Dean Beckman
[redacted]
16/05/2014 01:21 PM

To Hazelwood Inquiry info/DPC@DTF
cc David Bacher <David.Bacher@tyrecycle.com.au>
bcc
Subject Enquiry from website

6 attachments

HAZELWOOD-MINE-FIRE-INQUIRY-Submission-cover-sheet Tyrecycle CEO.pdf

Hazelwood Mine Fire Tyrecycle CEO Submission.pdf Vic Regulaions 2014.pdf Capture.PNG

Fire_Services_Guideline_Open_Air_Storage_of_New_or_Used_Tyres.pdf

FinalRubberTireRecyclingCarbonFootprint.pdf

To whom it may concern,

Please find attached the Tyrecycle submission that will assist with the inquiry regarding the Hazelwood mine fire.

Regards,

Dean Beckman

CEO

Tyrecycle Pty Ltd

[redacted]

Web: www.tyrecycle.com.au

[redacted]

Somerton Victoria Australia 3062

HAZELWOOD MINE FIRE INQUIRY

Submission cover sheet

Post your submission with this cover sheet to:

Submissions Hazelwood Mine Fire Inquiry
PO Box 3460
GIPPSLAND MC Vic 3841

Email your submission with this cover sheet to info@hazelwoodinquiry.vic.gov.au.

Title: CEO	First Name: Dean	Surname: Beckman
Organisation represented(*if applicable*): Tyrecycle Pty Ltd		
Email address:	[redacted]	
Postal address:	[redacted] **Somerton Vic 3062**	
Telephone: [redacted]	Mobile: [redacted]	
☐ Origin and circumstances of fire X Measures by Hazelwood Coal Mine to prevent fire X Application and administration of regulatory regimes ☐ Other (please state) X Tyre and Conveyor Rubber Stockpiling	Response to fire by: ☐ Hazelwood Coal Mine ☐ Emergency Services ☐ Environmental Agencies ☐ Public Health Officials ☐ Other Government Agencies	

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12/05/2014

Tyrecycle

30-56 Encore Ave Somerton VIC 3062
p: +61 (3) 8339 3555 f: +61 (3) 9305 2545

Submissions Hazelwood Mine Fire Inquiry,
PO Box 3460
Gippsland MC VIC 3841

To whom it may concern,

RE: Hazelwood Mine Fire Inquiry – Storage of Waste Tyres and Conveyor Belt Rubber

Thankyou for allowing Tyrecycle to provide our extensive experience to the inquiry of the Hazelwood mine fire, ensuring that the significant environmental damage resulting from this event can never occur again. Tyrecycle was established in 1992, is foundation member of the Australian Tyre Recyclers Association (ATRA) and is the largest tyre recycler in Australia. Tyrecycle currently recycles over 110,000 tonnes of waste rubber per annum which includes passenger tyres, truck tyres, the largest mining tyres and conveyor belt rubber.

The footage from the Hazelwood mine fire was disturbing as large quantities of waste tyres and conveyor belts were observed burning, producing toxic fumes from the aromatic hydrocarbons they contain such benzene, toluene, etc. The environmental damage to human health and the environment from rubber fires is well documented with at least 32 toxic gases produced, including a large amount of dioxins and furans which are known carcinogens. The oil runoff from rubber fires is also significant with 10kgs of rubber producing 7.5 litres of oil, which will pollute the soil and groundwater if not contained. Waste rubber has higher a calorific value of coal by approximately 20% and new regulations for tyres have just been introduced into Victoria to eliminate the threat of future rubber fires, such as the incident that has just occurred. The documents attached includes the new regulations and fire guidelines for open air storage of tyre rubber.

The infrastructure exists for all waste rubber and conveyor belts to be recycled in Australia, so the stockpiling of waste rubber must be prohibited, unless stored in areas that contain sufficient water dousing systems and waste water catchment areas. The environmental benefits of recycling rubber is well documented with recycled rubber used in roads to produce safer, longer lasting and quieter roads than traditional polymer based construction. I have attached a copy of a report highlighting the benefits from Institute of ISRI, the leading global recycling body.

Can you please immediately ensure, for the betterment of human health and the environment, that all waste rubber on mine sites is either stored in suitable facilities that appropriately manage the risks, or the waste rubber is immediately sent to recycling facilities for recycling. This will eliminate the risk of fire which directly caused the released toxic pollutants from burning rubber into the environment during this avoidable incident.

Regards,

Dean Beckman

CEO

Victoria Government Gazette

No. S 139 Wednesday 30 April 2014
By Authority of Victorian Government Printer

Environment Protection Act 1970

WASTE MANAGEMENT POLICY (STORAGE OF WASTE TYRES)

Certification of Special Reasons as a Result of Which a Waste Management Policy Should Be Declared without Delay

I, Ryan Smith, Minister for Environment and Climate Change, certify under section 18B of the **Environment Protection Act 1970** that the Waste Management Policy (Storage of Waste Tyres) (the Policy) should be declared without delay.

The Policy is necessary to ensure that waste tyres are stored in a manner that minimises risks to the environment and human health, predominantly due to the risk of fire.

The key risk associated with improper storage of waste tyres is fire resulting from arson, accidents or bushfires. Tyre fires can burn for weeks, generating hazardous smoke, oil and leachate that affect the soil, waterways and air. The risk of fire has been demonstrated with a number of tyre fires that have occurred in Australia and around the world. During the recent Grampians bush fires, emergency services were required to actively defended a large tyre stockpile in Stawell from fire.

In contrast with New South Wales and South Australia, Victoria does not have effective regulatory requirements for the management of waste tyres. Consequently, tyre stockpiles are growing rapidly and will be expected to increase as NSW strengthens its regulations of waste tyres.

The immediate introduction of the proposed Waste Management Policy (Storage of Waste Tyres) will allow my department to adequately address high risk stockpile sites over the winter period in preparation for the 2014/15 fire season.

As such, special reasons exist which require the Policy to be declared without delay.

