

Tyre recycling Markets



Raw material for the future

Valerie L. Shulman, Ph.D.

ETRA The European Tyre Recycling Association

- Founded in 1994
- ±250 members in 43 countries, including each EU State;
- The mission : to develop tyre recycling as an environmentally sound and commercially sustainable European industry
- Objectives: to develop and advance policies that support the industry;
to expand and develop markets;
to develop and implement professional standards;
to prepare and promote guidelines for materials, products, applications;
to provide communication links
- Membership is open to the public and private sectors around the world

ETRA is the only European organisation devoted exclusively to tyre recycling



ETRA's role

At industry level :

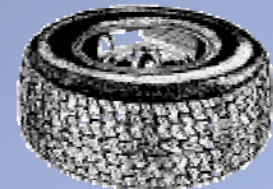
- Collection of data from Member State on arisings and use
- Assembly of national legislation concerning post-consumer tyres
- Analysis of data to determine market trends and new markets options
- Participation in multi-partner development research
- Development of new markets

At EU level :

- As a member of the European Recycling Coalition ETRA Works closely with a core group of six recycling industries to provide analysis and commentary on the Commission's proposals and contribute to the debate on future EU waste policy

At the Member State level :

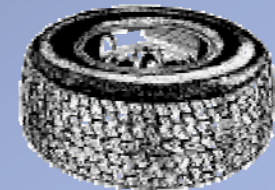
- Work with the National bodies responsible for tyre management
- Assist in developing local industry for material use



Tyre recycling

- Tyre recyclers process a raw material that has been discarded and defined as waste - although it remains a valuable resource
- These 'wastes' are processed so that they are capable of entering into a new material cycle as a material, product or substance
- The processes themselves are environmentally sound and yield environmentally sound outputs that meet stringent performance criteria to compete with traditional materials, products, substances
- Recycled outputs usually enter mainstream markets to fulfil commercial needs - often more cost-effectively than the materials they replace

The raw materials for recycling are becoming more diverse





Post-consumer tyres

Arisings
Material contents
Recyclability

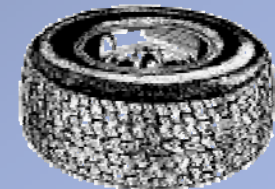
Post-consumer tyres



± 1,000,000,000 tyres are manufactured each year around the world with principal production areas in Asia, Europe, North America

Tyres are available in a variety of sizes to fit all types and sizes of vehicles including bicycles, motor cycles, scooters, cars, utility vehicles, trucks, and buses, as well as airplanes, agricultural and mining equipment - among many others

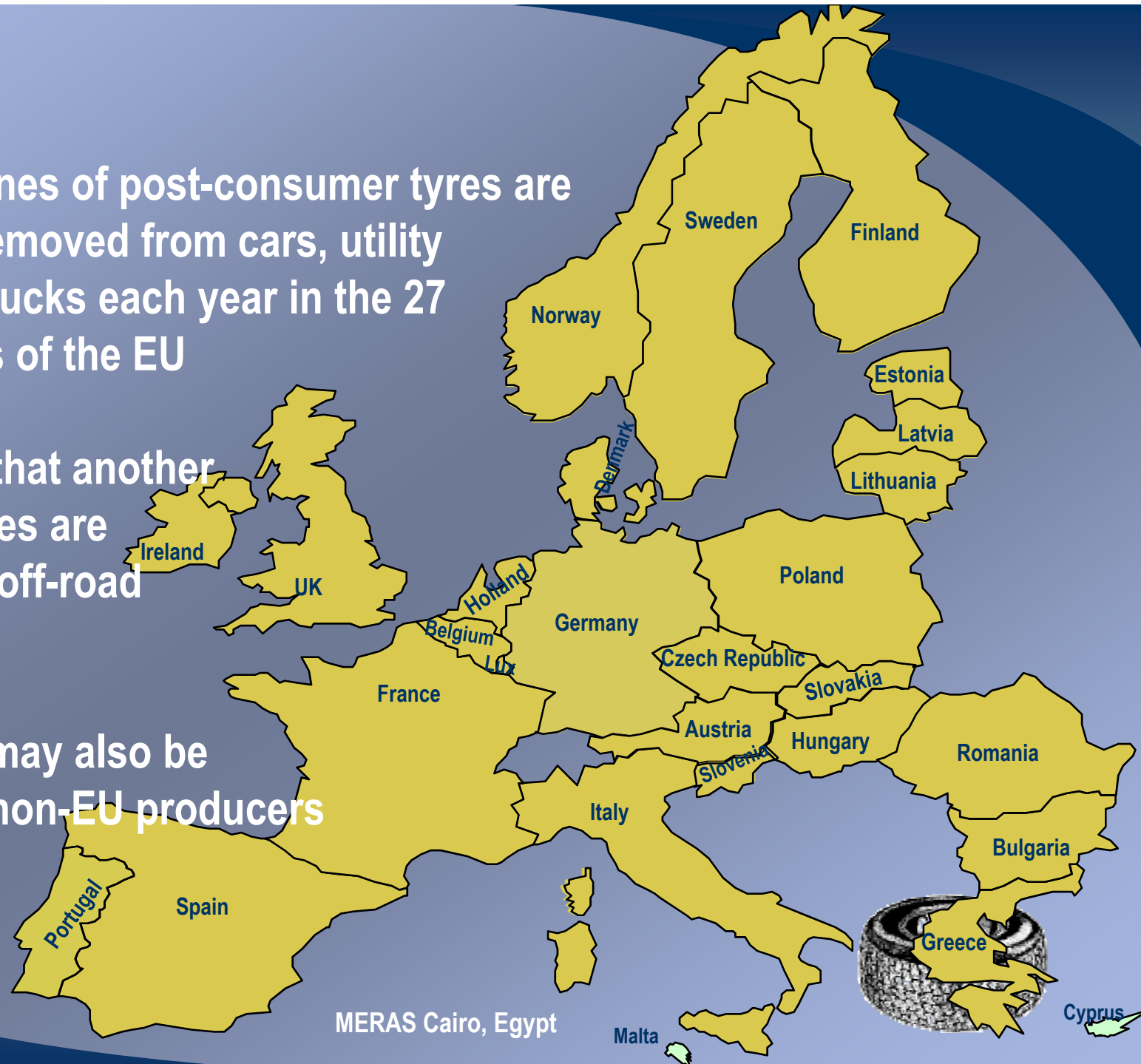
Estimates are that for each tyre produced - one is permanently removed from a vehicle and becomes waste



