THE PIONEERS OF PRODUCER RESPONSIBILITY

Tyre Recycling in Finland, Sweden and Norway

HOW TO MAKE IT WORK

FINNISH TYRE RECYCLING LTD

SVENSK DÄCKÅTERVINNING AB

NORSK DEKKRETUR AS

SUMMARY

PRODUCER RESPONSIBILITY WORKS IN TYRE RECYCLING

The pioneers came from the Nordic countries

The Nordic countries are forerunners in developing tyre recycling based on collective producer responsibility. By the turn of the millennium, the recovery rate of end-of-life tyres in Finland, Sweden and Norway had already been established at above 90 percent, whereas in Europe it was only 50 percent on average. In 2012, as much as 95 percent of used tyres were recovered in Europe (including EU27, Norway and Switzerland).

Tyre recycling in Finland, Sweden and Norway is based on national legislation set in 1993–95 which order tyre producers to organise the collection and treatment of end-of-life tyres (ELT). The key actors in the tyre industry set up a non-profit ELT management company in each country to meet the recycling obligation in the most cost-effective way.

Commitment and continuous improvement

The creation of recycling systems were driven by a strong common interest between the tyre producers. Tyre distributors were right away committed to the system, even though initially many of them had to deliver the received tyres to the collection point at their own expense. Since then the grade of service has improved in every system by making the pick-up service available to all.

The recovery routes have varied over the years. According to the 2013 statistics, in Finland most of the tyres were recovered as material, mainly for civil engineering. In Sweden and Norway, the most common recovery route was the energy production. In the future there will be also a lot of sports field construction following the introduction of a new granulation plant.

Appreciation for tyre derived products

The main challenges of tyre recycling concern the development of end-of-waste criteria, appreciation for tyre derived products and to get free-riders onboard. These are worthwhile subjects to get involved with individually and collectively, in order to continue finding optimal applications for this versatile material and to keep recycling fees at a low level.

End-of-life tyres are classified as waste, which causes needless bureaucracy and additional costs to the recycling process. However, the waste legislation offers an opportunity to cease the waste status, if the material meets certain criteria concerning use and demand, technical requirements and standards, as well as the environmental and health impact.

It has been estimated, that 5–20 percent of tyres treated by the recycling systems come from producers, which have not financially contributed the systems. Authorities supervising the producer responsibility have already adopted a stricter stance on free-riders. The Nordic ELT management companies encourage consumers to pay more attention to corporate responsibility in environmental issues.

Further information:

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SUMMARY
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1. INTRODUCTION TO TYRE RECYCLING

1.1 Sharing best practices

The Nordic countries are pioneers of developing tyre recycling based on collective producer responsibility. The key actors in the tyre industries of Finland, Sweden and Norway set up a non-profit ELT management company in each country already in the mid-1990s. The other European countries were following with similar kind of systems in the 2000s.

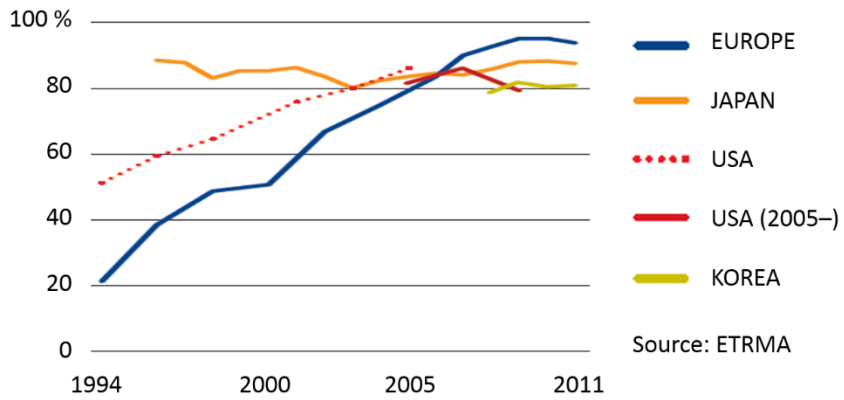
Finnish Tyre Recycling Ltd, Svensk Däckåtervinning AB and Norsk Dekkretur AS have built their own recycling systems, which have a lot in common. Representatives of the companies tend to share experiences with each other on a regular basis and within the framework of international industry organisations. Co-operation in Sweden and Norway has intensified in recent years with the same recycling operator.