Dated 22 April 2014

THE HON RYAN SMITH MP
Minister for Environment and Climate Change

Environment Protection Act 1970

WASTE MANAGEMENT POLICY (STORAGE OF WASTE TYRES)

Order in Council

The Governor in Council under section 16A of the **Environment Protection Act 1970**, and on the recommendation of the Environment Protection Authority, declares the Waste Management Policy (Storage of Waste Tyres) as follows:

1. Objective

The objectives of this Policy are to ensure that waste tyres are –

(a) stored in a manner that minimises risks to the environment and human health, predominantly due to the risk of fire; and

(b) stored for purposes such as transfer, reuse, recycling, reprocessing or energy recovery.

2. Commencement

This Policy will come into operation on the day it is published in the Government Gazette.

3. Definitions

In this Policy–

waste tyres, also called end-of-life, used or scrap tyres, means rubber tyres, whether whole or in pieces, which are considered waste under the **Environment Protection Act 1970**;

EPU (equivalent passenger units), in relation to waste tyres, means the standardised value assigned to a type of tyres in the Schedule to this Policy.

4. Policy clauses

(1) This Policy applies to premises that store more than 5000 EPU or 40 tonnes of waste tyres at any time.

(2) Waste tyres must only be stored for purposes such as transfer, reuse, recycling, reprocessing or energy recovery.

(3) Waste tyres must be stored in a manner that minimises risks to the environment and human health, predominantly due to the risk of fire.

(4) Waste tyres will be taken to be stored in compliance with clause 4(3) if –

(a) any outdoor storage of waste tyres at the premises is in accordance with the recommendations in the Victorian *Fire Services Guideline – Open Air Storage of New or Used Tyres* (2014), as amended; and

(b) any indoor storage of waste tyres at the premises is in accordance with the recommendations in the Victorian *Fire Services Guideline – Indoor Storage of New or Used Tyres* (2014), as amended.

5. Expiry

This Policy expires 12 months from the day it is declared.

SCHEDULE

Type of tyre	**EPU Value**
Motorcycle	0.5
Passenger car	1
Light Truck	2
Truck	5
Super Single	10
Solid small (up to 0.3m high)	3
Solid medium (>0.3m up to 0.45m)	5
Solid large (>0.45 m up to 0.6m)	7
Solid extra large (>0.6m)	9
Tractor small (up to 1m high)	15
Tractor large (>1m up to 2m)	25
Fork lift small (up to 0.3m high)	2
Fork lift medium (>0.3m up to 0.45m)	4
Fork lift large (>0.45m up to 0.6m)	6
Grader	15
Earth mover small (up to 1m high)	20
Earth mover medium (>1m up to 1.5m)	50
Earth mover large (>1.5 up to 2m)	100
Earthmover extra large (>2m up to 3.0m)	200
Earthmover giant (>3 up to 4m)	400
Bobcat	2

Dated 29 April 2014

Responsible Minister:

RYAN SMITH

Minister for Environment and Climate Change

YVETTE CARISBROOKE

Clerk of the Executive Council

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FIRE SERVICES GUIDELINE
Open Air Storage of New or Used Tyres

1. PURPOSE

1.1 The primary purpose of this guideline is to provide advice and to make recommendations for the safe storage of new or used rubber tyres on sites in the open air. It also serves to assist operational fire fighters to be aware of the issues that may affect their standard operational procedures.

1.2 This guideline is aimed specifically at operators to help them run the sites as safely as possible, and to ensure that fire protection is provided based on accepted engineering principles, tests, data, fire incidents and field experience.

1.3 This guideline has been produced for advisory purposes only, and does not establish a binding legal or regulatory scheme in respect of the safe storage of tyres.

2. SCOPE

2.1 This guideline is suitable for all sites within Victoria that store, or plan to store, new or used tyres in the open air. Advice and recommendation's pertaining to indoor storage of new and used rubber tyres, is included in *Fire Services Guideline - Indoor Storage of New or Used Tyres.* [Bibliography Ref 7.1]

3. BACKGROUND - Fire and Environmental Hazards

3.1 Rubber tyres are made of compounds that cause rapid combustion, including carbon, oil, benzene, toluene, rubber, and sulphur. While, tyres are not easy to ignite because they are designed to absorb the heat generated by the friction of road contact, once ignition takes place, this same ability of tyres to absorb heat makes extinguishment difficult. The high carbon content and steel cords serve as a heat sink, absorbing and storing heat within the tyre. Although extinguishment process cools the tyre from open flaming to a smouldering stage, the stored tyre heat can re-ignite the tyres.

3.2 Tyres have a heat of combustion of about 35kJ/g, or roughly twice that of ordinary combustibles such as paper or wood. Once ignited, fire development is rapid and high temperatures can be expected due to the large exposed surface area of tyre piles and the available ventilation. Burning is likely to persist for extended periods. In all fires there is a high probability of re-ignition of the tyre pile, even if the fire is controlled.

3.3 While Tyres are stable and not considered to be a hazardous material, once there is a fire, the tyre product breaks down into hazardous compounds including gases, heavy metals, and oil, generating a great deal of smoke. Experience at large tyre fires in the US indicates that for every million tyres consumed by fire, approximately 208,000 litres of unburned run-off oil can pollute the environment unless contained. The average passenger car tyre is estimated to produce more than 7.5 litres of oil. Tyre fire run-off is a significant environmental pollutant that can get into ground water and contaminate well water. In addition to run-off oil, at least 32 toxic gases are produced by tyre fires. [Bibliography Ref 7.2]

3.4 Storage and stacking arrangements of rubber tyres create difficult challenges for fire fighting, since the tyres hollow toroidal (hollow doughnut shaped) form provides ventilation and allows flames to grow on its inner surface while at the same time shielding flames from sprinkler and fire hose spray. [Bibliography Ref 7.2 & 7.3]

3.5 The many ways tyres may be stored outdoors make it impossible to apply any single or set of rules that cover all circumstances adequately. In general the provision of automatic fire protection is impractical for outdoor storage. Emphasis is therefore placed upon:

- Adequate separation distance from site boundaries and buildings to resist the spread of fire
- Where in a Bushfire Prone Area (BPA) adequate bushfire protection, with the design limiting received radiant heat flux level from a passing bushfire to a maximum of 12.5 kw/m^2
- Limiting pile sizes and providing access between piles to restrict the fire size and facilitate effective fire fighting operations
- Effective fire prevention practices to minimise the risk of fire
- Protection of the environment from damage in the event of a fire

4. PLANNING RECOMMENDATIONS

4.1 Site Selection

4.1.1 It is important for operators to liaise with all relevant authorities and interested parties over proposals for new storage sites. These include:

- The Metropolitan Fire Brigade (MFB) or
- The Country Fire Authority (CFA)
- The appropriate Planning Authority (usually Local Council)
- The Environment Protection Authority (EPA)
- WorkSafe Victoria

4.1.2 An ideal site for the storage of tyres will not be within the catchment area of any water used for water supply purposes, or where there may be a risk of ground water contamination, should a fire occur.