+3,250,000 tonnes of post-consumer tyres are permanently removed from cars, utility vehicles and trucks each year in the 27 member States of the EU

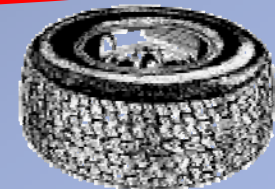
Estimates are that another +100,000 tonnes are removed from off-road vehicles

Another +30% may also be available from non-EU producers

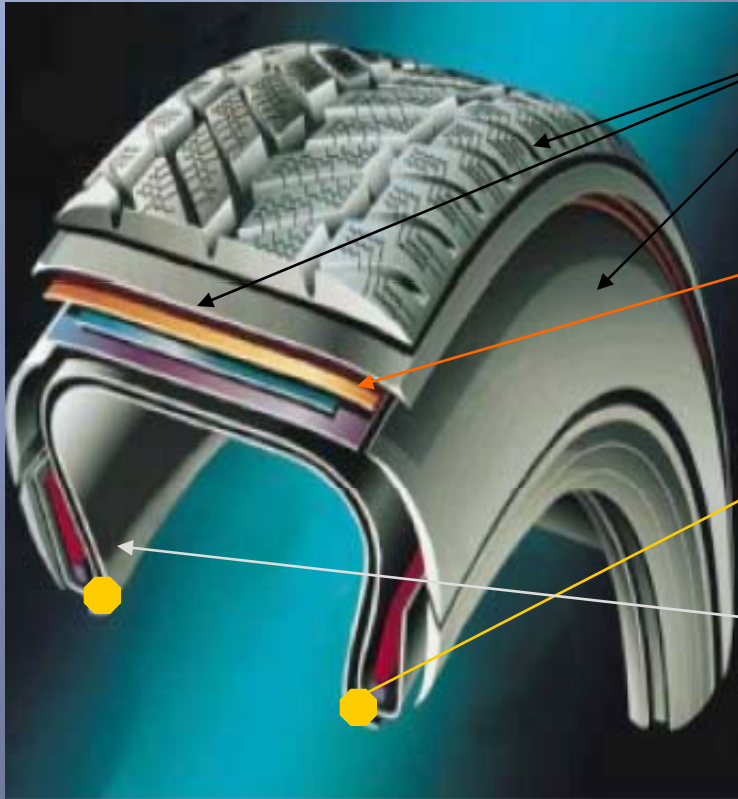


Compared with other waste streams

Product	Consumption	Sub-set
Paper	±79,000,000	
Plastics	±37,000,000	
Packaging		
Glass	±15,000,000	
Aluminium	±8,860,000	
Automotive/construction		
Packaging		
Rubber	±5,000,000	
<i>Tyres</i>		



The raw materials



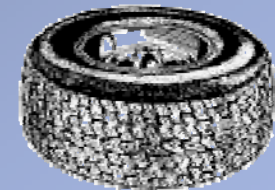
Rubber compounds - throughout the tyre :
treads, sidewalls, etc.

Plies and belts : layers of brass coated steel
with rubber

Bead wire : Cords of high tensile steel that
give form to the tyre

Casing : Made of metal, rayon, nylon.
Polyester cords

Tyres are 100% recyclable

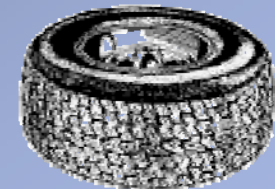


Composition by weight of tyres

Material	Car/utility%	Truck/lorry%
Rubber/elastomers ^a	±48	±45
Carbon black or silica ^b	±22	±22
Metal	±15	±25
Textile	±5	-
Zinc oxide	±1	±2
Sulphur	±1	±1
Additives	±8	±5

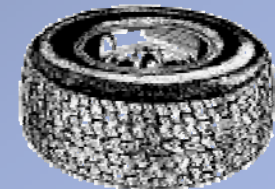
A Truck tyres contain proportionately more natural rubber in comparison to synthetic rubber than do car tyres
b Different varieties of carbon black are used for different purposes and may appear in other categories of material

The metals and textiles, perceived as recycling wastes, can be recovered as high value added materials



Tyres are 100% recyclable

- Rubber/elastomer compounds including carbon black and silica are materially recycled to produce raw materials for more than 500 different applications and products
- Metal from both the bead wires (trucks) and the plies, are cleaned and treated for use in replacement of virgin materials in a variety of high value added applications
- Textile from the casing can be used directly as a reinforcement for concrete, or formed into briquettes for use as secondary fuel