This publication describes the development of systems and solutions that have enabled us to recycle more efficiently. In the last section we will have a look at future challenges and opportunities. Hopefully, this will promote a producer responsibility scheme for other industries and encourage the open sharing of best practices internationally.

1.2 ELT recovery trends

By the turn of the millennium, the recovery rate of end-of-life tyres in Finland, Sweden and Norway had already been established at above 90 percent, whereas in Europe it was only 50 percent on average. Since then the development has accelerated further after the implementation of EU Landfill Directive (1999/31/EC) and due to the proactive industry initiative of establishing national producer responsibility schemes.

Graph 1. Recovery rates of end-of-life tyres in 1994–2011 (%)



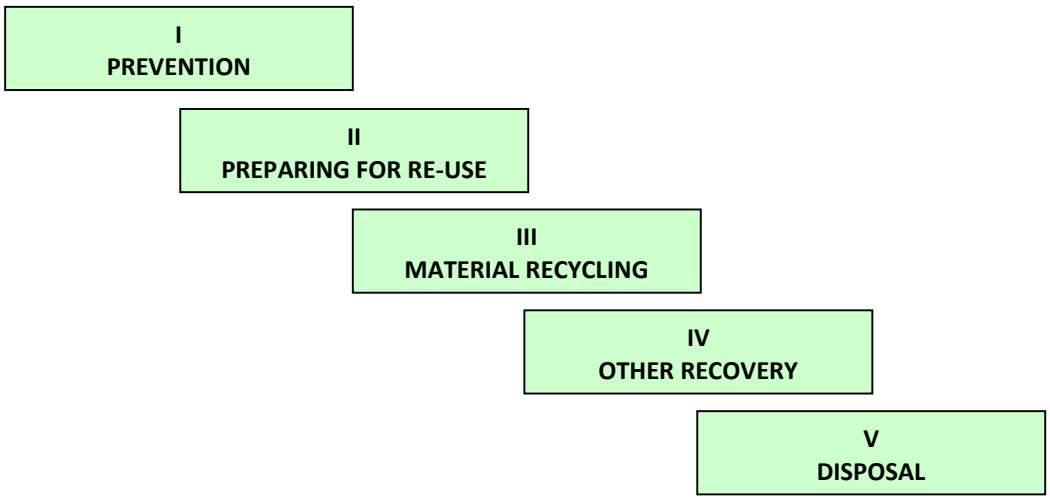
The recovery rate of end-of-life tyres has increased dramatically in the last two decades. In 2012, as much as 95 percent of used tyres were recovered in the EU countries, Norway and Switzerland on average (incl. retreading, re-use and exports). Other industries have had to settle for clearly lower levels, for example the paper recycling rate was about 72 percent.

Producer responsibility obliges producers to collect and treat end-of-life tyres and to cover the related costs. So far the tyre producers have set up an ELT management company in 14 European countries to ensure compliance with the ordinance on behalf of all contracted tyre suppliers.

1.3 Towards a recycling society

The EU Waste Directive (2008/98/EC) directs member countries to move closer to a "recycling society", seeking to avoid waste and to use it as a resource. The directive defines a five-step waste hierarchy which shall apply as a priority order in waste prevention and management legislation and policy.

Graph 2. Waste hierarchy



Finland's new Waste Act requires keeping to the order of priority so as to achieve the best overall environmental outcome. The assessment takes into account, among other things, the environmental impact of different options, as well as the technical feasibility and economic viability. For example, according to a life-cycle analysis (LCA) made in France, the material recycling of tyres is not always preferable to the energy recovery.

> *"In Sweden, we commissioned the LCA for three different recovery methods. The environmental impact of tyre derived products was at the most on par with alternative materials."*
>
> *Lars Åman, Svensk Däckåtervinning AB*

Tyre producers are committed to reduce environmental impact during the entire life cycle of tyres. Tyre consumers are encouraged to drive economically and to take care of their tyres to lengthen the safe service life. Environmentally speaking, the best option would be using tyres down to their minimum tread depth, but with safety in mind the recommendation is to replace them much earlier.

2 SYSTEM EVOLUTION

2.1 Based on producer responsibility

Tyre recycling in Finland, Sweden and Norway is based on national legislation set in 1993–95 which order tyre producers to organise the collecting and treating of end-of-life tyres. The key actors in tyre industry were driven by a common interest to meet their responsibilities with a collective producer responsibility scheme, which has since been adopted elsewhere in Europe.

