End of Life Tire (ELT) Management

A global state of knowledge on regulation, management systems, impacts of recovery and technologies

8th Scrap Tire Recycling Conference
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wbcsd
Tire Industry Project.

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- **Introduction** - World Business Council for Sustainable Development, Tire Industry Project, End-of-Life Tires Working Group studies
- **Global generation and recovery -** Summary and cross-analysis of ELT markets including regional focus & evaluation of maturity of different management systems
- **ELT management methods** – Overview of main approaches, key factors for establishing a successful ELT management system including supporting factors (best practices) and challenges faced
- **Overview of recovery methods, products and applications**
  Summary of recovery route evaluation findings
  Focus on advanced and developing technologies and research in progress

Introduction

TIP at a glance

11
Leading tire companies

A CEO-led project.
Founded in 2005 by member CEOs

~65%
Global tire production

Primary global forum for the tire industry on sustainability issues

8
Working groups

Focus on health & environment aspects of tire life cycle

TIP members

BRIDGESTONE
Your Journey, Our Passion

Continental

COOPERTIRES

GOODYEAR

Hankook

KUMHO TIRE

MICHELIN
A BETTER WAY FORWARD

PIRELLI

SUMITOMO
RUBBER INDUSTRIES

TOYO TIRES

YOKOHAMA

TIP approach

Proactive

Identifying & addressing potential human health & environmental impacts of tires through their life cycle

Innovative

Establishing measurement & benchmarking frameworks to advance sustainability

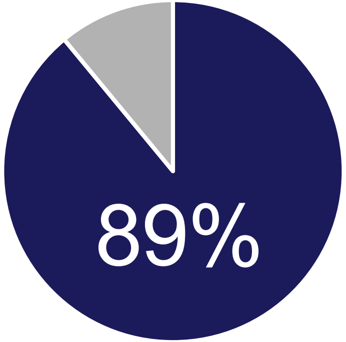
Research-based

Initiating & supporting in-depth research that leverages resources & expertise

Introduction

Deloitte Sustainability Services was commissioned by WBCSD TIP to study global ELT management processes.

Between 2016 and 2019 two complementary ELT studies were conducted to provide a state of knowledge on regulation, management systems, and recovery routes.



Coverage rate* of vehicles in use worldwide: scope of both studies combined, equating to close to **30 million metric tons (66 billion pounds) of ELT generated annually.**

Feasibility of different major ELT recovery categories evaluated based on the following criteria:

**International Organization of Motor Vehicle Manufacturers, WBCSD study country scope for vehicles in use 2015*

State of Knowledge

Overview of current and prospective regulations and ELT management systems (collection, transport & intermediate treatment stages):

- Distribution of ELT across recovery routes
- Overview health and environment risk studies

