National Solid Waste Management Department
Ministry of Housing and Local Government

A Study on Scrap Tyres Management for Peninsular Malaysia

Final Report

Date: September 2011

Prepared By:

Chemsain Konsultant Sdn Bhd (130904U)
No. 41, 1st Floor, Jalan USJ 10/1D, UEP Subang Jaya, Selangor, Malaysia
Tel: 03-56370163 Fax: 03-56370385 Email: consult@chemsain.com
OFFICES: KUCHING, SIBU, BINTULU, MIRI, KOTA KINABALU, LABUAN FT, BRUNEI

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Tel: 03-56370163 Fax: 03-56370385 Email: consult@chemsain.com

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LIST OF ABBREVIATIONS

Abbreviations	Descriptions
<	Less than
>	More than
Act 127	Environmental Quality Act, 1974
Act 672	Solid Waste and Public Cleansing Management Act 2007
Act 673	Solid Waste and Public Cleansing Management Corporation Act 2007
AFTA	Asean Free Trade Area
AP	Import License administered by MITI
Customs	The Royal Malaysian Customs Department of Malaysia
DANIDA	Danish International Development Agency
DOE	Department of Environment (DOE) Malaysia
DOT	Department of Transport, Malaysia
EIA	Environmental Impacts Assessment
ELT	End of life tyre
FMM	Federation of Malaysian Manufacturer
GIS	Geo-spatial Information System
GTFS	Green Technology Financing Scheme
JPJ	Department of Road Transport (Jabatan Pengangkutan Jalan)
KeTTHA	Ministry of Energy, Green Technology and Water, Malaysia
Kg	kilogram
km	kilometer
LGM	Malaysian Rubber Board (Lembaga Getah Malaysia)
MRB	Malaysian Rubber Board
MATRDS	Malaysian Association of Tyre Retreaders and Dealers Society
MDK	Kampar District Council
MDP	Pekan District Council
MHLG	Ministry of Housing and Local Government
MIDA	Malaysian Industrial Development Authority
MITI	Ministry of International Trade and Industry
MPK	Kangar Municipal Council
MPK	Kuantan Municipal Council
MPKB	Kota Bharu Municipal Council

Abbreviations	Descriptions
MPPP	Pulau Pinang Municipal Council
MPV	Multi-Purpose Vehicle
NSWMD	National Solid Waste Management Department, Malaysia
PPSPPA	Solid Waste and Public Cleansing Management Corporation (Perbadanan Pengurusan Sisa Pepejal dan Pembersihan Awam)
PWD	Public Works Department, Malaysia
RM	Ringgit Malaysia
SIRIM	Standards and Industrial Research Institute of Malaysia
SUV	Sport Utility Vehicle
SWMC	Solid Waste Management Component
SWPCMC	Solid Waste and Public Cleansing Management Corporation
T	Tonnes Metric
TDF	Tyre derived fuel
TDP	Tyre derived product
TOR	Terms of Reference for Scrap Tyre Study in Peninsula Malaysia
TR	Tyre Recycler

1 INTRODUCTION

1.1 Background and Statement of Needs

The scheduled implementation of Act 672, the Solid Waste and Public Cleansing Management Act 2007 (referred to as "The Act" hereafter) on 1st September 2011[1], shall herald a new beginning in Malaysia, in the provision of a holistic regulatory and operational framework for the management of solid waste. The Act shall provide the Government a platform to set up specific waste logistics, management and incentive systems to encourage not only a systematic and waste management best practices, but also the reuse, recycling and recovery of waste materials.

The Act adopts a comprehensive approach in ensuring that there are means and regulatory provisions for the proper and legal management of all varying types and classification of wastes in Malaysia. This also includes the management of special solid waste which is described in the Act as;

"...any kind of controlled solid waste as may be prescribed which

(a) is or may be dangerous to public health; or
(b) is difficult to treat, keep or dispose of,

that special provisions are required to deal with it."

Scrap tyres (using the term that was used in the Terms of Reference (TOR) document for this study) are one of those types of solid wastes that can be classified as special solid waste, as scrap tyres are not included in any way specifically by the Act or any other regulatory provisions on solid waste.

A study on scrap tyre management, the Terms of Reference (TOR) of which is attached as **Appendix A** in this report, was commissioned by the National Solid Waste Management Department (NSWMD), Ministry of Housing and Local Government Malaysia. The study seeks to set the baseline, framework and basis for future management of scrap tyres.