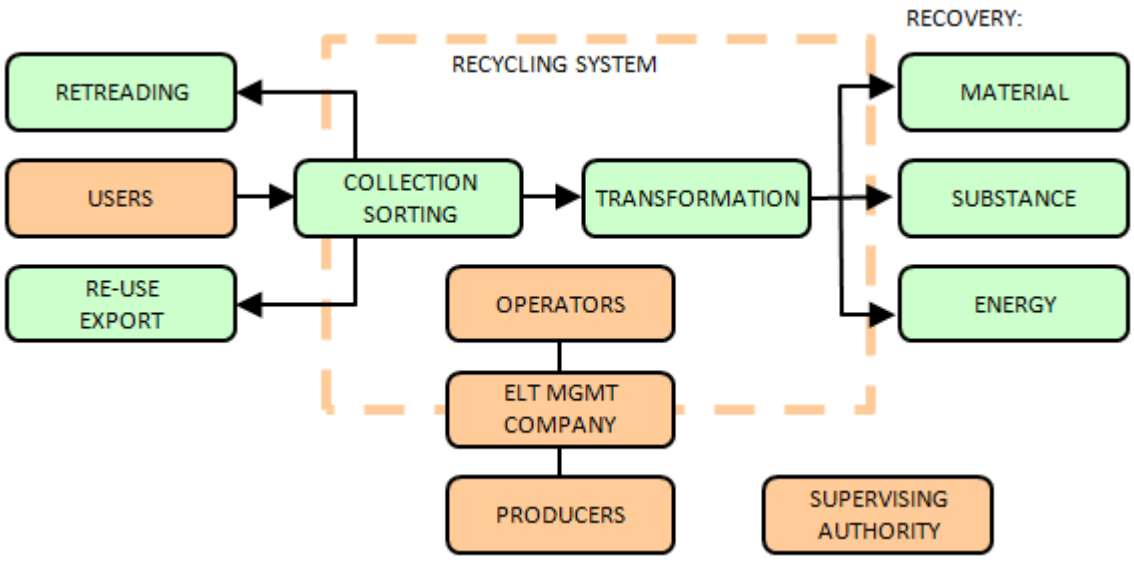
The tyre manufacturers, importers, retreaders and distributors (or their representative associations) set up in each country a non-profit ELT management company to build and manage a comprehensive tyre recycling system. The companies work on behalf of the co-operating producers, tending to the recycling obligations in the most cost-effective manner.

> *"The creation of a recycling system was driven by a strong common interest. For engagement, it was important that the distribution channel was involved as an owner and a developer."*
>
> *Hanna Maja, Autonrengasliitto ry*

Tyre recycling is made easy for the tyre producers and consumers alike. The consumer has the right to dispose of old tyres, free of charge at any tyre outlet. The operator picks up the tyres from the contracted collecting points and sees to the further processing and recovery.

The implementation of producer responsibility is overseen by the responsible authority in each country. The ELT management company provides the supervising authority annual reports on tonnage of new and retreaded tyres on the market, as well as collected and recovered tyres.

Graph 3. Tyre flow from user to recovery



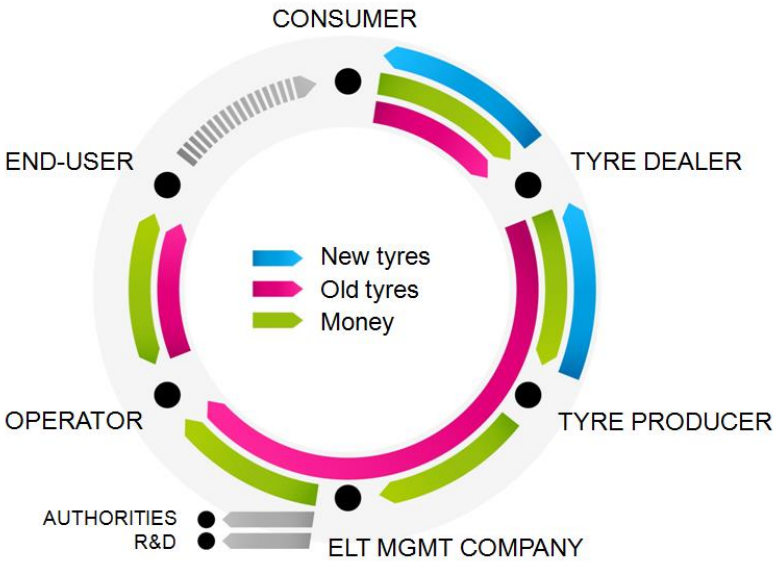
2.2 Reasonable recycling fees

Recycling systems are funded with recycling fees placed on the purchases of new tyres. The efficient design of the collective producer responsibility scheme has kept the recycling fees quite reasonable. Passenger car tyres at the moment have a recycling fee of 1,75 €/tyre in Finland, 16 SEK (about 1.79 €) in Sweden and 12 NOK (about 1.44 €) in Norway, plus VAT (24–25 % added). Recycling fees are determined nationally according to the tyre size.