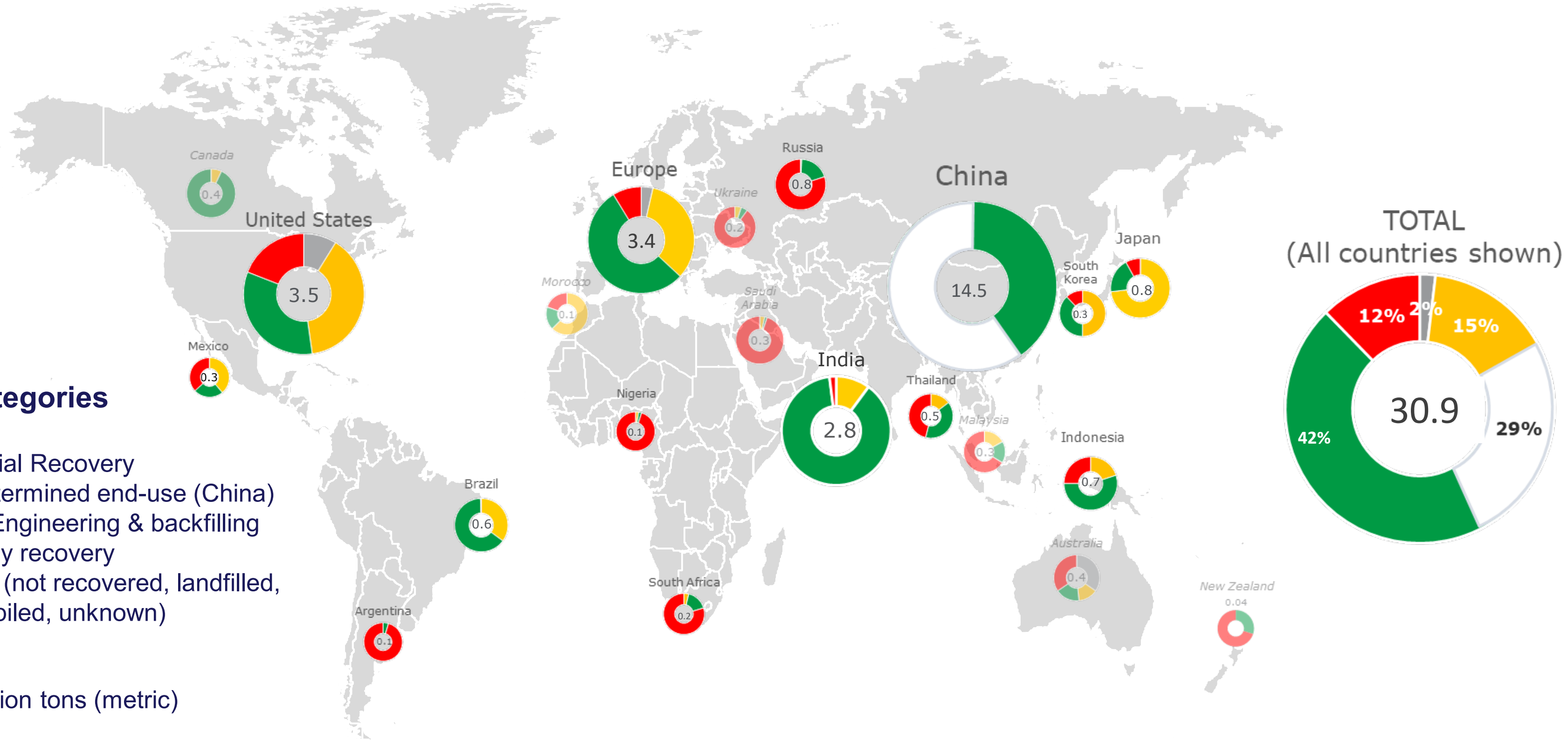
Feasibility of different major ELT recovery categories evaluated based on the following criteria:

- Regulatory context
- Technical feasibility
- Economic drivers
- Sustainability considerations

A panorama of innovative and advanced technology (Research and development)

Global ELT generation, recovery and management methods

ELT generation and recovery by country/region



ELT categories

- Material Recovery
- Undetermined end-use (China)
- Civil Engineering & backfilling
- Energy recovery
- Other (not recovered, landfilled, stockpiled, unknown)

Units: Million tons (metric)

Key global & regional level take-aways

China, Brazil and India are identified as having the highest recovery rates within the selected countries*. Brazil, which has an extended producer responsibility system, has been increasing its recovery rate to reach targets through delivery to cement kilns and granulators. For both China and India, around two thirds of recovery is understood to occur in informal markets.

Argentina, South Africa, Nigeria, Russia, Indonesia and Thailand have the lowest recovery rates and most potential for improvement

NA

Relatively high recovery rates are observed in both the US and Mexico, which have free market systems with aspects of framework for ELT management. In the US, there is active research into new recovery technologies. In Mexico, there are discussions regarding EPR.

LATAM

Argentina and Brazil are found to sit at two extremes in terms of ELT recovery rates, with Brazil's particularly successful EPR system resulting in one of the highest formally reported rates. Argentina on the other hand has significant room for improvement in ELT management where some municipalities have recently been setting an example.

EMEA

Circular economy strategies are driving recovery in Europe where ELT management is considered mature. Russia has incrementally improved its recovery rate thanks to the implementation of EPR. In Africa processing capacity remains low. While South Africa strives to put its system back on course, actors in Nigeria are discussing ways of developing ELT management through policy.

APAC

Informal markets are common in China and India and are considered to contribute to some of the highest recovery rates around the world. However, related to these operations there is increasing attention environmental and safety standards.