4.1.3 The site should also be on flat or gently undulating land, have soil with low levels of salt, have access to an adequate supply of salt free water, be devoid of dense vegetation and trees, have no overhead power lines, and not located in environmentally sensitive areas.

4.1.4 Priority should be given to locating potential storage sites outside of a Bushfire Management Overlay (BMO).

4.1.5 Consideration of siting should be made with reference to prevailing wind conditions, particularly if the proposed site is near residential, health/care facilities, industrial or commercial developments. The proximity of major infrastructure such as roads, railways, navigable waterways, water reservoirs/dams storing potable drinking water, airports, etc., should be considered if dense smoke and toxic products of combustion from a fire could obscure travel routes or adversely impact the health and safety of neighbours. When considering siting with respect to prevailing winds, designers should also consider the impact that a tyre fire could have with regard starting secondary fires in nearby forest/woodland or significant bushland, as a result of fire brands/embers being carried in the prevailing winds from the initial fire location.

4.1.6 Disused quarries, sandpits, natural crevices, etc, which promote deep pile storage of tyres, should be avoided.

4.1.7 An impervious layer should also be applied to sites with pervious soil.

4.2 Tyre Pile Size and Separation Distances

4.2.1 Storage pile sizes should be minimised to restrict the available fuel in the event of a fire.

4.2.2 Long and narrow tyre piles should be employed in preference to large square piles. Maximum pile dimensions of 20m long x 6m wide x 3m high is recommended.

4.2.3 The separation distances provided by aisles between individual piles should be designed to inhibit fire spread due to radiant heat and/or direct flame contact during adverse windy conditions. Adequate aisle dimensions are critical for safe fire fighter access during the deployment of hose streams for exposure protection and where possible fire extinguishment, and for the operation of excavation equipment. A minimum separation distance of 20m between piles is recommended, but is not guaranteed to prevent fire spread.

4.2.4 Storage pile heights should be determined by the stability of the pile, both for normal storage conditions and in the event of a fire, and must not exceed 3m.

4.2.5 Separation distance of the storage piles to buildings will depend on the building construction. For buildings without appropriate fire resistant construction, this distance should not be less than 20m to allow for fire fighter access and to help prevent fire spread to adjacent buildings. This distance could be reduced on a case by case basis, as part of a fire risk assessment, if the building is constructed of appropriate fire resistance levels.

4.2.6 Separation distance to boundaries facing public roads should be not less than 6m and not less than 20m to the far boundary of the public road. Separation distance between the edge of storage piles to other boundaries should be no less than 20m. Where in a BPA however, this separation distance may need to be increased as a function of satisfying the required bushfire protection measures of not exceeding a received radiation of 12.5 kW/m^2.

4.2.7 Any increases in recommended pile dimensions or decreases in recommended separation distances should be assessed as part of a fire risk assessment as detailed in Part 5 of this guideline.

4.3 Ignition Source Control

4.3.1 It is recommended that operators develop and document procedures to control possible ignition sources on site, which should include as a minimum:

- A hot work permit procedure for all cutting, welding, grinding type activities
- Regular inspection and repair of electrical equipment, vehicles, machinery, security fences, etc.
- Maintain site clear of fine fuels or minimise the accumulation of fine fuels from around stored tyres
- Restriction of smoking to designated areas
- No open fires
- No storage of other flammable or combustible materials, hazardous materials or other easily ignitable material within 30m of any tyre storage.
- Maintain separation distances to buildings and boundaries.

4.4 Security

4.4.1 The perimeter of the site should be surrounded by a firmly anchored fence or other effective method of security which prevents unauthorised access and is constructed to discourage entry.

4.5 Fire Protection

4.5.1 Operators should provide first aid fire fighting equipment for use by staff which may include water and foam fire extinguishers, water and foam hose reels, etc. Research indicates that early extinguishment of a tyre fire may be possible in the first five minutes using water, Class A foam or wetting agents. Staff should be provided with appropriate training on the use, limitations, maintenance, etc., of the equipment provided. Refer to Appendix 1, which was developed from the source document at Bibliography Ref 7.2.

4.5.2 Operators should provide a ***hydrant system*** compliant with the provisions of AS 2419.1 and maintained in accordance with AS 1851 – Section 4. [Bibliography Ref 7.4]

4.5.3 For sites that comply with the maximum recommended pile dimensions and minimum separation distances, sufficient firewater for exposure protection and fire extinguishment may be provided by a fire hydrant system designed and installed in accordance with AS2419.1-2005 and the NCC Volume 1 [Bibliography Ref 7.12]. This should be confirmed by the operator as part of the site fire risk assessment

4.6 Water Supplies

4.6.1 The quantities of fire water and foam required to manage the identified fire scenarios for the site, as well as the equipment required to deliver the fire water and foam, should be determined by performing a site fire risk assessment, as detailed in Part 5 of this guide.

4.6.2 Where town water is unavailable or insufficient, an adequate ***static water supply*** of a minimum of 2 x 250,000L tanks located in diagonally opposed positions on site is recommended. Fire pumps for stockpiles in remote locations needs to be considered. The location and capacity of pumps and tanks should be determined as part of a site fire risk assessment, in conjunction with the Fire Services.

4.6.3 Water provided for fire systems should be potable or Class A recycled water and should be salt free, due to the production of dioxins. [Bibliography Ref 7.5]

4.7 Site Containment of Contaminated Firewater, oil and liquid by-products of combustion

4.7.1 An impervious layer should be applied to sites with pervious soil. [Bibliography Ref 7.11]

4.7.2 Bund walls or catchment pits should be provided to contain surface run off from the site during fire fighting activities. The containment capacity should be determined as part of the site fire risk assessment and in conjunction with the responding fire service. Note that the required containment capacity is likely to exceed that required by EPA Bund Guideline, Bibliography Ref 7.11.