> *”Consumers are extremely satisfied with the system, which lets them get rid of their old tyres so easily. No one has yet complained of the environmental fees levied in Norway.”*
>
> *Hroar Braathen, Norsk Dekkretur AS*

ELT management companies select their recycling operators for a fixed period through bidding. The operator charge the company based on either the amounts collected or delivered for recovery. In addition, they may receive compensation from end-users for processing the material. Prices vary greatly between different applications and may turn even negative due to supply and demand.

Graph 4. Material and money flow of new and old tyres



2.3 Characteristics by country

In Finland the collection of all kind of tyres started in June 1996. Tyre distributors are fully committed to the Finnish Tyre Recycling Ltd's system, even though initially many had to deliver the received tyres to the collection point at their own expense. The level of service was improved in 2007 with an operator change that made the pick-up service available to all.

In addition to the tyre industry the car importers, distributors and dismantlers have been extensively integrated in the system. Legislation governing producer responsibility in Finland is stricter than in the neighboring countries and also offers authorities stronger means of addressing failures. In 2011, research and development of recovery methods was boosted by a new manager, after the retirement of Harry Sjöberg, the real pioneer of tyre recycling.

In Sweden, the systematic collection of tyres was launched in January 1995. At the time tyre producers already had Nordic organisations, but there was a desire for independent and national recycling systems. This demanding undertaking owed its success to a clear, shared objective on behalf of the tyre producers. Also the dialogue between the waste and recycling industry professionals was constructive from the start.

The automotive sector is not involved in Svensk Däckåtervinning AB's recycling system, because original equipments are mostly treated when dismantling end-of-life vehicles (ELV). The system made the overall switch to a tyre pick-up service in 2004. For the long-term, the company has been developing tyre derived products and possible applications in co-operation with the operator and various research institutes.

In Norway, tyre collection was launched in March 1995. Norsk Dekkretur AS is co-owned by tyre producers and car importers, which contributed to the commitment by the automobile industry. Tyre distributors do not have their own association, but the industry is committed to the system, led by six large chains. In Norway an overall pick-up service was started in 1998. The next year saw even the heaviest tyres were included in the recycling system.

In the Norwegian and Swedish recycling systems the distributors are free to trade the received tyres. In the Finnish model however, tyres collected by the recycling points are defined as the system's possessions. The granulation plant in Trollhättan, Sweden, opened in the summer of 2012, will in the future make use of tyres collected also in Norway.