Chemsain Konsultant Sdn. Bhd. is the consultant appointed by NSWMD vide their acceptance letter dated 4th January 2011 referenced KPKT/NSWMD/(S)800/2/2/1(59). The approval letter is attached to this report in **Appendix B**.

The study on scrap tyre management in the Peninsula Malaysia (the Study) commenced on 7th March 2011 carried out over 4 calendar months from the date of commencement until 7th July 2011.

[1] *BERNAMA, 2nd July 2011. At the time of printing, the Act has been officially implemented.*

1.2 Steering Committee and Study Team

1.2.1 Steering Committee

A Steering Committee of the Study has been set up by the National Solid Waste Management Department, Ministry of Housing and Local Government and chaired by the Director General of NSWMD.

The members of the steering committee are as follows;

i. The National Solid Waste Management Department (NSWMD)
ii. The Solid Waste and Public Cleansing Management Corporation (SWPCMC)
iii. The Department of Environment (DOE)
iv. The Department of Transport (DOT)
v. The Royal Malaysian Customs Department (RMC)
vi. The Ministry of International Trade and Industry (MITI)

1.2.2 Study Team

The study team comprised of the following:

Consultant : Chemsain Konsultant Sdn. Bhd.

Address : 47 Wisma Ko Perkasa, Jalan Simpang Tiga, 93350 Kuching
Sarawak Malaysia
Tel :082 422736 Fax: 082 415506

The team members of the study team are tabulated in **Table 1** below:

Table 1 : The team members for the study on scrap tyre management in Peninsula Malaysia

	Contribution	Personnel
Professional	Project Director / Waste Treatment Technology	Mohammad Bin Siphon
	Project Coordinator	Edward Yap
	Environmental Management Planning	Ir Brian Chong
	Legal & Institutional	Lina Chan
	Economic Analyst	Edward Yap
	Data Inventory - Production & Reuse	Henry Sebastian
	Data Inventory – Treatment & Disposal	Foong Poh Hing
	Mapping / GIS	Bernard Chong
Sub-Professional	Leader – production & Reuse	Zurida Razak
	Leader – Recycling & Disposal	Mazura Murat
	Asst. – Production & Reuse	Nazari Zakaria
	Asst. – Recycling & Disposal	Mohd Azul Hisham Makri
	Draughtsman/GIS	Rosman Muhammad
	Clerical / Secretarial	Nurul Aishah Zon

The organization chart of the consultant team is shown in **Appendix C** of this report.

2 OBJECTIVES

2.1 Objectives of The Study

Main Objective

The main overall objective of this study is to provide the Malaysian Government with sufficient background information and recommendations for a decision to establish a collection and treatment system for scrap tyres for Peninsular Malaysia.

Specific Objectives

Within this overall objective, the more specific objectives are as follow:

(i) To update the existing inventory of scrap tyre generation in peninsular Malaysia

(ii) To determine the legal and administrative system required to direct the flow of scrap tyres towards approved recycling facilities and to identify and propose such systems for directing the flow

(iii) To explore the options for scrap tyres recycling in Peninsular Malaysia, to specify the advantages and disadvantages of the different recycling systems and to propose future recycling option(s)

(iv) To analyse the market for products from recycled scrap tyres from different recycling systems

(v) To analyse the need for adding an economic incentive system to the legal and administrative systems to direct the flow of scrap tyres towards the approved recycling and propose such system as required

(vi) To evaluate the impacts of issuing exclusive license for collection of scrap tyres on the market and proposed system

(vii) To propose the legal framework for the implementation of the system

(viii) To propose action plans to be carried out by all related organisations

3 SCRAP TYRE MANAGEMENT IN MALAYSIA; STATUS QUO

Enabling options in sustainable scrap tyres management in Malaysia need to consider a holistic approach that takes into account the stakeholders involved in both formal and informal market. In the absence of this holistic approach, a working scrap tyre management system may be challenged or fail eventually due to the interrupted linkages between the stakeholders.