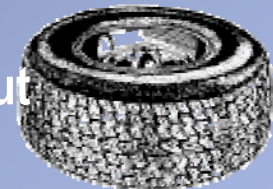
Tyre Recycling makes sense

Means of valorisation
Processing
Outputs

Means of tyre valorisation

- ❖ Re-use and or export
- ❖ Retreading
- ❖ Material recycling including :
 - Civil engineering and construction applications
 - Sport surfaces
 - Surface transport applications
 - Environmental rehabilitation projects
 - Consumer and industrial products
- ❖ Energy recovery for :
 - Co-incineration
 - Cement kilns

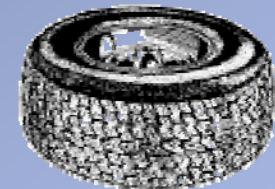
Each form of valorisation requires a consistent flow of input



Tyres used for recycling

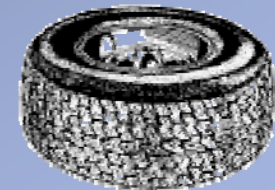
Category	Approx. Wt./ tyre	Tyres p/tonne
• Off road/agricultural tyres (new)	170 kg	5.88
• Truck tyres	56 kg	17.86
• Bus tyres	54 kg	18.52
• Utility tyres	8 kg	125
• Passenger car tyres	7 kg	142.60
• Winter tyres	8kg	125

Tyres recycled in the EU under producer responsibility



Elements of the recycling process

- **Collecting**
- **Sorting**
- **Pre-treating**
 - **Debeading**
 - **Cutting**
- **Processing**
 - **Shredding**
 - **Granulating**
 - » **Sieving**
 - » **Packaging**
 - » **Storing**
 - » **Delivering**

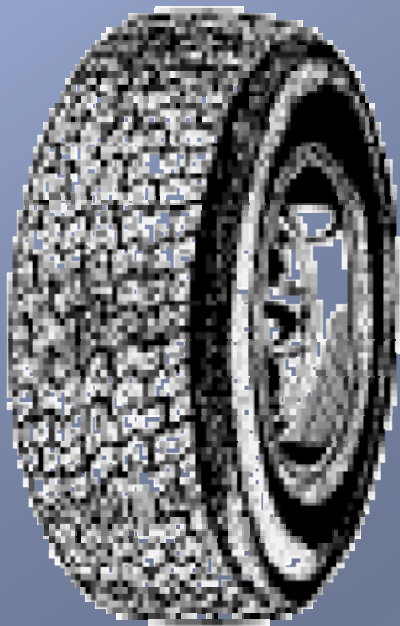




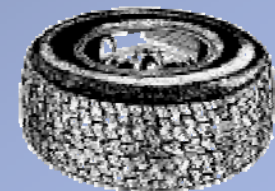
Recycling treatments

Whole tyres
Shred and chips
Granulate and powders

Whole tyres



- Whole tyres can be recycled without physical or chemical transformation
- Principal methods of treatment include cutting into halves or quarters,
- untreated or, treated by removing the beads or sidewalls, or by compression



Whole tyre treatments

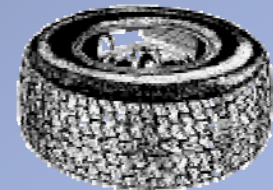
Recycling treatments used on whole tyres are primarily simple mechanical processes that destroy one or more physical attributes of the tyre, e.g. :

Size : cutting into halves or quarters

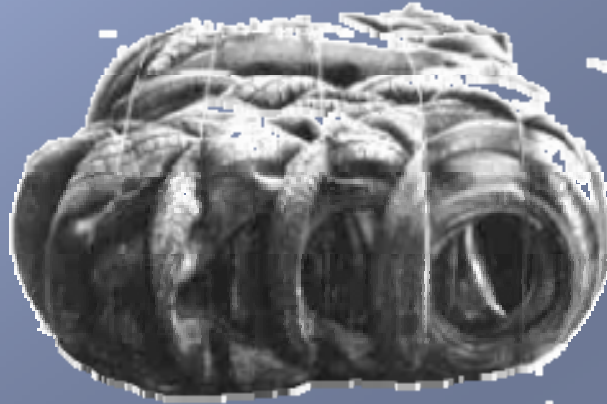
Shape or rigidity : bead wire, tread or sidewall removal

Weight bearing capacity : compression, such as baling

The majority of the outputs are used directly in civil engineering or construction applications.



Examples of whole tyre uses

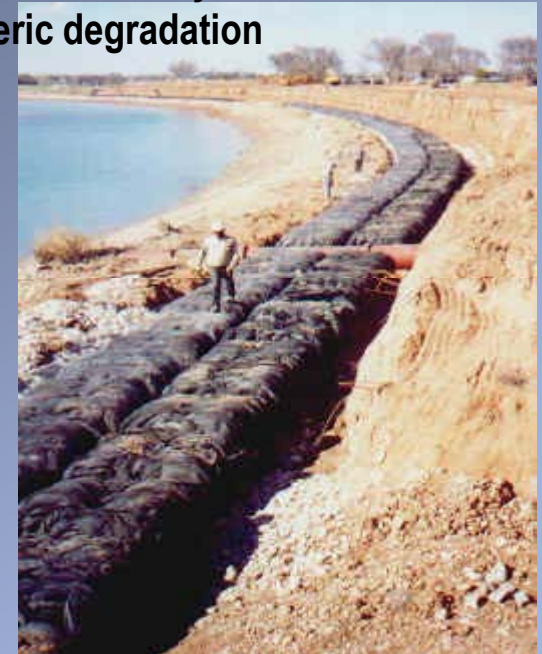


Construction bale Produced from ± 125 tyres compressed and contained by steel wires