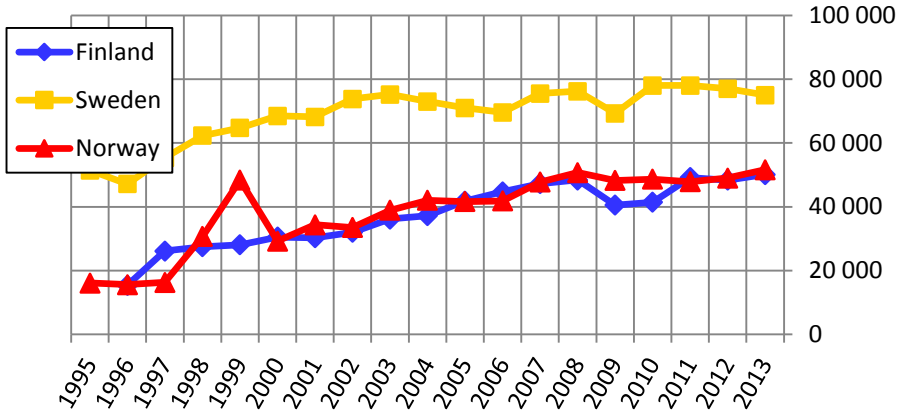
COMPANY FACTS:	**FINLAND**	**SWEDEN**	**NORWAY**
ELT management company:	Finnish Tyre Recycling Ltd (Suomen Rengaskierrätys Oy)	Svensk Däckåtervinning AB (SDAB)	Norsk Dekkretur AS (NDR)
Address:	Teknobulevardi 3-5 01530 Vantaa, Finland	Box 90131 120 21 Stockholm, Sweden	Stasjonsveien 59 1940 Bjørkelangen, Norway
Telephone: Mobile: email: www:	+358 9 612 6880 +358 40 717 7200 palaute@rengaskierratys.com www.rengaskierratys.com	+46 8 5060 1055 info@sdab.se www.sdab.se	+47 6385 5560 +47 9077 1714 post@dekkretur.no www.dekkretur.no
Managing Director:	Risto Tuominen 2011– Harry Sjöberg 1995–2011 	Fredrik Ardefors 2014– Lars Åman 1994–2014 	Hroar Braathen 1994– 
Company established:	1995	1994	1994
Collection started:	6/1996	1/1995	3/1995
Stakeholders:	• ARL-palvelu Oy • Bridgestone Finland Oy • Continental Rengas Oy • Goodyear Dunlop Tires Finland Oy • Nokian Renkaat Oyj • Oy Suomen Michelin Ab	• Däck-, Fälg- & Tillbehör-leverantörernas Förening DFTF (80 %) • Däckspecialisternas Riksförbund DRF (20 %)	• Dekkimportørenes Forening (75 %) • Bilimportørenes Landsforening (25 %)
Operator:	• Kuusakoski Oy 2007– • Säkkiväline Oy/L&T 1996–2006	• Ragn-Sells AB 1995–	• Ragn-Sells AS 2000– • Opal Dekkinnsamling AS 1995–2000
Main R&D partners:	• Apila Group Oy Ab • Laatuinsinöörit Oy	• IVL Svenska Miljöinstitutet • Ecoloop • Luleå Tekniska Universitet	• Consultancies in Norway and abroad

3 RECYCLING DEVELOPMENT

3.1 Arisings and recovery rates

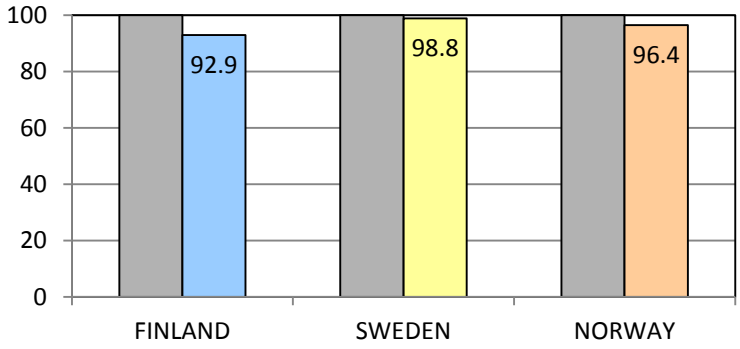
The collection rate of used tyres in Finland, Sweden and Norway is 100 percent, since practically all the new or retreaded tyres on the market will return at some point for recycling. The differences in accumulation are mainly explained by differences in the vehicle fleet, average mileage and driving conditions. Summer and winter tyres take somewhat over six years from being manufactured to end up collected in Finland.

Graph 5. Used tyre arisings by country (tons)



Used tyre arisings indicate also the tyre market development, when taking into account tyre wearing in the overall weight of the collected tyres. It is estimated that the ELT management companies collect and treat clearly more tyres than the contracted tyre producers supply on the market. This is due to free-riders who take advantage of the recycling system without participating in the costs.

Graph 6. Recovery rates of collected tyres in 1995–2013 (%)



This follows ETRMA's statistical practice, where the recovery rate is composed of the ratio of recovery to collected tyres (including tyres for retreading and re-use/exports).

For example, the Finnish legislation requires the recovery of at least 90 percent of the end-of-life tyres, which slightly differs from this presentation. The requirement will be at least 95 percent from the beginning of 2015.

3.2 Application opportunities

Collected tyres are sorted and further processed for different recovery routes. The tyres may be used in whole or processed as cuts, shreds, chips, granulate or powder. Tyre material is lightweight and elastic and has insulation and filtering properties, which provide countless application opportunities and clear benefits compared to alternative materials.

The best tyre casings are intended for retreading, according to the waste hierarchy. In the Nordic countries the majority of retreading concerns truck tyres that may be retreaded several times. Truck tyre retreading is usually done on customers' own tyres and therefore are not included in the statistics.