Stakeholders in scrap tyre management can generally be categorized into the following groups:

(i) Governmental agencies
(ii) Tyre manufacturers
(iii) Tyre industry associations
(iv) Tyre businesses – service and repair centres
(v) Scrap tyre collectors, transporters and traders
(vi) Scrap tyre treatment and disposal companies or organizations

There are three primary influential factors in scrap tyre management in Malaysia.

(i) Availability of scrap tyres
(ii) Profitable economic instruments
(iii) Availability of capable institutions

Scrap tyre management in Malaysia today is generally ad-hoc, driven by economic incentives derived from specific commercial demands in the form of downstream products generated from the processing of the scrap tyres. The existing regulatory framework does not generally address the management of scrap tyres objectively except where scrap tyres are imported from foreign sources.

Scrap tyres reprocessing products are in the form of carbon blacks, secondary diesel fuel and waste metals. Scrap tyres calorific values potential however are mainly pursued by few in the cement industries, notably the large ones. Availability of scrap tyres from local sources is inconsistent and influenced by informal logistics (collection, transportation and distances covered) that are in turn responds towards the prevailing market values of scrap tyres downstream products.

3.1 Institutional Analysis[2]

Institutional analysis refers to the capacity determination of the various stakeholder organizations and institutions that are involved in the management of scrap tyres inventory. The analysis provides a detailed review and examination of the responsibilities, capabilities,

[2] *Activity 2 of TOR document*

facilities, strength and weaknesses, funding and present level co-operation and information exchange between the principal organizations, (in the case of government agencies) between the federal and state agencies currently involved in scrap tyres management in Malaysia. Acquisition of data for the institutional analyses was through a combination of site visits, interviews and discussions, email correspondences and desktop reviews. An overview and description of the roles of the various stakeholders are given below in **Table 2**.

Table 2 : List of primary stakeholders and their primary functions or roles

No.	Stakeholders	Function / Role
1.	Government Agencies	Institutional management of new and scrap tyres
2.	Tyre Manufacturer	Manufacturing plants that produces new tyres
3.	Tyre Importer	A person / company that bring in tyres from foreign country for use, sale, or re-export
4.	Tyre Distributor	Wholesaler who has exclusive rights to tyre market, within a given territory, selling and representing tyre goods of a particular tyre manufacturer or company
5.	Tyre Workshop	Provide various tyre services and the producers of scrap tyres as it is normal for customers to leave their waste tyres in the workshop after they have replaced their new tyres for the old ones. They might have their own transport to dispose of the scrap tyre or assign private tyre collectors
6.	Scrap tyre Collectors	Collect and transport waste tyres from workshops to recycling centres / retreaders / cement kilns
7.	Tyre Retreader	Specialised in retreading of scrap tyres
8.	Recycling Centres	-Recycling of waste tyres -Production of reclaimed rubber e.g. Shredding and granulation, recovery of rubber crumb / tiles - Pyrolysis waste tyre recycling facility - Carbon black manufacturing
9.	Cement Kilns	Cement industry uses waste tyres as supplementary fuel e.g. La Farge Cement Berhad
10.	Landfills / Dumpsites (legal)	A controlled tipping dump area or a sanitary landfill that accepts waste tyres for disposal. A tipping fee is normal charged for waste tyres, depending on the landfill

The institutional relationships between the various stakeholders of tyres and scrap tyre management in Malaysia is fairly differentiated except within the jurisdictions of the various government departments where there are presently a handful of government agencies that constitute part of the tyres and scrap tyres management chain. These are illustrated in **Figure 1** below while **Figure 2** shows the relationship between the various stakeholders in

tyres and scrap tyres management in Malaysia and the general flow of the two in the Malaysian market.

