the producers pay a tax to the State, which is responsible overall for the organisation and remunerates the operators in the recovery chain.

Countries: Denmark, Slovak Republic, and Slovenia.

c) Free market system

Under this system the legislation sets the objectives to be met but does not designate those responsible. In this way all the operators in the recovery chain contract under free market conditions and act in compliance with legislation. This may be backed up by voluntary cooperation between companies to promote best practices.

Countries: Austria, Bulgaria, Croatia, Germany, Ireland, Switzerland, and United Kingdom.

3- Applications for tyre derived products

Anticipating regulations

Despite a still quite heterogeneous situation in Europe the remarkable progress that has been achieved is due largely to the proactive attitude of the profession. Even prior to the passing of the Directive on the landfill of waste in 1999 the industry had been active in taking action to organise the different players in the recovery chain with the creation of ELTs management companies/associations at national level.

The national associations, voluntary consortia, joint companies and boards that were set up jointly by tyre producers/importers to take responsibility for end of life tyres are financed in different manners according to the legal system prevalent in the country and these organisations in turn organise and manage the end of life recovery chain in different ways.

By professionalising the service providers – collectors, sorters and reprocessors – the goal is to significantly improve the recovery rate and traceability and develop applications with added value which utilise the full potential of the properties of rubber.

Promoting Producer Responsibility

The countries arisings and recovery rates presented on the maps (page 4) demonstrate that producer responsibility achieves more robust results than the purely market driven approach as well as the ultimate objective of 100% recovery whereby not only the annual arisings are recovered but the historic stockpiles are also progressively eliminated.
The tyre’s intrinsic quality gives added value (to all recovery applications)

The tyre is a complex and high-tech safety product representing a century of manufacturing innovation, which is still on-going. The tyre comprises many materials, the very best the metallurgical, textile and chemical industries can produce. There is no room for even the slightest defect and it is an extremely complex process to develop and manufacture the product.

From a materials point of view, the tyre is a mixture of synthetic and natural rubber, to which are added a range of specific substances to ensure performance, durability and safety. These include mineral oil, reinforcing fillers (carbon black and silica) and vulcanising agents (sulphur) which act as catalysts to accelerate the vulcanisation process.

These characteristics contribute in many ways to enabling the development of a variety of recovery routes.

--- MATERIAL RECYCLING

**Civil engineering applications** - These applications are the main recovery route for whole tyres. The applications vary from coastal protection, erosion barriers, artificial reefs, breakwaters, avalanche shelters, slope stabilisation, road embankments and landfill construction operations, sound barriers, insulation.

This market is for the moment confined to single projects and therefore fairly small scale. It is an application, which is under-utilised and that could represent a significant growth area for end of life tyres.

**Shredded tyres** - Whole tyres are mechanically sheared into shreds ranging in size from 25-300 mm.

Tyre Derived Aggregate is used as foundation for roads and railways, as a draining material replacement for sand and gravels, landfill construction, subgrad fill and embankments, backfill for walls and bridges and subgrad insulation for roads.

**Advantages of Tyre Derived Aggregate**

*Tyre derived aggregate is lighter by 30-50%. It drains 10 times better than well graded soil and provides 8 times better insulation than gravel.*

**Crumb and powdered rubber** - After the removal of the steel and fabric components the remaining rubber is reduced to granular rubber.

Applications include moulded rubber products such as wheels for caddies, dustbins, wheelbarrows and lawnmowers, urban furniture and sign posts. Today they represent 12% of the ELTs treated.

Crumb and powdered rubber are also to be found as flooring for playgrounds and sports stadiums, as shock absorbing mats for schools and stables, as paving blocks or tiles for patios and swimming pool surrounds as well as roofing materials.

A promising use of crumb rubber is in the construction of artificial turf for example in football fields. These applications currently represent 8% of the ELT management solutions.
Rubber modified asphalt takes advantage of the elasticity and noise absorbing characteristics of the rubber. Although this increases the life span of the road surface, reduces the noise pollution and increases safety in wet road conditions, it is still relatively underutilised (1% of the ELTs treated) despite its many advantages.

**Electric Arc Furnaces** – Shredded tyres can be used in steelworks equipped with electric arc furnaces as a substitute for anthracite and scrap metal. This application has already been validated for industrial use in Belgium and in France where more than 7,000 tons of end of life tyres were used. This is encouraging as the application uses both the carbon and steel content of the tyres. Such use is already under development in the US and will most certainly follow a similar trend in Europe in the years to come.