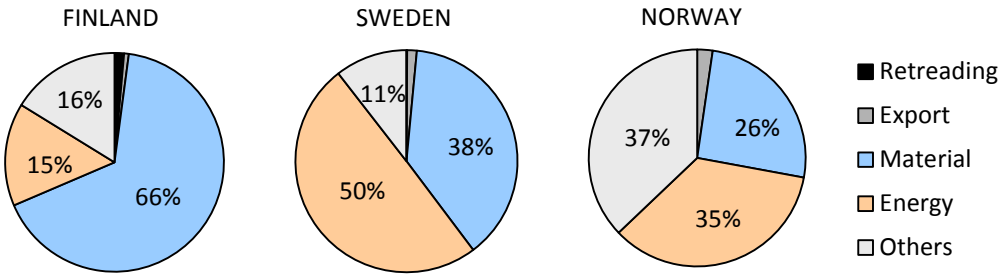
Tyre shreds are an excellent material for such applications as sound barriers, frost insulation, as well as for new and closing landfills. Granulate in turn makes perfect elastic layers for riding arenas and surfacing for sports fields. Blasting mats are being used also as temporary coating for forest roads. Tyre shred use for rail and road vibration protection is looking very promising, as well.

End-of-life tyres are also recovered to produce energy. They have a very competitive thermal value and cost compared to alternative fossil fuels. Rising oil prices and the need to conserve non-renewable resources provide additional impetus to develop the energy use of tyres.

> *"Our new granulation plant produces granulate for artificial turf and silent asphalt in Sweden and Norway. Previously, the material had to be imported from Central Europe."*
>
> *Anders Lindblom, Ragn-Sells AB*

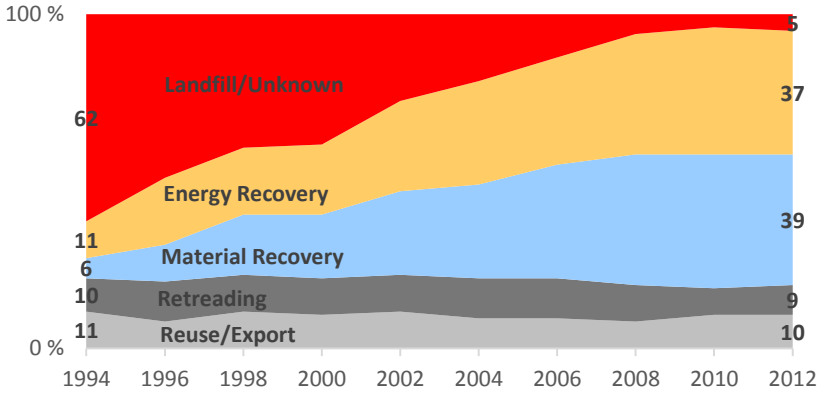
Recovery routes of used tyres have varied over the years. According to the 2013 recycling statistics, the most common recovery route in Sweden and Norway was the energy production. In Finland, most of tyres were recovered as material, mainly for civil engineering. Detailed amounts and percentages are found in Annex 2.2.

Graph 7. Recovery routes by country in 2013 (%)



The distribution of recovery routes in Europe has changed significantly in less than 20 years. Material and energy recovery has grown up to 76 percent, while the amount of tyres ending up in landfills has dropped to 5 percent. The share of tyre retreading, re-use and exports has remained more or less unchanged. In 2012 there were nearly 3.3 million tons of used tyres recovered in Europe.

Graph 8. Evolution of recovery routes in Europe in 1996–2012 (%)



Source: ETRMA

3.3 Innovations and experiments

There has been an EU funded project of developing tyre pyrolysis process coordinated by Norsk Dekkretur AS. The process involves a thermal decomposition of end-of-life tyres into intermediate substances such as carbon black, gas and oil. Clean carbon black could be used in producing new tyres or different rubber-based products. It will be challenging to get the substance clean enough with reasonable costs.

In Finland we have encouraging experiences in using tyre shreds as a biofiltration media. The experiment project at Heinola purification plant in 2012–2013 indicated that a process of nutrient removal can be activated effectively by tyre shreds. It will be examined if the procedure works at an industrial scale and could be accepted by the authorities and implemented in an economically sustainable way.

”The legislation seems to be tightening which makes development of tyre derived products more complicated. We will solve the challenges with new innovations.”