4.7.3 Emergency response procedures developed by the operator should include the use of excavation equipment such as bulldozers, excavators, etc, to separate unburnt tyres from the burning pile and to build containment berms and oil run off ponds.

4.7 Access for fire brigade appliances

4.7.1 Access for emergency vehicles should be provided as detailed in Fire Services Safety Guidelines. [References 7.6 and 7.7]

4.7.2 Large sites should have at least two separate and opposing entry points for fire appliance access.

5. Fire Risk Assessment

5.1 The fire risk assessment should be performed in consultation with the relevant fire authority. The fire risk assessment should also be performed in consultation with appropriately qualified and / or experienced consultants

5.2 The fire risk assessment will determine all fire hazards at the site, determine the likelihood that a fire will occur, then determine the consequences of the nominated fire incidents, in terms of life safety, property protection and the environment.

5.3 The fire risk assessment will determine all the resources and equipment required to manage the consequences of the identified fire scenarios.

5.4 It is expected that, depending on site conditions, equipment available, emergency response procedures, available staff and level of training, etc, the fire risk assessment may require appropriate fire modelling and emission and dispersion modelling to determine possible off site extents of toxic products of combustion.

6. Emergency Preparedness

6.1 Emergency Plan

6.1.1 Operators should develop and document an emergency plan which includes all the matters contained in Appendix 2, which has been developed with reference to Bibliography Ref 7.8. The emergency plan should be prepared in consultation with the responding fire service.

6.1.2 It is recommended that operators develop and document a tactical fire plan for the site that includes:

- Location of fire hydrants, boosters, fire service tapping(s), fire pumps, static water tanks, etc.
- Location of all first aid fire fighting equipment, including the location and quantity of stocks of Class A and Class B foam concentrate held
- Fire fighting actions appropriate to the site
- Control of fire fighting run off
- Location of drains, isolation valves, etc
- Location of access points to the site
- Location of hazardous materials or dangerous goods stored on site
- Deployment procedures for excavating equipment, operators, etc.

6.2 Emergency Procedures

6.2.1 Emergency procedures should be developed to cover all foreseeable emergencies for the site.

6.2.2 The emergency procedures should include, as a minimum:

- The means of raising the alarm
- Contact details of the emergency services, the EPA, etc.
- Actions to be taken by employees in the event of an emergency
- Deployment procedures for excavating equipment, operators, etc.
- The operator's expectation of actions by the Fire Services

6.2.3 Emergency response procedures developed by the operator should include the use of excavation equipment such as bulldozers, excavators, etc, to separate unburnt tyres from the burning pile and to build containment berms and oil run off ponds.

6.3 Emergency Equipment

6.3.1 The operator should determine equipment required to contain and manage emergency incidents. For outdoor tyre storage sites this would include equipment such as bulldozers, excavators, tracked loaders, etc., which are required to separate unburnt tyres from the burning pile, and to build containment berms and oil run off ponds. Guidance is provided in Bibliography Ref 7.2.

6.3.2 For equipment that is not always available on site, appropriate arrangements should be in place with equipment suppliers and equipment operators, with deployment procedures developed.

6.3.3 Operators of excavation equipment should be trained in the use of Self Contained Breathing Apparatus (SCBA), and operators should ensure that sufficient SCBA equipment is available and maintained at all times. Fire Services personnel will not operate on-site excavation equipment, or provide PPE for site equipment operators.

6.3.4 All staff, including equipment providers and operators, should be appropriately trained in the site emergency plan and emergency response procedures.

7. Bibliography

Reference has been made to the following documents in preparation of this guideline:

7.1 Draft *Fire Services Guideline – Indoor Storage of New or Used Tyres* 2014

7.2 Special Report: Scrap and Shredded Tire Fires, US Fire Administration/Technical Report Series, USFA-TR-093/December 1998

7.3 FM Global Property Loss Data Sheet 8-3, Rubber Tire Storage, January 2009.

7.4 AS2419.1-2005 Fire Hydrant Systems – System Design, Installation and Commissioning

7.5 Fire Safety for Tyre Sites, Home Office/The Scottish Office, 1995

7.6 CFA Guidelines for Subdivision Planning, available at http://www.cfa.vic.gov.au/plan-prepare/subdivision/

7.7 MFB Guideline GL-13, Hardstand and Emergency Vehicle Access for Fighting Appliances, 12 August 2008, and MFB Guideline GL-27, Planning Guidelines for Emergency Vehicle Access and Minimum Water Supplies within the Metropolitan Fire District, 14 April 2009 (available at http://www.mfb.vic.gov.au/Community-Safety/Workplace/Fire-Safety-Guidelines.html)

7.8 Dangerous Goods Act 1985, Code of Practice for the Storage and Handling of Dangerous Goods, 2013, WorkSafe Victoria

7.9 GL 013, General Guidelines for the Outdoor Storage of Used Tyres, Amendment A, 28 December 2005, South Australian Fire Services

7.10 Policy No 2, Guidelines for Bulk Storage of Rubber Tyres, Version 1.01, 21 April 2008, Structural Fire Safety Unit, NSW Fire Brigades

7.11 Bund Guideline, EPA Publication Number 347, December 1992 (available at www.epa.vic.gov.au)

7.12 National Construction Code Series, Volume 1, Building Code of Australia, Class 2 to Class 9 Buildings

Appendix 1 TYRE PRODUCT COMBUSTION STAGES CHRONOLOGY, from Bibliography Ref 7.2

Stages of Tyre Combustion	Time	Whole Tyre Fire Progress	Shredded Tyres	Action
Ignition/Propagation Stage	0 to 5 minutes	Active tyre burning of individual tyres but has not extended to the entire pile.	Tyre shreds are readily ignited and involve the entire pile quickly.	Early extinguishment with water, class A foam or wetting agents may be possible.
	15 to 30 minutes	Once the fire extends to the pile, the flame spread is two square feet every five minutes	Fire spreads along the surface of the pile very quickly.	Separate unburned tyre/product from the burning pile, downwind first
Compression Stage	30 to 60 minutes	The top layers of the tyres will collapse on themselves. The visible flaming is reduced. The fire then is seated deep in the pile.	Burns like coal pile with hot coal bed in center and a clay-like ash crust on top of pile.	Focus efforts on separation; build containment berms and oil run-off collection ponds.
Equilibrium/Pyrolysis and Smouldering Stages	60 minutes and beyond	Fuel consumption and heat production equalizes. Combustion is efficiently producing sufficient heat to consume most combustion products. Downward pres-sure of the encompassing pile causes the run-off oil flow to increase.	Clay-like ash crust protects burning core from water stream penetration.	Contain fire spread. Contain run-off oil. Option 1 – using the excavator separate burning debris into manageable piles and extinguish with fog streams. Option 2 – allow tyre/product fire to burn until the pile can be buried.