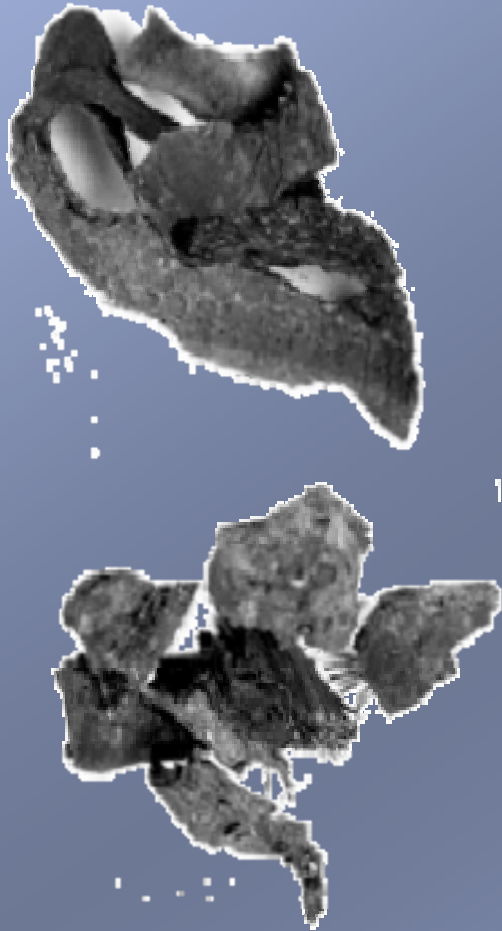
Erosion control : Using construction bales to rehabilitate areas eroded by wind, waves or other atmospheric degradation



Slope stabilisation : Using cut whole tyres to retain the earth as road side



Shred and Chips



- Shred and chips are the result of mechanical processes by which tyres are fragmented into irregular pieces
- Shred can vary in size from $\pm 75\text{mm}$ to 300mm in any dimension.
- Smaller shred, of $< \pm 100\text{mm}$, can be used loose or compacted, in applications with or without binders
- Chips, from $\pm 15 - \pm 75\text{mm}$, can be used in applications with or without binders



Examples of shred and chips



Drainage systems

Compacted shred
(geotextile)



Landfill cell

Loose shred

Loose unbound chips :

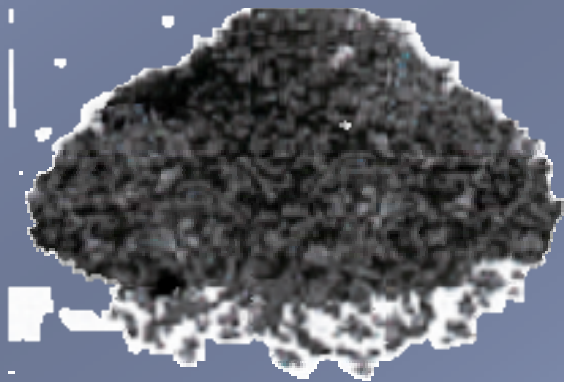
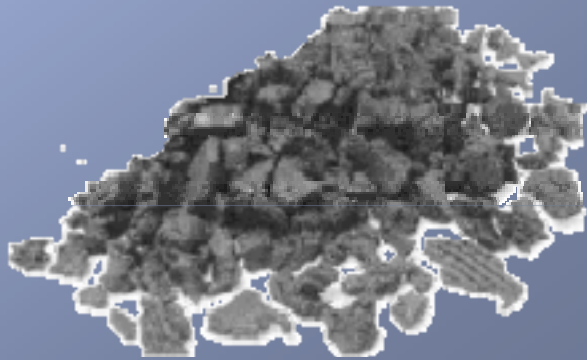
Compacted unbound chips

Bound chips

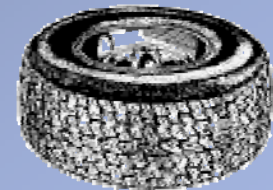


Building insulation

Granulate



- Granulate is the result of processing rubber to reduce it in size into finely dispersed particles from $\pm 1\text{mm}$ to $\pm 10\text{mm}$
- There are two principal methods of production : ambient and cryogenic
- Ambient size reduction is the most common, particularly for larger truck tyres.



Versatility, durability, soundness

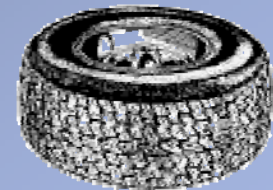
- Granulate is the largest market
- It is increasingly used in replacement for virgin materials in :
 - Sport surfaces,
 - Road construction (not just surfaces),
 - Noise, sound and vibration absorbing products
 - Solid wheels for equipment - even baggage
 - Shoe soles

And hundreds of other consumer and industrial products



Key advantages over virgin materials

- Availability - as long as cars and trucks are on the road
- Ease of production and delivery
- Ease of mixing and use
- Sustainability
- Durability
- Competitive pricing
- Long-term cost-effectiveness