Risto Tuominen, Finnish Tyre Recycling Ltd

Trafikverket (The Swedish Transport Administration) has intensively researched and developed a rubber-modified asphalt since 2007. The application takes advantage of the elasticity and noise-absorbing characteristics of rubber. The project is going on in testing durability of a road surface. There is an international congress held every third year focusing on rubber asphalt opportunities.

The development of ELT derived products seems to require the long-term commitment of project participants. In the late 1990s plenty of projects were started with enthusiasm, but most of them flopped if they did not generate money right away. Nowadays the expectations are based in more realistic visions. At the same time many key players have recognized that breakthroughs can happen by sharing best practices all together.

ETRMA has developed an ”ELT technical and scientific database” with access reserved to it´s members and ELT management companies. The database already contains more than 100 studies regarding ELT recovery techniques, granulate applications and life cycle analysis, etc.

4 FUTURE CHALLENGES

The main challenges of tyre recycling concern the development of end-of-waste criteria, appreciation for tyre derived products and getting free-riders onboard. These are worthwhile subjects to get involved with individually and collectively, in order to continue finding optimal applications for this versatile material and to keep recycling fees at a low level.

4.1 End-of-waste status

End-of-life tyres are classified as waste, which causes needless bureaucracy and additional costs to the recycling process. However, the waste legislation offers an opportunity to cease the waste status, if the material meets certain criteria concerning use and demand, technical requirements and standards, as well as the environmental and health impact. More detailed criteria will be provided through EU-wide or national legislation.

To get rid of the waste status, ETRMA and ETRA have been developing since 2000 a European standardization for ELT derived products. In 2010, a material standard (CEN/TC 366) was created, which defines parameters and test methods for ELT cuts, shreds, chips, granulate and powders as well as for impurities. Also a more comprehensive standardization for other properties of the materials is under way.

4.2 Branding ELT derived products

Material standards increase the appreciation of ELT derived products and will bring new application opportunities. They form a basis for clear branding of different recovery routes. Recycled materials certainly continue to be an affordable solution for end-users, and furthermore, they can be even better than alternative materials containing the values of sustainable development.

The appreciation of ELT derived products would be likely to increase the interest of different actors and long-term investments in research and development. For larger development projects, it is beneficial to inform foreign colleagues at the start. Proven recovery opportunities and applications should be made widely known among potential end-users, as well.

4.3 Getting free-riders onboard

It has been estimated, that 5–20 percent of used tyres treated by the Nordic recycling systems come from producers, which have not financially contributed the recycling, but take advantage of the existing systems. Free-riding is particularly rampant in nowadays common online shopping, which reduces the coverage of statistical analysis and increases the pressure to raise recycling fees.

In Finland, implementation of producer responsibility is controlled by one authority, while in Sweden, supervision is carried out fairly inefficiently by local authorities, so far. The subject can also be influenced by encouraging consumers to pay attention to corporate responsibility in environmental issues. Tyre suppliers and dealers would benefit from emphasizing their accountability in environmental matters.

ANNEXES

Annex 1. Information sources

KEY TERMINOLOGY

Used and end-of-life tyres

New tyres become used after the first drive. Consumers are likely to discard used tyres even before the end of their useful life. End-of-life tyres (ELT) are defined by no longer returning to their original use.

Collection and recovery rate

The collection rate of used tyres in Finland, Sweden and Norway is 100 percent, since practically all the tyres on the market will return at some point for recycling. Also, the recovery rate of collected tyres is close to 100 percent annually.

Producer responsibility in waste management

Tyre producers are responsible for organising the appropriate recycling on end-of-life tyres. Producers are all professional manufacturers, importers and retreaders of tyres and of vehicles and equipment fitted with tyres.

PRODUCER RESPONSIBILITY AND WASTE MANAGEMENT REGULATIONS

Finland

Waste Act and its amendments 1072/1993, 452/2004 and 646/2011
Government decision 1246/1995 and decrees 583/2004 and 527/2013

Sweden

Förordning om producentansvar för däck 1994:1236

Norway

Forskrift av 25.3.1994 (Korr. 2.9.1994)
Avfallsforskriften 2004:930

ADDITIONAL INFORMATION

Publications

Recycled tyres – material with great potential (SDAB, 2007)
End of life tyres: A valuable resource with growing potential (ETRMA, 2012)
ETRMA annual report 2012–2013 (ETRMA, 2013)
European tyre and rubber industry statistics, Edition 2013 (ETRMA, 2013)
Lifecycle analysis of 9 ELT recovery routes (Aliapur R&D, 2010)
Livscykelanalys på återvinning av däck (IVL Svenska Miljöinstitutet, 2012)