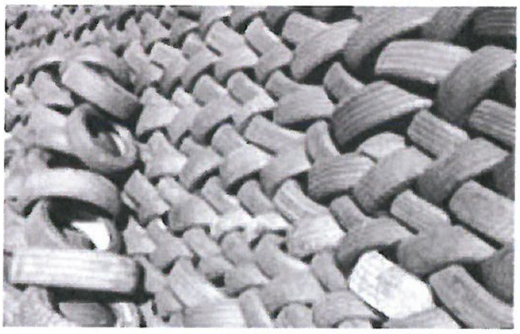
Appendix 2 Emergency Plan Content [Bibliography Ref 7.8] – The Emergency Plan should include the following:

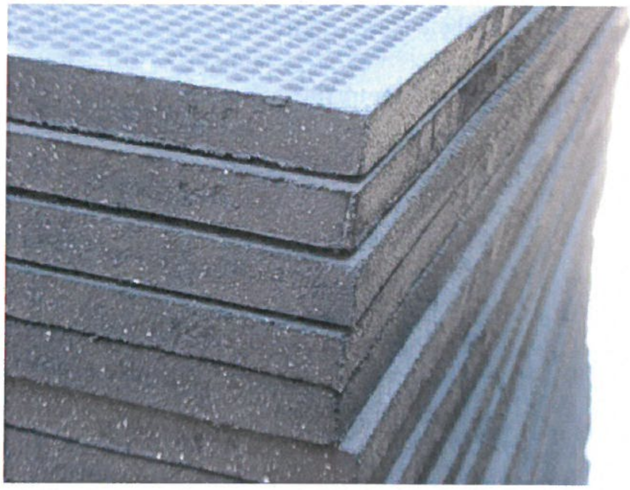
1	Name, location, postal address and nature of operations
2	Detailed map of the facility and surrounding area detail
3	Inventory of stored materials
4	Min & Max number of persons expected at the facility
5	Infrastructure likely to be affected by an incident and details of possible off site impacts on neighbours, including residential, commercial and industrial premises
6	Emergency Planning assumptions
7	Description of measures to control the consequences of each hazard and major incident
8	Details of emergency contact personnel
9	Allocation of personnel for implementing the plan
10	Arrangements for mutual aid between adjacent facilities
11	Procedures for early warning to the emergency services of an incident
12	Details of on-site and off-site warning systems
13	Contact details for emergency services
14	Details of on-site communication systems
15	Details of emergency resources on site
16	Arrangement for obtaining additional external resources
17	Procedures for safe evacuation and muster of personnel
18	Details of control points and procedures for essential services
19	Procedures for containment of any incident
20	Procedures for decontamination following an incident

Institute of Scrap Recycling Industries, Inc.

Voice of the Recycling Industry

Carbon Footprint of USA Rubber Tire Recycling 2007





November 2009

The Institute for Environmental Research and Education

IERE

Institute for Environmental Research & Education

Executive Summary

The Institute of the Scrap Recycling Industries retained the Institute for Environmental Research and Education to perform a carbon footprint of rubber recycling. The analysis was performed in conformance with applicable international standards for life cycle assessment and carbon footprinting. Approximately 16 percent of the USA tire recycling industry was analyzed. The study found:

- The weighted average carbon footprint was 124 kilograms of CO_2 equivalent per metric ton of materials recycled back into commerce.
- The mean carbon footprint was 153 ± 92 kilograms of CO_2 equivalent per metric ton of material recycled. Larger tire recycling facilities tended to have lower carbon footprints than smaller tire recycling facilities.
- The use of recycled rubber in molded products provides a substantial carbon footprint advantage over the use of virgin plastic resins, having between four and 20 times lower carbon footprint.
- When used in road surfaces, recycled rubber had between three and seven times lower carbon footprint than asphalt on a materials basis.
- The carbon footprint was dominated by the processing of the tires followed by transport of the used tires to the processing facility.
- Electricity was the largest source of the carbon footprint, followed by the use of diesel fuel.
- When used in energy recovery, recycled rubber tires provided about a 20 percent carbon footprint advantage over coal, but tires had substantially more carbon emissions than other fossil fuels.

The upstream carbon footprint for the production of asphalt is 840 kgCO_2e per metric ton. In comparison, the carbon footprint for recycling tires is 124 kgCO_2e per metric ton. This reuse of rubber tires in roads is clearly highly favorable from a climate change perspective.

In summary, the reuse of rubber products from used tires has the potential to make a substantial contribution to reducing carbon emissions.

Rubber Tire Recycling Carbon Footprint

The Rubber tire recycling industry recycled almost 80% of the total production of rubber tires in the United States in 2007.[1] Most often, the tires were used for energy reclaim, but the rubber was also used in a diversity of products, as shown in the table below[2]

Rubber Tire End of Life North America 2007			
	million tires	million lbs	Percent
Fuel Markets Total	***133***	***2657***	***44***
Cement Kilns	56	1,119	19
Pulp & Paper Mills	33	661	11
Industrial Boiler	36	709	12
Tire-to-Energy Plants	7.5	150	2.5
Electric Arc Furnaces	0.9	18	0.3
Landfill	***65***	***1,292***	***22***
Crumb Rubber Total	***52***	***1029***	***17***
Molded Products	16.6	332	5.5
Surfacing/Ground Cover	14.8	295	4.9
Asphalt Modifications	9.3	185	3.1
Tires/Automotive	5.4	108	1.8
Animal Bedding	2.1	42	0.7
Plastic Blends	1.6	32	0.5
Surface Modification/Reclaim	1.5	30	0.5
Other Crumb Rubber	0.3	5	0.1
Civil Engineering Use	***42***	***839***	***14***
Export	***7***	***140***	***2***
Agriculture/Miscellaneous	***2***	***40***	***0.7***

A study by ICF (2006) calculated the greenhouse gas emissions saved by the recycling and energy recovery of rubber tires, by comparing the emissions with the fuels they displace. They concluded that there is a small greenhouse gas savings when rubber tires are recycled. However, this analysis did not collect primary data about the greenhouse gas emissions of the recycling process itself, assuming it to be negligible.