A study conducted in France on the use of ELT derived products in steel plants confirmed that carbon and iron contained in tyres may be used partly or entirely to substitute the use of anthracite during the manufacturing of steel at 1650 degrees. Indeed 1.7 Kg of ELTs is equivalent to 1 Kg of anthracite. The environmental impacts are positive regarding dust and gaseous effluents. Overall there are no significant differences in the total environmental impact due to the use of tyres or anthracite.

The capacity would be unlimited. Currently this application represents 7,000 tons of ELTs treated.

**EMERGING OPPORTUNITIES**

**Pyrolysis/Thermolysis** - Thermal treatment technologies – pyrolysis, thermolysis and gasification – are some of the emerging solutions for recovering value from end of life tyres.

Tyre pyrolysis involves the thermal decomposition of end of life tyres into intermediate substances such as gas, oil and char. The economic viability of this alternative route for high temperature resource recovery from tyres is hampered by the fact that the prices obtained for the by-products often fail to justify the process costs. Under current market conditions the economic viability of these options has yet to be proved (there are few or no large-scale plants currently in operation) but they have the merit to offer scope for increasing recycling rates.
B) ENERGY RECOVERY

With a calorific value equivalent to that of good quality coal, end of life tyres are used as an alternative to fossil fuels. The increase in the price of oil and the necessity to preserve resources could favour the development of this type of application.

The specifications are:

- The calorific power of 1 passenger car tyre is equivalent to 7.6 litres of oil (lower sulphur content);
- ELT have a similar caloric value as a high quality coal, with the advantage that the emissions of (heavy) metals are much lower;
- For a complete combustion, 1 ton of ELTs is equivalent to 647.6 Kg of CO2;
- The incineration residue is used as replacement for other raw materials (e.g. raw material in clinker for cement industry).

Combustion industries are currently facing a number of significant issues with the spike in energy costs and the constraints imposed by the introduction of air emission standards. In both cases, this could create opportunities for use of tyre derived products (NB: the use of tyre derived products is a low-cost NOx reduction option).

In the US a system of standards has been created for tyre derived products (ASTM). The improvement in the quality, consistency and supply chain for tyre derived products will enhance its chances of being seen as a valid alternative fuel for an increased number of customers.

At European level, a Technical Committee (TF 145) has been recently set up within CEN in which ETRMA has been an active member to develop proper standards for tyre derived applications.

Cement kilns - Currently in Europe whole or shredded tyres as a supplementary fuel provide some of the energy requirements of the cement industry. The cement sector requires 30 million tons of fuel equivalent per annum and the total annual arising of tyres is 3 million tons! Even if all Europe’s end of life tyres were sent to cement kilns they would only represent 10% of the total amount of fuel required by the cement industry. Even if for technical reasons, tyre derived products should not exceed 20%, this still leaves great leeway for this market sector.
The cement sector is the main application for energy recovery and new kilns are increasingly equipped to use end of life tyres as supplementary fuel. Additionally they will still be in compliance with the atmospheric emission standards due to come into force in 2008.

**Thermal power stations** - This particular application is underdeveloped in the EU but much more widespread in the US.

**Pulp and paper mills** - Again the elevated cost of energy could create openings for use of tyre derived products in this sector. At present this application is not developed in Europe but it is quite common in the US (at the end of 2005, 24 pulp and paper mills were consuming 39 million scrap tyres).

**Market outlook for tyre derived products**
The various market segments face different challenges and the rising cost of energy will no doubt remain a critical factor and stimulate market growth for tyre derived products used as an alternative fuel.

### c) European Standardisation

CEN (European Committee for Standardisation) reoriented in 2007 the activities of the Task Force 145 with the aim of defining the specifications of requirements and test methods for the tyre recycling cycle as well as for the utilisation of the tyre derived products in many specific applications in the European market. These applications include use as mould full wheels and other technical articles, as inert material in asphalt surface, in civil engineering, as infill or as elastic mat for football pitches for artificial turf, as alternative fuel, ...

The objective is the adoption of European standards that will contribute to a significant increase of the level of quality of tyre derived products while opening the market to new applications, promoting technology exchanges and access to know-how and innovation and protecting the environment.

As part of the tyre manufacturers’ continued commitment to promote the best available techniques in the effective recycling and recovery of end of life tyres, ETRMA is contributing to the activities of the Task Force, which have been launched in November 2007.
The new enlarged EU has created a single market with freedom of movement for goods, persons and capital. End of life tyres are considered as goods and some flows have been identified within the single market. These flows can have significant impacts on recovery rates when the movement occurs between two countries with different legal frameworks and management systems.

The fact that end of life tyres are classified as waste undoubtedly creates hurdles for the development of certain markets. This classification can create difficulties concerning permits, emissions, transportation and incineration. Even for use in civil engineering applications this denomination raises problems of perception in the minds of the general public.