**Note that for China 61% of ELT generated is collected with undetermined end use*

ELT Management Methods

Free market system

Tax system

Extended producer responsibility (EPR) system

Approaches for a successful ELT management system

- Data collection, monitoring and control (reporting) with dedicated responsibilities
- Roadmaps and recovery plans
- Coordination through associations
- Infrastructure, including deposit, collection, and transportation systems and supply chain synergy
- Public funding and private investment

Major Challenges

- Lack of comprehensive data for means of recovery of or other management for many countries
- Limited tracking to application level even in mature systems
- Illegal imports and non-declaration
- Informal activity with lower environmental and safety standards

Data collection and presentation

United States

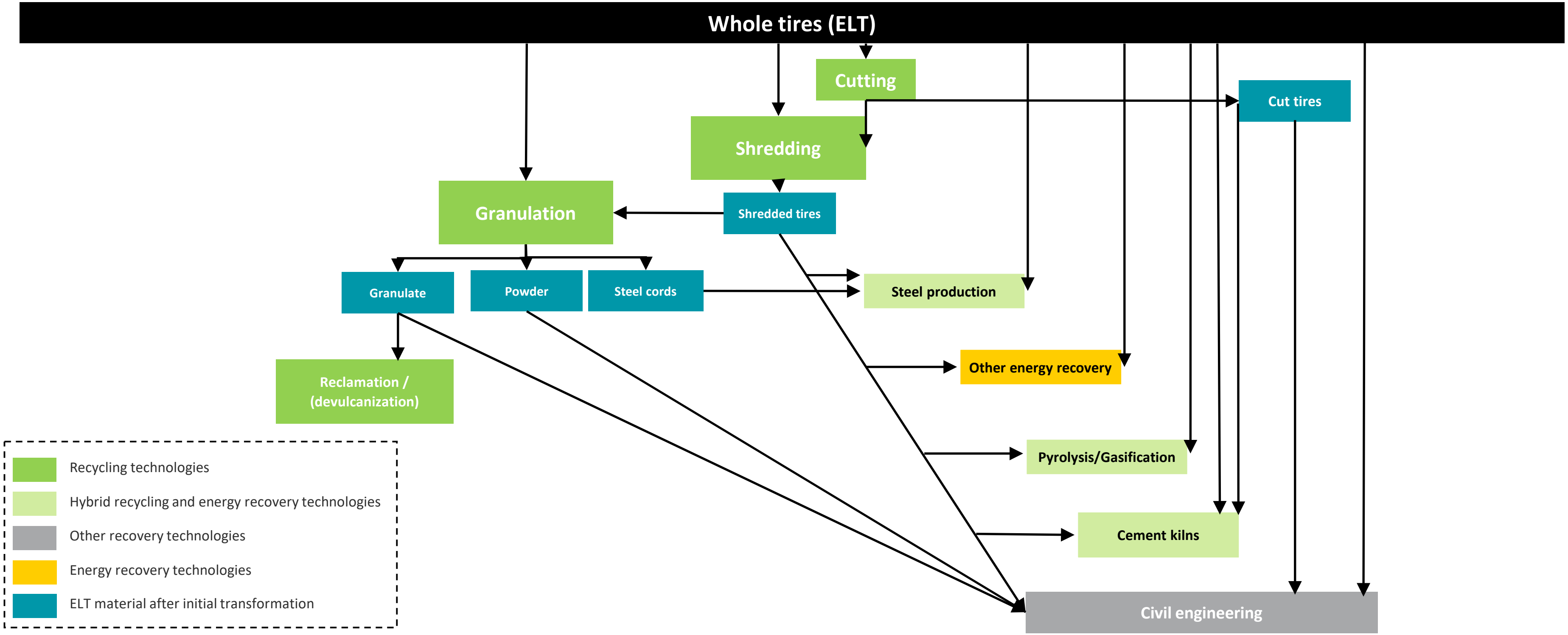
ELT data (USTMA, 2018)	Kilotons (metric) (2017)	Percentage of total ELT generated (2017)
TOTAL ELT Generated (from available sources)	**3700**	**-**
TOTAL Recovered (excluding Civil Engineering and backfilling)	**2668**	**72.1%**
TOTAL Recovered (including Civil Engineering and backfilling)	**2995**	**80.9%**
Sub-total Material Recovery	1227	33.2%
Sub-total Energy Recovery	1442	39%
Sub-total Civil Engineering and backfilling	326	8.8%
TOTAL Other (not-recovered, landfill, stockpiled or unknown)	706	**19.1%**