The Institute of the Scrap Recycling Industries retained IERE (the Institute for Environmental Research and Education) to calculate the carbon footprint of rubber tire recycling in order to have accurate publishable data on the US tire recycling industry.

Scoping

The goal of this study is to provide credible carbon footprint data on rubber tire recycling in the United States. The audience for the study is the ISRI membership, state, local and national public officials and members of the media. No comparative assertions are intended.

IERE performed this study in conformance with the ISO 14040 and ISO 14044 standards on life cycle assessment and the British Standards Institute PAS 2050[3] standard on Carbon Footprinting. Details of the scoping can be seen in the appendix.

Figure 1 System for Rubber Tire Recycling

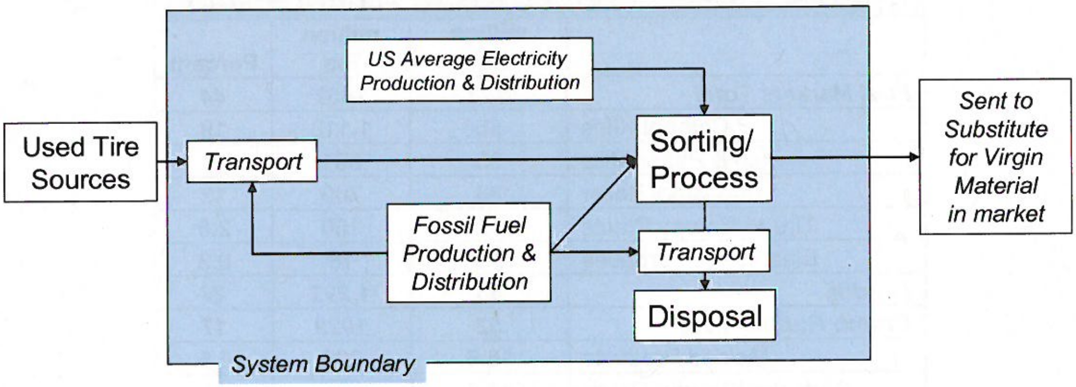


Figure 1 shows the rubber recycling system that was analyzed. The system starts at the point at which the rubber tires are discarded and ends at the facility gate where the material enters commerce as a substitute for virgin material. All upstream greenhouse gas emissions for the production and distribution of fossil fuels and of electricity are included. The US average 2007 grid is the basis of the calculation.

The functional unit chosen was one ton of material sold. Thus the emissions related to disposal were allocated on a mass basis to the material entering commerce. All allocations were based on mass. Emissions of gases at the landfill were assumed to be zero, per the US EPA WAste Reduction Model[4] (WARM).

Data Sources and Collection

The data was collected from eight separate locations throughout the United States, and represented five different recycling companies, all members of ISRI. This sample size was chosen to represent a sample likely to be able to distinguish between the sample mean and the mean carbon footprint of another material that was at least a factor of two different with 95% confidence.

The data cover the calendar year 2007. Participants in the study provided data on energy use for transport to the facility, within the facility and transport to the landfill, as well as information about the amount of material received, recycled (sold) and disposed.

Background data sources include the US LCI Database[5], data from GREET 1.7[6] and data from the Energy Information Agency[7].

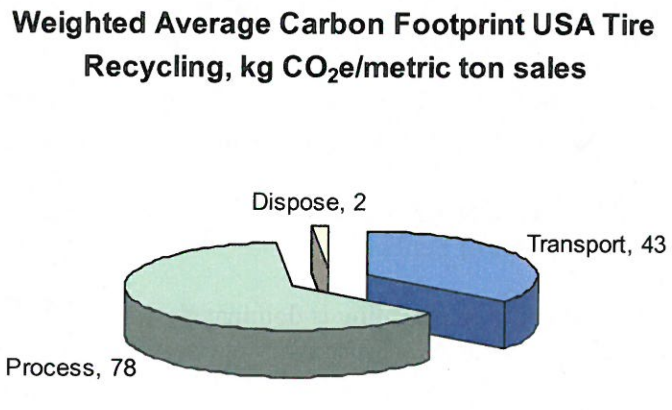
Impact Assessment

The carbon footprints were expressed as 100-year horizon CO_2 equivalents based on the most recent guidance from the Intergovernmental Panel on Climate Change (IPCC).[8] This is the model recommended in PAS 2050.

Results

The sample weighted average carbon emissions for recycling scrap tires was 124 kg CO_2 equivalents per ton sold. The sample mean and standard deviations were 153 $\pm$ 92 kg CO_2 per metric ton sold (N = 8). Most of the greenhouse gas emissions occur during the processing of the tires, although a significant amount of emissions are due to transport of the tires to the facility. A small amount of emissions come from the transport to landfill of tires, as can be seen in Figure 2 and Table 1 below.

Figure 2 Unit Process Sources of Greenhouse Gases in Tire Recycling



This weighted average represents 16% of the total tire recycling industry in the USA.