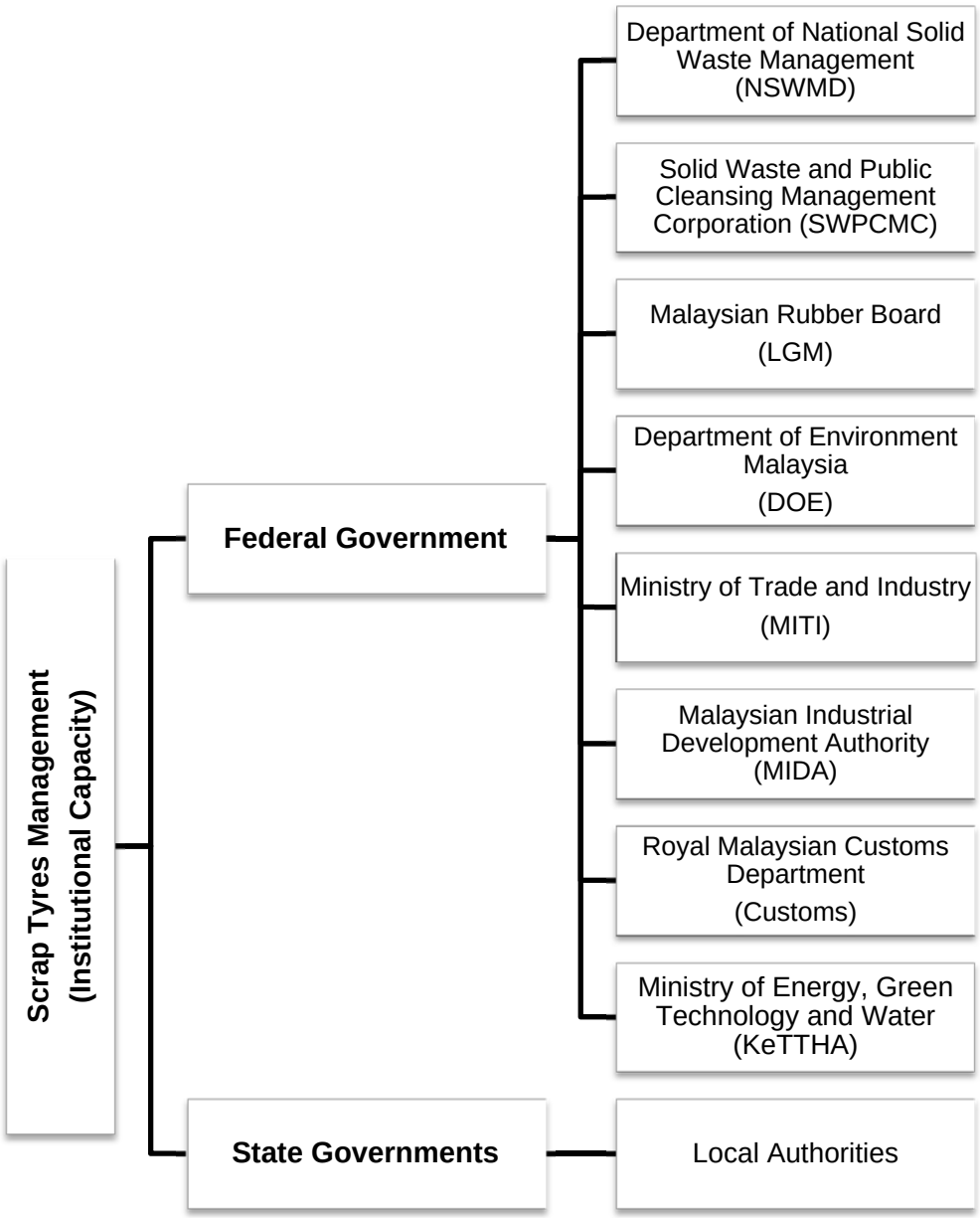


Figure 1 : Institutional Analysis of Scrap Tyre Management in Malaysia : Government Agencies