Examples of granulate uses



Artificial turf

Artificial turf

Road furniture
Road furniture

Insulation



Running tracks

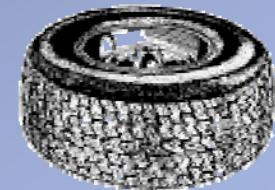


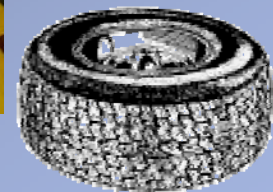
Indoor or outdoor
tiles/pavers



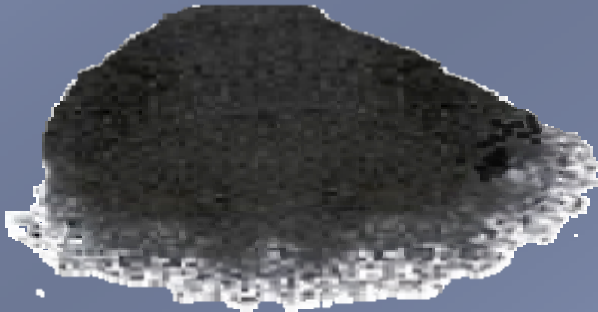
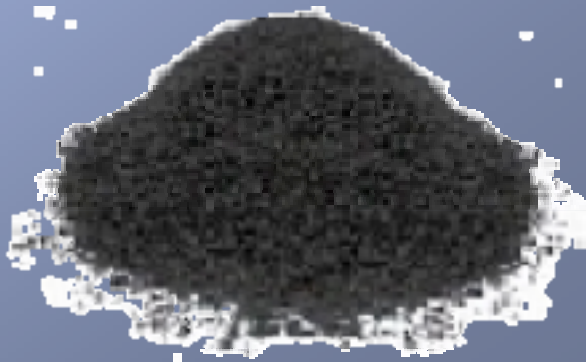
Sports arenas

MERAS Cairo, Egypt



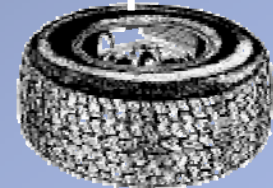


Powders and fine powders

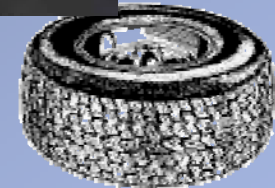


- Fine granulate is the result of ambient or cryogenic processing to obtain finely dispersed particles of less than $\pm 2\text{mm}$.

- Powders and fine powders are the result of processing and post-treating the material to obtain finely dispersed particles of $\pm 500\mu\text{m}$ - $<1\text{mm}$



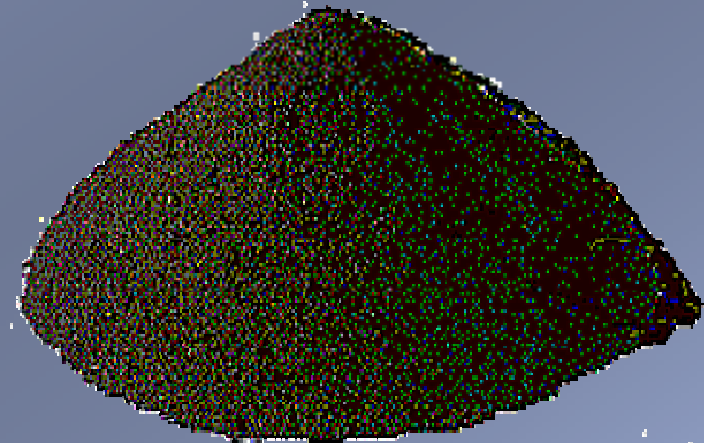
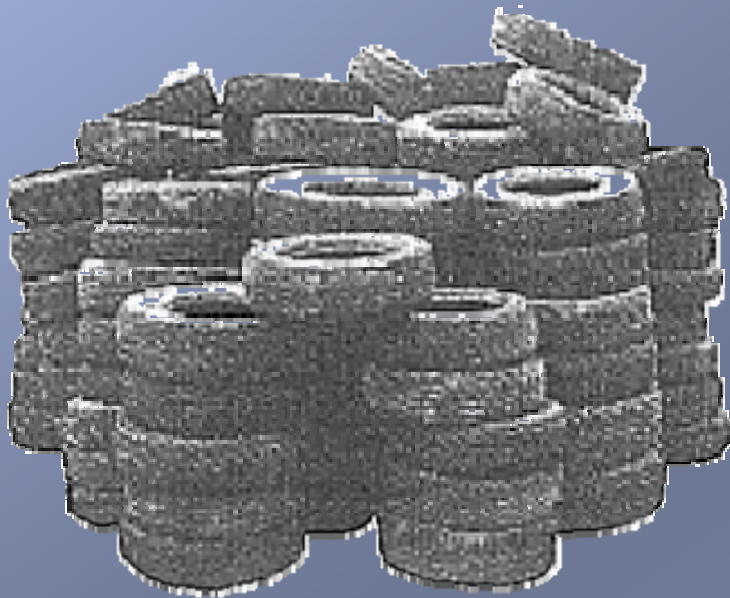
Examples of powders and fine powders





Summary and conclusions

Material output



400 - 700 kg of granulate

1 tonne of tyres

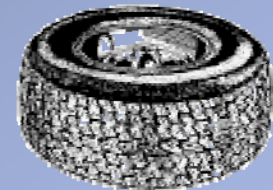
**= +500 - 700 kg of granulate, dependent on size
+300 - 500 kg of powders, dependent on size**



Tyre processing : 1 tonne of tyres

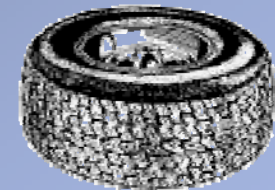
Continuous processing

- Shredding : approximately 18 - 20 minutes
- Chipping : approximately 12 - 15 minutes
- Granulating : (1) about 15 minutes
(2) or (+) 10 - 15 minutes
- Fine granulating : dependent upon the number of lines
approximately 10 minutes
- Powders : from granulate - can be sifted or further processing
approximately 10 - 15 minutes, depends on size