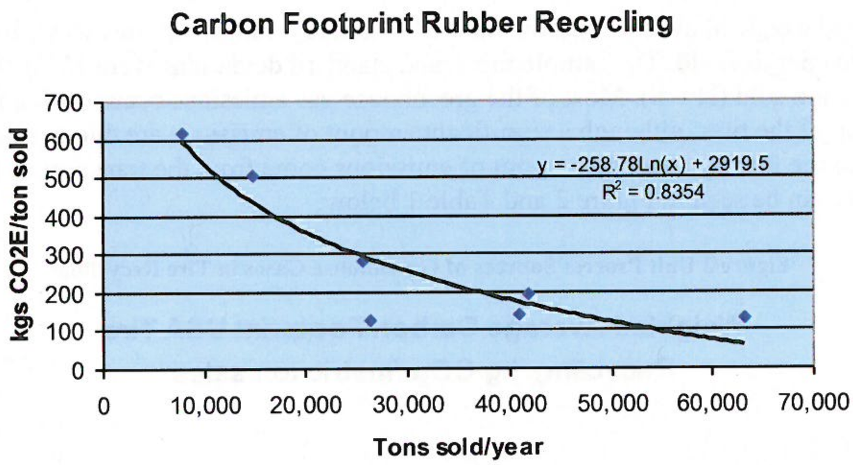
During recycling tires are processed and different components separated for recycle. Typically crumb rubber of different sizes, steel wire and fiber are the products created. Approximately 33 percent of the mass taken in for recycling eventually was landfilled, either at a commercial landfill or on site, but the variability of disposal by site was very large, ranging from two to 50 percent. In general, portions of the tire for which no markets existed at the time of the processing were landfilled. On occasion, entire tires were landfilled due to lack of markets, but this was the exception, not the rule.

Table 1 Mean and Standard Deviations of the Tire Recycling Unit Processes

	Transport	Process	Dispose	Total
Mean	48	103	2	153
SD	17	98	2	92

There was a wide range of values for the carbon footprint of tire recycling, from 87 to 341 kg CO_2e per ton recycled. There was a correlation of carbon footprint to the size of the facility doing the recycling, with larger facilities being more energy efficient. Figure 3 below shows this trend*. Note that any improvements in efficiency decrease rapidly above 30,000 tons sold per year.

Figure 3 Effect of Scale on Tire Recycling Carbon Footprints



Similar kinds of results of eco-efficiency as a function of size have been observed elsewhere, notably in the works of Schlich.[9]

The carbon footprint of rubber tire recycling is dominated by the electricity used in processing, followed by the use of diesel, primarily in transport.

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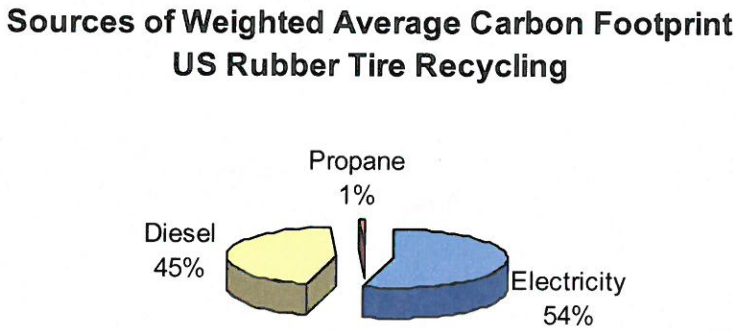
* A single outlier was removed from this graph.

Figure 4 Fuel sources of rubber tire recycling



Comparison with Other Studies and Materials

Ideally, one would like recycled materials to be recycled in closed loops, so that the same materials can be used over and over for the same purposes. However, this is not always possible and in many cases it is not desirable. In the case of rubber tires, a certain proportion of the used tires are re-used or re-treaded for an extended life, but this represents only about two percent of the total market. The rubber from tires is typically not returned to the tire market, but finds use in many other applications.

Energy

The most common use of recycled tires is as an energy source. In order to compare the carbon footprints of different uses, we have modeled the life cycle emissions of greenhouse gasses of fossil fuel used to make electricity and compared that to the creation of electricity from used tires, using the following assumptions:

1) Electricity production was based on the US average grid in 2007, per the Energy Information Agency (including 8% line losses)
2) Data from GREET was used to model the greenhouse gas emissions on a life cycle basis
3) We assumed that only the rubber portion of the tire was burned, and that typical heat values for rubber were appropriate (i.e. 15,000 btu/lb)[10]
4) The recycled rubber was 95% hydrocarbon, and the remaining 5% on combustion did not recreate greenhouse gases.
5) Efficiency at the plant was 30% (2908 kWh/ton rubber)
6) Transport distance to the power plant from the tire recycling facility was 50 miles via 20-ton truck.

Modeling the energy use as electricity generation implies the highest value energy, but not the highest energy recovery. However, the relative greenhouse gas emissions of the different fuels will increase or decrease in lockstep in different energy recovery systems and so any conclusions based on electricity generation will have general applicability.

Table 2 Carbon Footprint of Fossil Fuels

Energy Source	Grams CO_2 Equivalents/kWh
Coal	1,300
Gas	450
Nuclear	16
Recycled Rubber	1,072

As Table 2 shows, energy from recycled rubber has a lower overall carbon footprint than coal, but higher than all other fossil fuel resources. In the USA, about half of the electricity is generated from coal, so there is some scope for rubber tires to decrease the overall carbon emissions of the nation.

Asphalt

We also looked at the carbon footprint of asphalt, for recycled tires are increasingly being used to displace a portion of the asphalt in rubberized asphalt mix roads. The upstream carbon footprint for the production of asphalt is 840 $kgCO_2e$ per metric ton. In comparison, the weighted average carbon footprint for recycling tires is 124 $kgCO_2e$ per metric ton. This reuse of rubber tires in roads is clearly highly favorable from a climate change perspective, creating almost 7 times less carbon emissions than asphalt.

Rubber is not simply a passive replacement material in asphalt roads: road surfaces made from rubberized asphalt are typically half the thickness of conventional asphalt roads[11]. This provides additional potential improvement in the carbon footprint, but was not evaluated in this study. Using recycled rubber in asphalt in roads also has the potential to reduce the rolling resistance of tires, thus reducing the energy consumption of all vehicles using the road[12,13]. This is likely to be a much more important source of carbon reduction than simple displacement of the upstream asphalt emissions as calculated here.

Molded and Plastic Products

Recycled rubber is also being used in molded products. Here the material can be used to substitute for virgin plastic or as a filler.

The American Chemistry Council has recently performed life cycle assessments of the US average resin production.[14] The table below shows the cradle-to-gate carbon footprints for some of the more common plastic resins.

Table 3 Carbon Footprint of Virgin Resins

Virgin Plastic Resins	
Resin	**kg CO_2e/metric ton**
Low Density Polyethylene	1,477
Linear Low-density Polyethylene	1,479
Polypropylene	1,373
Polyethyl Terephthalate	2,538
General Purpose Polystyrene	2,763

Here again, the recycled rubber product is preferable from a climate change perspective. The carbon footprint of recycled rubber is between four and 20 times lower than the carbon footprint of virgin resins.