- Generally, ELT generation = quantity of tires sold onto the market (declarations on production and imports).
- Regulatory authorities, trade associations or ELT management organizations collect and consolidate data available.
- Globally, the key area for improvement would be better identification of different applications or end uses.

Overview of recovery methods, products and applications

WASTE HIERARCHY	REUSE	RECYCLING		OTHER MATERIAL RECOVERY	RECOVERY HYBRID			ENERGY RECOVERY	DISPOSAL
ELT INPUT	Whole tires	Whole or Shredded tires	Rubber granulate	Whole or Shredded tires, Rubber granulate, Crumb rubber and Powder	Whole or Shredded tires	Whole or Shredded tires	Steel cords, Whole or Shredded tires	Textile, Whole or Shredded tires	Whole tires
MANAGEMENT METHODS	Repairing Regrooving Retreading	Granulation and associated applications	Reclamation	Civil engineering	Pyrolysis and gasification				Landfill Incineration
PRODUCTS (OUTPUT)		Granulate and powder	Reclaimed rubber	N/A	Oil, gas, carbon/char, steel			Other energy recovery	
APPLICATIONS		▪ Artificial turf infill ▪ Athletics tracks ▪ Molded rubber products ▪ Playgrounds ▪ Roofing material ▪ Rubber-modified asphalt	▪ Inner tubes ▪ Insulation tiles used in public transportation for reducing the noise level ▪ Tiles for laying pedestrian concrete areas ▪ Tubeless tire liners	▪ Agricultural use ▪ Baled tires ▪ Breakwaters ▪ Coastal protection ▪ Erosion barriers ▪ Ground improvement ▪ Landfill construction operations ▪ Road embankments ▪ Shelters ▪ Slope stabilization ▪ Sound barriers, insulation applications	Carbon black: industrial gaseous effluents treatment (e.g. mercury, suplhur dioxide) Char: water and purification Oil and gas: TDF	Cement Kilns	Steel production	Alternative or additional fuel for energy generation in: ▪ Brick production ▪ Industrial boilers ▪ Power plants ▪ Pulp and paper mills ▪ Waste-to-energy plants	

Illustration of non-linear links between recovery routes (initial stages of transformation pre-application)



Cement kilns and other energy production

Regulatory context

- Energy recovery aspect generally not favored by waste policy
- Supported by emissions policy in certain markets
- Demanding permit procedures

Technical feasibility

- Some adaptation and testing required
- High capacity of large facilities
- Preference to use shredded tires (dosage)
- Stable composition and high calorific value

Economic drivers

- Existence of gate fees
- Sensitive to price of traditional fuels
- Investment on infrastructure and adaptations

Sustainability considerations

- Relatively low greenhouse gas (GHG) or other polluting emissions vs. some traditional fuels
- Some negative public perception
- Replacement of energy intensive extractive material
- Biomass content (natural rubber) of the ELT

Civil engineering (e.g. of applications: barriers, embankments and more)

Regulatory context

- Cases of incentives such as price rebates or subsidies on the purchase of ELT or shredded ELT for use in high value applications

Technical feasibility

- Generally low-tech
- ELT have many technical properties (e.g. lightweight, thermal insulation etc.)
- High volumes of ELT required

Economic drivers

- Limited market
- Low cost material for applications
- Small, with applications serving different purposes
- Technically advantageous properties

Sustainability considerations

- Lower environmental performance due to material replaced

Reclamation

Regulatory context

- Material recycling technology often favored by policy aligned with the waste hierarchy
- Use of some chemicals restricted by policy in certain areas

Technical feasibility

- Variety of processes and levels of complexity
- Generally reclaimed rubber is considered a low-quality product