Sieving, bagging : 1 tonne of tyres

- **Sieving - depending upon screen size**
 - 1 - 2 tonnes per hour for granulate
 - +1 tonne per hour for fine powders
 - Calculation includes allowed time to avoid bottlenecks
- **Bagging - big bags of 1 tonne**
 - 1 - 2 tonnes per hour
 - Calculation includes time for bottlenecks
- **Cleaning and maintenance : Dependent upon equipment**
 - Equipment - full cleaning once per week
 - Sieves, screens - once per week, disassemble, reassemble
 - Daily maintenance - wipe over, cleanup, shake out
 - One shift per week to clean the whole plant



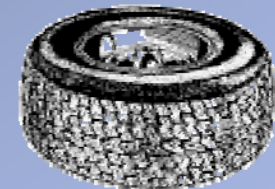
Environmental impacts : per tonne

Material	Feedstock	Energy use	Process	Emission limits/unit of operation
Debeading	Whole truck and other tyres	15 kWh/t 60 sec spurt	Mechanical removal of bead wires from each side of the tyre	+0,4 mg/m ³ dust +90 dB (A) noise
Shred, chips	Dependent upon use : Whole and/or cut car, utility, truck and other tyres	35-50 kWh/t	Shredding and chipping are mech-anical processes which shear the material with a system of knives. The metals remain.	+0,2 mg/m ³ dust +95 dB (A) noise SO _x 0 NO _x 0 Water - trace
Size reduction Granulate & powder	Dependent upon product: whole, cuts, shred, chips, treads, sidewalls, technical rubber	110 - 130 kWh/t	Ambient grinding shears the material with a system of knives, at or above room temperature. The material may continue through one or more sequential granulators to further reduce it in size.	0,2 mg/m ³ dust G; 0,4 mg/m ³ dust P +85 dB (A) noise (newer systems encased) +90 dB (A) noise (encased) some older, dual process systems So _x 0 NO _x 0 Water – below allowable levels
Metal removal	Dependent upon product: Shredded/ granulated tyres, As produced above	30 - 35 kWh/t	Metals are removed during granulations with a series of magnets which pass over the material	+0,2 mg/m ³ dust +35 dB noise SO _x 0 NO _x 0 Water – below allowable levels
Metal cleaning	Dependent upon metal format	30 - 35 kWh/t	Metal cleaning is a separate pro-cess during which additional ad-hered rubber is removed	+0,2 mg/m ³ dust 30– 45 dB noise Water – below allowable levels



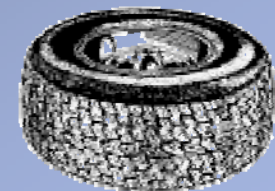
Percent of processed material per tonne

Rubber output	±% product	±% loss p/t
Shred and chips (un-separated)	95%	±5%
Large granulate ±7 - 12 mm	70%	±30%
Granulate or powder (truck)	60%	±40%
Granulate or powder (car)	40%	±60%