Organisations and websites

Finnish Tyre Recycling Ltd: www.rengaskierratys.com
Svensk Däckåtervinning AB: www.sdab.se
Norsk Dekkretur AS: www.dekkretur.no
ETRMA (European Tyre & Rubber Manufacturers' Association): www.etrma.org
ETRA (The European Tyre Recycling Association): www.etra-eu.org

Annex 2.1 Used tyre arisings and recovery in 1995–2013 (tons)

	FINLAND		SWEDEN		NORWAY	
	Arisings	Recovery	Arisings	Recovery	Arisings	Recovery
2013	50 112	50 680	75 000	76 600	51 666	51 620
2012	48 343	46 774	80 000	77 500	49 000	48 665
2011	49 138	52 043	78 000	71 000	47 849	50 156
2010	41 435	40 562	78 000	77 000	48 663	49 935
2009	40 523	40 997	69 300	75 000	48 275	41 862
2008	48 394	43 352	76 200	71 900	50 695	41 884
2007	47 259	35 796	75 500	76 200	47 748	41 107
2006	44 698	32 278	69 600	73 000	41 832	41 318
2005	41 774	44 379	71 000	67 500	41 642	45 892
2004	37 240	36 406	73 000	74 000	42 055	40 526
2003	36 156	30 578	75 200	76 700	38 943	53 737
2002	31 986	37 713	73 800	90 500	33 503	16 741
2001	30 301	41 222	68 200	62 300	34 367	21 463
2000	30 474	25 804	68 500	70 000	29 258	27 336
1999	28 064	24 973	64 700	75 000	48 375	45 921
1998	27 457	18 128	62 300	59 200	30 670	32 572
1997	26 140	20 055	55 350	49 050	16 278	21 728
1996	15 372	4 985	47 150	55 550	15 605	19 288
1995			51 400	18 000	16 100	14 563
Total:	**674 866**	**626 725**	**1 312 200**	**1 296 000**	**732 524**	**706 314**
Recovery rate:		**92.9 %**		**98.8 %**		**96,4 %**

Annex 2.2 Recovery routes in 2013

	FINLAND		SWEDEN		NORWAY *	
	tons	%	tons	%	tons	%
Retreading	719	1.4	48	0.1	0	0.0
Export	378	0.7	1 084	1.4	1 177	2.3
Material recovery	33 661	66.4	29 299	38.2	13 235	25.6
Energy recovery	7 708	15.2	38 121	49.7	18 046	35.0
Other recovery	8 214	16.2	8 080	10.5	19 162	37.1
Total:	**50 680**	**100.0**	**76 632**	**100.0**	**51 620**	**100.0**

Annex 3. Application cases

Case A:

LANDFILL DRAINAGE

- To construct an efficient drainage layer when closing a landfill
- A 45 cm layer, covered by a geotextile, consuming about 5 000 tons of shredded tyres
- Implemented in Sweden (Stordalen, Timrå) in 2002–2004

Case B:

HORSE RACE TRACKS

- To get horse race tracks and paddocks more elastic for the horses
- The horse trainers appreciate the solution which decrease leg injuries in horses
- In Oslo 1 000 m track was constructed with a 50 cm layer of shredded tyres

Case C:

BLASTING MATS

- To ensure safe blasting in civil engineering plants
- The product can be used also as temporary coating for forest roads
- In Norway 1 650 tons of ELT's are yearly used for blasting mats (fulfilling a part of the demand)

Case D:

ROAD INSULATION

- To make a light insulation subgrade in road construction
- No harmful environmental impact has been found during 10-year follow-up in Finland
- There could be a need for thousands of bales in one project (100 tyres per bale)

Case E:

RUBBER ASPHALT

- To extend life of road surfaces by using rubber modified asphalt
- The ongoing development project started by Trafikverket in 2007
- In Sweden 1 500 tons of granulate has been used in 90 km long experimental projects

Case F:

ALTERNATIVE ENERGY

- To reduce fuel expenses by preserving non-renewable natural sources
- New cement kilns are increasingly equipped to use end of life tyres
- In Sweden 62 % of used tyres were recovered for energy in 2012

FINNISH TYRE RECYCLING

SDAB
SVENSK DÄCKÅTERVINNING AB

NORSK DEKKRETUR AS

J Lahti Interaction / Painojussit Oy 3/2014