With the EU Directive, which bans landfilling of whole (July 2003) and shredded (July 2006) tyres, it is clear that the retreading, recycling, and energy recovery capacities will have to increase.

The setting of specific recycling targets within overall recovery goals in certain countries will kill the competition between the various options and thus artificially increase the gate fees to be paid to the reprocessors.

The continued use of end of life tyres as “silage clamps” in some countries is a drawback as it is highly unlikely that these tyres will ever re-enter the recovery chain and the risk is that they will end up being burned for an application that has no potential.

The very properties, which contribute to the tyre’s performances – strength, durability and safety – often, frustrate attempts to recycle end of life tyres.

Shredding, crumbing or thermal processes have relatively high operational costs and the sale of the by-products (crumbs, textiles and steel) does not always offset the initial cost, creating a need for gate fees to the granulating industry.

A lack of viable markets, materials recovery operations and good networks of tyre collectors as well as increased regulations at all levels, could all continue to hamper further market development.

**Funding research and development**

*In France Aliapur has set itself the target of devoting up to 10% of its annual budget to R&D. The British government has allocated £ 1.5 million per year for a three-year plan to develop markets for ELTs. These ‘WRAP’ include monies develop existing and new processes for all aspects of end of life tyre recovery and recycling. In Norway € 3 million have been provided by the national government, national association and EU through the LIFE programme (€ 1.5 million).*
Growing demand for tyre derived products

The efficient and cost-effective management of end of life tyres as a valuable resource with a high potential still has a long way to go. Many countries have successfully achieved a managed transition away from landfilling, but evolving market trends and regulations make the market uncertain.

The revision of the EU Waste Framework Directive launched end-2005 is providing a potential opportunity for obtaining end of waste status for ELTs derived products, down the supply chain. This should play an important role in the sustainable development of the tyre derived products.

In the case of natural rubber the tyre industry uses 70% of all natural rubber produced worldwide and estimates for the next 30 years predict that consumption will double. It is therefore critical to manage this source of secondary raw material in a sustainable way and all applications that recycle or recover rubber will help to preserve this valuable resource.

It is important to achieve a more sustainable change in our capacity to handle end of life tyres to avoid greater regulation. Extensive research into technologies for managing end of life tyres is crucial as is the monitoring of technologies and products entering the demonstration phase or full commercialisation. The role and commitment of the ELTs management companies to drive the search for new and innovative initiatives and strategies to address the end of life tyre issues is crucial.

The establishment of industry standards under the aegis of CEN is a considerable way to increasing the credibility of tyre derived applications.

Ever spiralling energy costs could have a positive impact on the end of life market, especially for tyre derived products used as raw materials for recycling and/or as alternative fuel.

To conclude, ETRMA members are committed to pursuing the promotion of their efficient strategy traceable down to the supply chain to encourage the development of the best available techniques for the recycling and recovery of end of life tyres in the EU Member States and beyond.

Fazilet Cinaralp
Secretary General
f.cinaralp@etrma.org

Brussels, 30 November 2007
## Annex I: Used tyres recovery in EU27 in 2006

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<th>Part-worn tyres</th>
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* Finland: stock waiting to be treated 13 000T. As of end May 2007, this stock was down to 2000 T left to be treated.

(e) Estimate
Annex II: European legislation impacting tyre recycling

      End of life tyres are classified as « non hazardous waste ».

1993  **Regulation on supervision and control of trans-border shipment of waste** 259/93/EEC

1999  **Directive on the Landfill of Waste** 1999/31/EC
      → Ban on used tyres (whole tyres) in landfill starting July 2003
      → Ban on shredded tyres in landfill starting July 2006

2000  **European Waste List 2000/532/EC and further amendments**
      End of life tyres are classified under code ‘16 01 03’

2000  **Directive on Incineration of Waste** 2000/76/EC
      → Fixes emission standards for all cement kilns starting in 2002
      → Older cement kilns prohibited from burning end-of-life tyres after 2008

      → 85% of scrap cars to be recovered starting 2006
      → tyres to be dismantled from vehicles increasing ELT arising by 10%

Annex III: International bodies recommendations on tyre recycling

1999  **UNEP Basel Convention**
      Technical Guidelines on Hazardous Wastes: Identification and Management of Used Tyres
      (SBC No. 99/008, October 1999)

2004  **OECD Environment Policy Committee**
      Improving Markets for Secondary Materials: Case Study Report on Rubber

National ELTs management companies

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<thead>
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<th>Country</th>
<th>Contact Name</th>
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<td>Lars Aman</td>
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http://www.etrma.org/public/activitieoseofltelts.asp