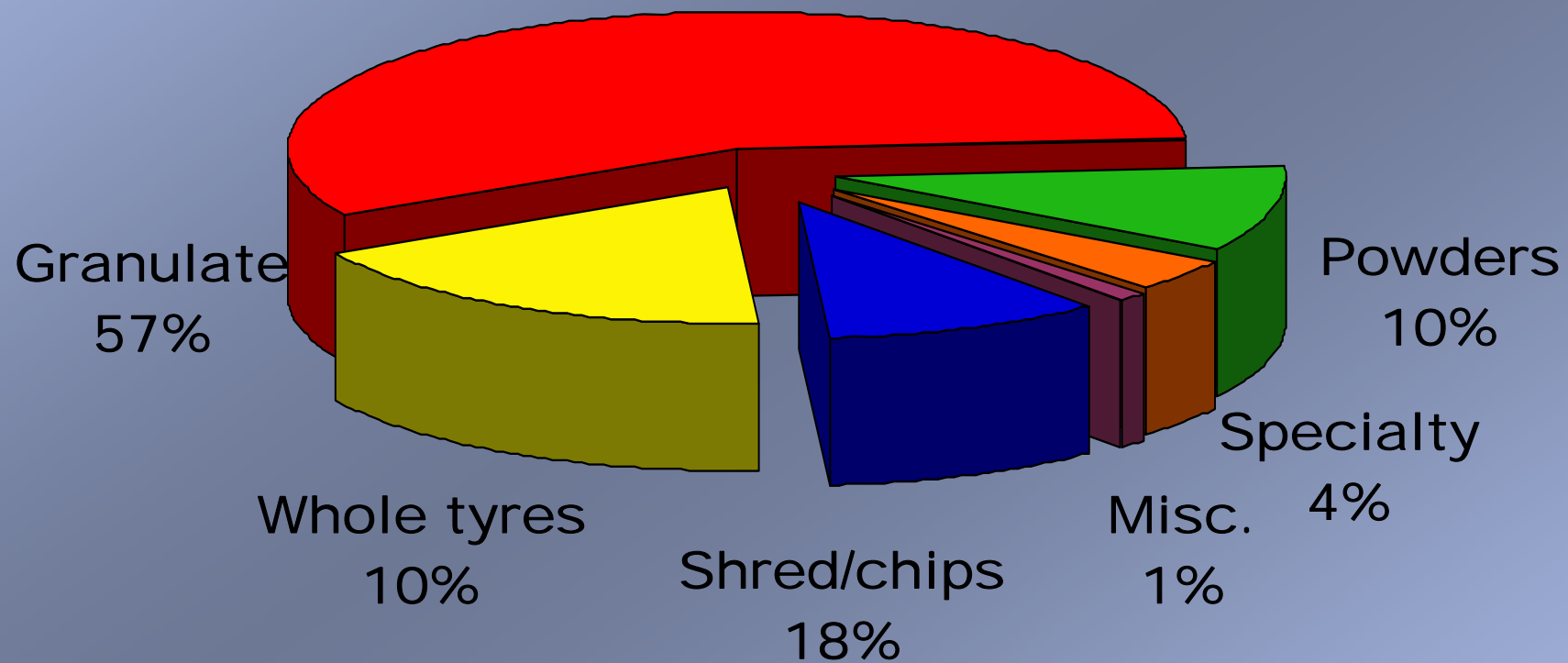


The actual quantities

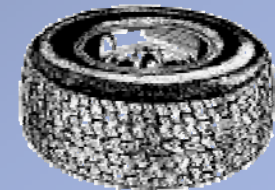
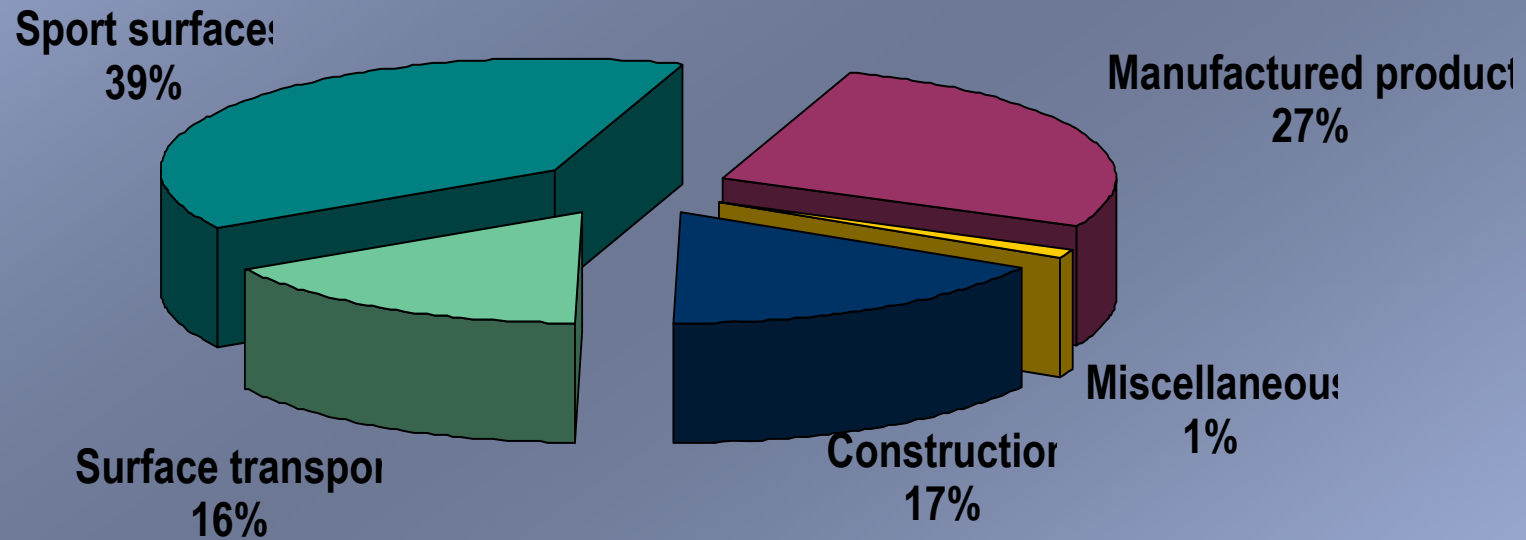
Material	tonnes	Primary application
Granulate	630 000	Sport surfaces/transport
Shred/chips	200 000	Construction/transport
Powders	110 000	Transport/products
Whole tyres	110 000	Rehabilitation/construction
Specialty materials	44 000	Products
Miscellaneous	10 000	Research, testing



Recycled tyre materials

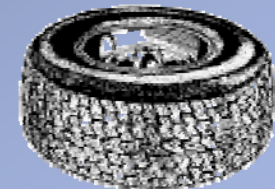


Principal market sectors



Road-related products

- In replacement of quarried aggregate (bales, shred, chips)
- Sound barriers (whole tyres, shred, chips, large granulate)
 - Pre-fabricated
 - In-situ
- Road furniture, signage (medium granulate)
- Surface layers, ramps (small granulate)
- Base layer (varied size granulate)
- Spray coatings (powders)



Recycling makes sense

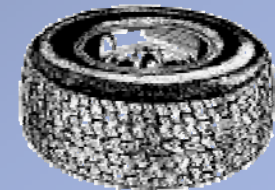
- It requires 121,000BTUs to produce 1 kg of new rubber materials
- It requires only 2,200BTUs to produce 1 kg of clean granulate or powder.

Put another way, the Co₂ equivalent for 1kg of rubber is :

4,351 for Natural rubber

3,409 for SBR

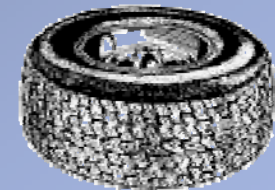
0,097 for recycled rubber



Considering energy use

The production of 1 tonne of rubber requires the following :

- Natural rubber requires the same amount of energy as driving from Cairo to New York City (about 10,000km)**
- Synthetic rubber (SBR) requires the equivalent of driving from Cairo to Maui, Hawaii (+15,000km)**
- Recycled rubber is a much shorter trip - it uses the equivalent of a 400 km ride roundtrip from Cairo to Alexandria**



The attainment level in the EU : 2007-8

In 2007-8, **±2 827 500 tonnes** of post-consumer tyres were treated in an environmentally sound manner within the 27 States of the EU.