Economic drivers

- Commercial stage
- Strong demand for output product in China in particular

Sustainability considerations

- Negative environmental externalities associated with chemical reclamation
- Potentially negatively perceived by the public

Granulation

Regulatory context

- Considered a priority over energy recovery
- Cases of incentives or subsidies on the purchase of their raw material (ELT or crumb rubber)
- Promotion of applications of high added value
- Potential regulatory barriers remain

Technical feasibility

- Well developed without major technical difficulties
- Generally high-quality output products

Economic drivers

- Secondary markets for fiber & steel are beneficial
- Investment required for advanced treatment and processing stages for higher value products (e.g. finer / more regular granulate)
- Reduction in market for artificial infill

Sustainability considerations

- LCAs show benefit of granulate use
- Artificial turf infill suffers negative public perception
- Studies conducted have not yet found consensus regarding the risk to human health and the environment associated with the use of ELT in artificial turf or playgrounds

Pyrolysis

Regulatory context

- TDF portion not always supported by waste management policies
- Attention of policy to environmental impacts of operations
- Grants may be available in some countries to support further development carbon black

Technical feasibility

- Efficient technology producing high quality output products is not widespread
- Production of oil as TDF is common
- Research ongoing into high quality output product for which significant pre-processing and post-processing measures are required

Economic drivers

- Output products have a variety of applications
- Sensitive to price and quality of virgin or traditional materials
- Potentially high cost to produce high quality products

Sustainability considerations

- Low sustainability performance due to the larger scale of the less advanced technologies with unsatisfactory standards
- Gas produced by the process can be used to fuel it

Steel production

Regulatory context

- Material recovery aspect favored to some extent where relevant waste hierarchy policy exists

Technical feasibility

- Capacity for ELT to replace anthracite to provide carbon
- Competition with other sources of scrap steel.

Economic drivers

- Relatively marginal market
- Sensitive to the price of anthracite / competition with other sources of scrap metal

Sustainability considerations

- Replacement of high energy intensive extractive anthracite/ iron ore

Innovative & advanced technologies

Research institutions in most countries have initiated some form of research on the use of ELT. The majority identified were material recovery-based research projects in line with the waste hierarchy promoting material recovery. Recent studies have given attention to granulation and associated applications of TDM and pyrolysis.

Granulation/ related technologies

- **Absorption capacity:** tested on phenol and oil in water for regular discharge and accidental spills (Nigeria)
- **Composite materials:** composites from polypropylene and TDM (South Korea) and incorporation into plastics (Europe)
- **Structural reinforcement:** integration into concrete for structural integrity and reduction of risk of damage from natural disasters e.g. earthquakes or tsunamis (Japan, Mexico, Brazil, India, Thailand and the USA)
- **Finer product for new applications:** Micronized rubber powder (USA)

Pyrolysis related technologies

- Battery components: Transformation of char (TDM) for use in fuel cells and batteries e.g. Use as anodes in lithium, potassium and sodium-ion batteries (Europe & USA)
- High quality oil and carbon black (Europe & South Africa)
- Accelerated process (Russia)
- Low emissions process (China)

Circular Economy

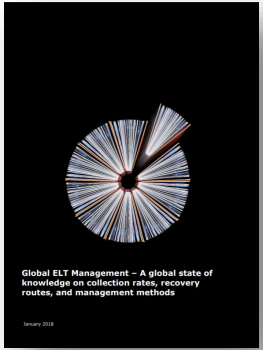
- The waste hierarchy presented before includes applications with varying levels of circularity.
- In Europe in particular, there is a significant strategic drive to improve circularity with an action plan set up by the European Commission to accelerate this transition.

Next steps TIP on ELT

- Continued efforts to deepen the state of knowledge on global ELT management through:
  - Stakeholder dialogue on key topics (i.e.: recovery routes of common interest such as rubberized asphalt)
  - Promoting proper ELT management systems in developing countries

For more information – WBCSD publications on ELT

A global state of knowledge on regulation, management systems, impacts of recovery and technologies



A global state of knowledge on collection rates, recovery routes, and management methods

A framework for effective management systems

Managing End-of-Life Tires

www.wbcsd.org/Sector-Projects/Tire-Industry-Project/End-of-Life-Tires-ELTs

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