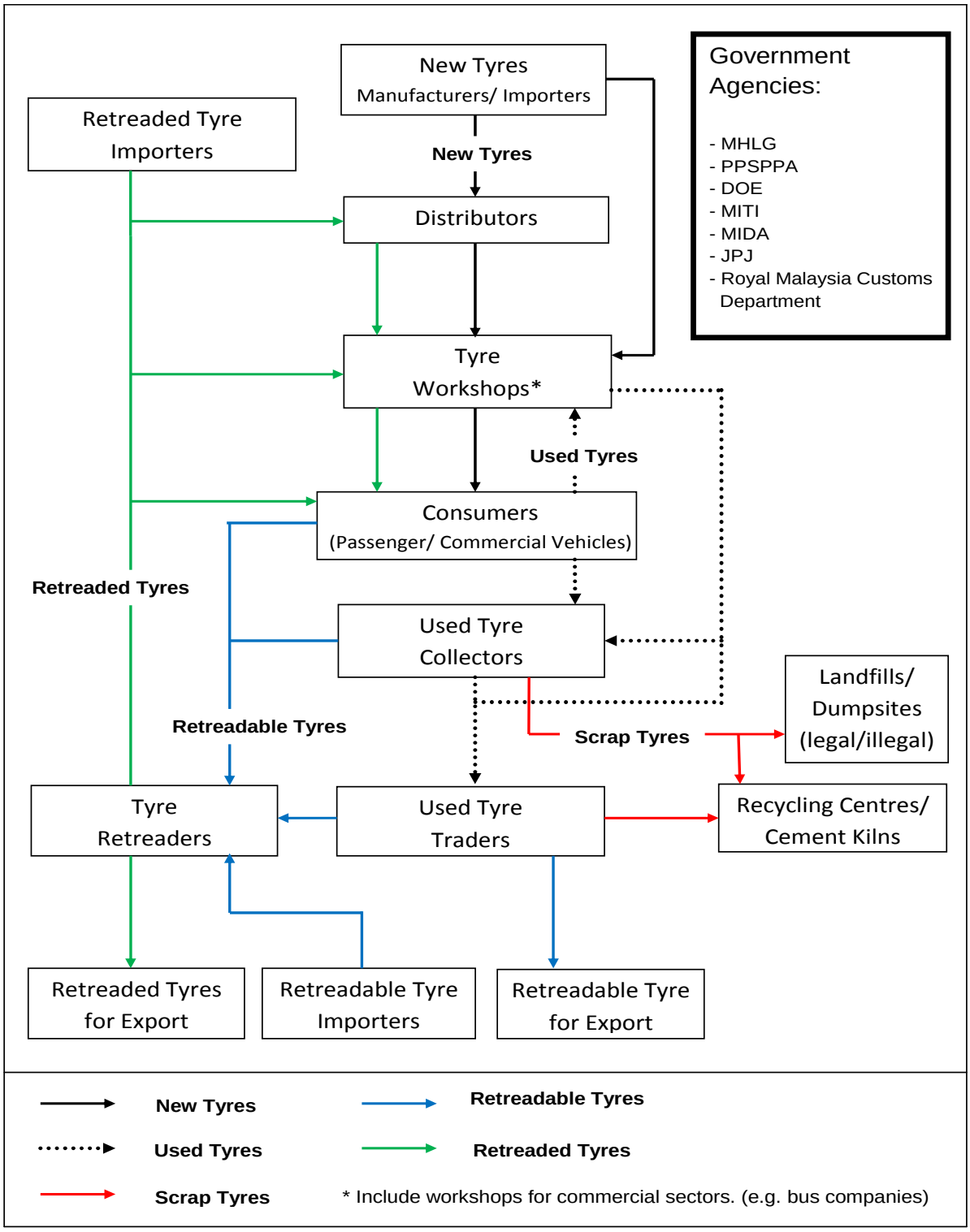


Figure 2: Material Flow of Scrap Tyres and Stakeholders Diagram

3.1.1 Government Agencies in Tyres and Scrap Tyres Management

3.1.1.1 Federal Level

A. National Solid Waste Management Department (NSWMD)

NSWMD is the primary regulatory agency on solid waste management in Malaysia. Under the Act, NSWMD has the various regulatory provisions in the management of any solid waste including controlled solid waste.

(i) To issue licenses
(ii) To impose charges, fees or levy
(iii) To enforce regulatory provisions
(iv) To reduce and recover controlled solid waste
.

Scrap tyre has not been defined specifically in Act 627 but is likely to be categorized as 'special solid wastes', collectively characterized by their difficultness in treatment, upkeep and storage or disposal that special provisions are required to deal with it.

By virtue of the various provisions in The Act, NSWMD does have the necessary capacity in setting up relevant policies, regulations and guidelines for scrap tyres management in Peninsula Malaysia.

B. Solid Waste and Public Cleansing Management Corporation (SWPCMC)

SWPCMC is the lead agency in the implementation of an integrated solid waste management in Malaysia. The Corporation was established under the Solid Waste and Public Cleansing Management Corporation Act 2007 (Act 673).The Corporation functions as the implementer of the systems and potentially they can be delegated the power to demand, collect and retain the controlled solid waste charges, fees or levy in respect of solid waste management services provided.