Conclusions

The carbon footprint of USA rubber tire recycling in 2007 was 153 $\pm$ 92 kilograms of CO_2 equivalent per metric ton of material recycled. The weighted average carbon footprint was 124 kilograms of CO_2 equivalent per metric ton of material recycled. The footprint is dominated by the electricity use in the processing facilities, followed by the diesel use for transport to the facilities. As the USA electric grid becomes greener, the carbon footprint of the recycling facilities will decrease even in the absence of internal rocess improvement.

Larger tire recycling facilities tended to have lower overall greenhouse gas emissions, and this implies that consolidation in the industry will tend to have a beneficial effect on the environment, although this effect is small above a modest operations size of 30,000 metric tons of material sold per year.

As noted above, about 80% of all rubber tires were recycled in 2007. About a third of the total mass of tires sent to recycling facilities ends up in a landfill, but the range in the different operations is from 2 to 50 percent. This implies that the markets for the recycled products are not fully developed, and there is a substantial scope for growth in the recycled rubber markets.

The carbon footprint of tire recycling is relatively low when compared to that of most virgin materials for which it can substitute. These applications, e.g. asphalt displacement or use in molded or plastic products, appear to offer the largest opportunity for the recycled tire industry to provide a real reduction in greenhouse gas emissions. In some cases carbon footprint reductions of up to 95% are possible. There are about 53 million tons of plastic resins produced annually in North America[15], and globally, a total of 23 million tons of rubber annually[16]. The opportunities for recycling are clear.

In contrast, the only fossil fuel that has a higher carbon footprint than recycled tires is coal. The industry is trying to move away from energy recovery as a use for tires, and this trend should be encouraged.

Perhaps the most interesting growth opportunity for the industry is the increased use of recycled rubber in asphalt mixes. In the USA about 70 Billion lbs (over 30 million metric tons) of asphalt is used annually [17]This is much more than the approximately 2 million tons of tires recycled annually, so it is unlikely that recycling tires will ever replace more than a fraction of the asphalt used in roads. Nevertheless, use of recycled rubber in key high-traffic locations may have a substantial positive environmental impact through reduced fuel use. Further studies could be useful in indentifying the best applications of this technology.

Appendix A. Scoping of the Rubber Tire Recycling Carbon Footprint Project

Required Point for ISO 14040/44	Scoping Decisions
The intended application 14040: 5.2.1.1; 14044:4.2.2	Develop Carbon footprinting of rubber material recycling in the USA: as a first step towards a more comprehensive LCA
The reasons for carrying out the study 14040:5.2.1.1; 14044:4.2.2	To provide credible information for the members of ISRI in policy discussions.
The intended audience, i.e. to whom the results of the study are intended to be communicated 14040: 5.2.1.1; 14044:4.2.2	ISRI members; state, local and national public officials; media
Whether the results are intended to be used in comparative assertions intended to be disclosed to the public. 14040:1.2.1.1; 14044:4.2.2	No comparative assertions are intended.
Product system to be studied 14040:5.2.1.2; 14044:4.2.3.1	Recycling of rubber tires
Functions of the product system 14040: 5.2.1.2; 14044:4.2.3.1	Substitutes for virgin material in commerce
Functional unit 14040: 5.2.1.2; 14040:5.2.2; 14044:4.2.3.1; 14044:4.2.3.2	Tons of recycled material
System boundary 14040: 5.2.1.2; 14040:5.2.3; 14044:4.2.3.1; 14044: 4.2.3.3.1	From the point where the decision to recycle is made to the point where the recycled material substitutes for virgin material in commerce.
Unit Process Descriptions 14044: 4.2.3.3.2	Includes collection, transport, sorting/grading/cleaning, processing & disposal
Allocation procedures 14040: 5.2.1.2; 14040:5.3.4; 14044:4.2.3.1	Allocation via mass allocation.
Impact categories selected and methodology of impact assessment, and subsequent interpretation to be used; 14040: 5.2.1.2; 14044:4.2.3.1; 14044:4.2.3.4;	**Impact Category** / **Model** climate change / IPCC 2007 factors, 100 year horizon
Interpretation 14040: 5.2.1.2; 14044:4.2.3.1	Data should be compared relative to published virgin material LCAs
Types and sources of Data 14044:4.2.3.5	Where possible, US LCI database, otherwise the Ecoinvent database.
Data quality requirements 14040: 5.2.1.2; 14044:4.2.3.1; 14044: 4.2.3.6.2	
age	No data over five years old, unless it can be documented that the unit process has not changed.
geography	USA
	Cutoff values: 97% of the mass and energy in the system
technology coverage	Addressed statistically
precision:	Addressed statistically
industry coverage	Statistically valid sampling of all relevant unit processes for packages where the final conversion step is in the USA or Canada

Required Point for ISO 14040/44	Scoping Decisions
representativeness	Data collected over January to December 2007
reproducibility	Reported on statistical sampling
sources of the data	Primary data or peer-reviewed published data preferred. US LCI Database backed by the Eco-invent Database
uncertainty of the information	Reported in mean, standard deviation, number of samples and tests of normality
Assumptions: 14040: 5.2.1.2; 14044:4.2.3.1	Material sent to landfill is inert, per the US EPA WARM Model
Value Choices: 14044:4.2.3.1	Focus is on climate change; international activities ignored
Limitations 14040: 5.2.1.2; 14044:4.2.3.1; 14044:4.2.3.1	Analysis is based on industry averages in the USA only
Initial data quality requirements 14040:5.2.1.2; 14044:4.2.3.1	Data no more than 5 years old; published peer-reviewed data where possible, data sets where not possible: sources should be disclosed.
Type of critical review, if any 14040:5.2.1.2; 14044:4.2.3.1; 14044: 4.2.3.8	Per ISO 14040:7.3.3, at least a 3-person review panel
Type and format of the report required for the study 14040:5.2.1.2; 14044:4.2.3.1	A single report for all recycled materials
	Where possible, Data from the US LCI database should be used.
	Reports should be in metric units.

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