± 195 000 tonnes : export (± 6%)

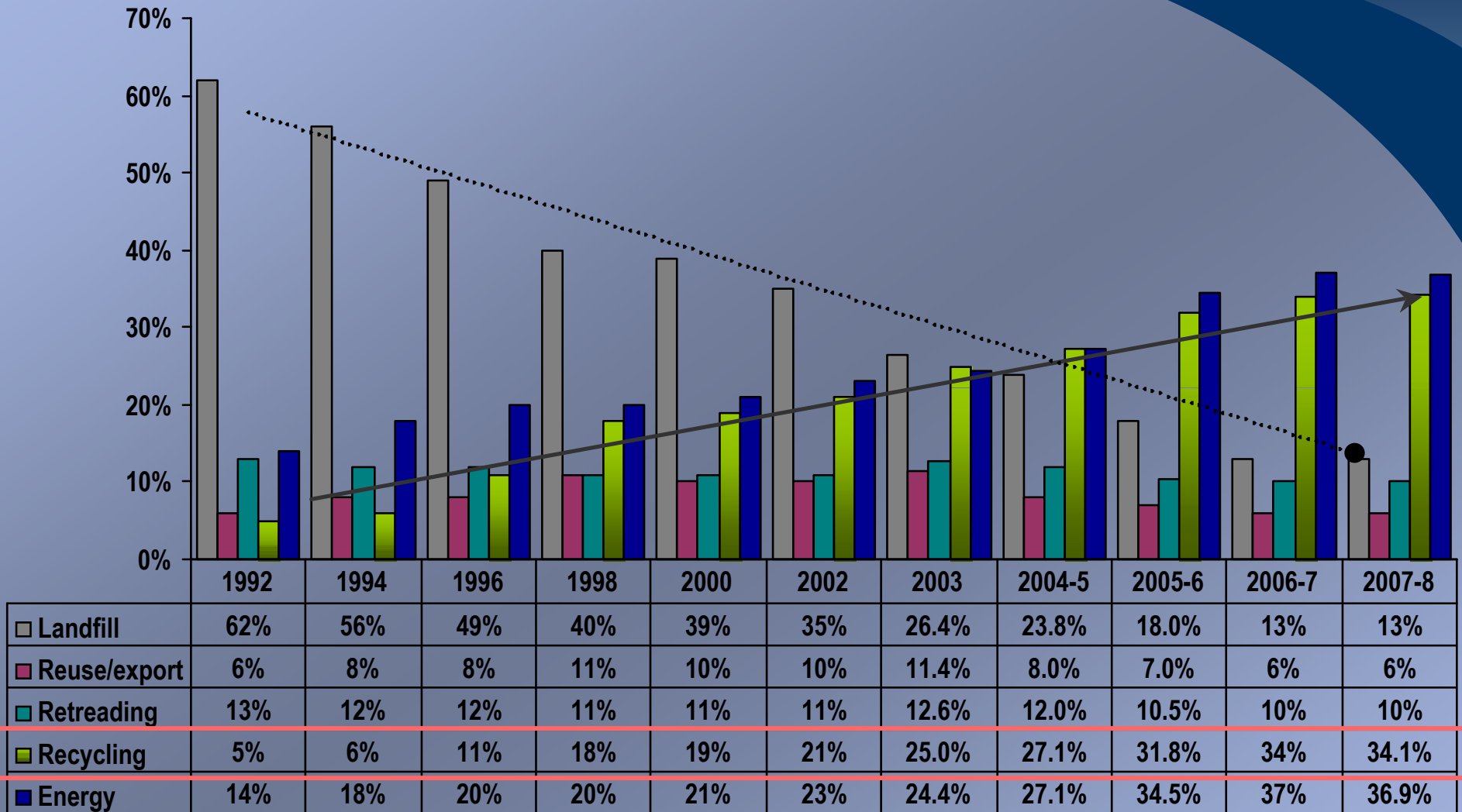
± 325 000 tonnes : retreading (± 10%)

±1 116 000 tonnes : material recycling (± 34.1%)

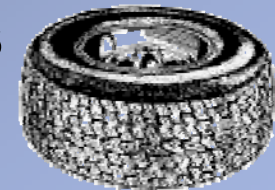
±1 191 500 tonnes : energy recovery (±36.9%)

±87% of post-consumer tyres were diverted from landfills.



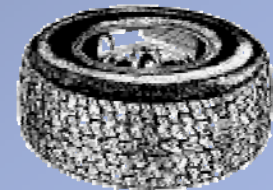


Current recycling capacity could treat almost 40% of tyres

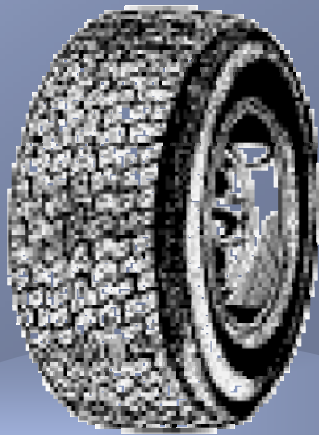


Profitability

- Tyre recycling is an evolving industry
- Recycling processes are becoming increasingly performant due to :
 - Increased availability of tyres
 - Improved equipment and lower maintenance costs
 - More diversified outlets and markets for different size materials
- A more commercial approach to the development and production of full product lines
- Research to demonstrate the environmental soundness and effectiveness of the materials - and hence, applications



17th ETRA Conference



17 - 19 March 2010

**The Crowne Plaza Europa
Brussels**