The Corporation has the following functions in relation to future scrap tyre management:

(i) To recommend policies, plans and strategies, including schemes in respect of solid waste management services and public cleansing management services to Federal Government.
(ii) To formulate and implement funding and cooperation programmes for the proper and effective performance of the functions of the Corporation.
(iii) To promote and stimulate the growth of the solid waste management and public cleansing management services by various means including arranging for the conduct of researches, assessments, studies and advisory services.

SWPCMC has set up offices in every States of the Peninsular Malaysia and can potentially play an important role to administer, implement and enforce the policies, regulations and guidelines for scrap tyres management. In addition, SWPCMC have sufficient workforce to implement the regulation on scrap tyre management in future. However, pending the enforcement of Act 627, at this moment the role of SWPCMC on scrap tyre is still limited.

C. Malaysian Rubber Board (LGM)

In ensuring a smooth and orderly development and progress of the rubber industry, the Malaysian Rubber Board issues licenses to monitor all business activities in the rubber industry.

Scrap tyre collectors are subjected to the use of a permit entitled "*Authorization Letter to Buy Scrap/ Waste Rubber Products*" issued by the Malaysian Rubber Board. This permit is also required by the scrap tyre treatment facilities. For instance, scrap tyre recyclers, reclaimed rubber producers and scrap tyre pyrolysis industry subjected to this permit.

Apart from that, these scrap tyre treatment facilities are also required to apply Licence Type C; "*Licence To Buy Rubber for The Manufacturer of Rubber Products*"[3]. The requirement for the application of License C is a minimum Paid-up Capital of RM20,000 depending on the factory size and product manufactured. In addition, proposed projects will be referred to the District Office/ Local Town Council/ Local Council, Health Department, Fire and Rescue Department and Department of Environment[4] for deliberation and approval.

D. Department of Environment (DOE)

The Department's main role is to prevent, control and abate pollution through the enforcement of the Environmental Quality Act 1974 (ECA 1974) (Act 127) and its 34 subsidiary legislation made thereunder. Under the EQA 1974, DOE is granted the power:

(i) To be the licensing authority of prescribed premises and activities.

(ii) To prohibit any form of open burning includes the burning of scrap tyres.

(iii) To prohibit use of any material and equipment or industrial plant within the areas specified in the order which capable of causing pollution.

(iv) To the establishment of environmental fund which operated as a Trust Account within the Federal Consolidated Fund for the purpose of recovering and dumping of waste.

(v) To compound any offences under this Act.

[3] *Communication with Mr. Jamal from the Registration and Licensing Unit and Mr. Kamarulzaman from the Enforcement Unit of Malaysian Rubber Board (LGM) on 25th April 2010.*

[4] *http://www.lgm.gov.my/LicenseCess/LicencesCessPage.aspx. Guidelines for Rubber Licenses, Malaysian Rubber Board.*

DOE is responsible for the approval of Environmental Impact Assessment (EIA) on Prescribed Activities (Waste Disposal and Sewerage). The regulation of prescribed activities includes the operation and maintenance of scrap tyres recycling and pyrolysis plants under the regulation of Environmental Quality Act, 1974. In addition, related factory permits involving air stack, fuel burning equipment and so forth is also under the purview of DOE.

E. Ministry of International Trade and Industry (MITI)

MITI plans, formulates and implements policies on industrial development, international trade and investment to enhance national productivity and competitiveness in the manufacturing sector.

MITI issues licenses for import/ export of items listed in the custom prohibition of import/ export orders under the Customs Act 1967. The importation of used tyres is subject to the application of import license (AP) to be issued by MITI under the following tariff codes:

(i) 4012.11.000 (Retreaded tyres: motor cars),
(ii) 4012.12.000 (Retreaded tyres: buses or lorries),
(iii) 4012.19.900 (Retreaded tyres: others),
(iv) 4012.20.100 (Used pneumatic tyres: motor cars),
(v) 4012.20.200 (Used pneumatic tyres: buses or lorries)
(vi) 4012.20.990 (Used pneumatic tyres: others)

Additional tariff codes of concern that may be applicable to the management of scarp tyres are as follows (in terms of import and export).

(i) 4003.00.000 (Reclaimed rubber in primary forms or in plates, sheets or strip
(ii) 4004.00 (Waste, parings and scrap of rubber (other than hard rubber) and powders and granules obtained therefrom.

Starting 1 July 2010, only retreaders that comply with SIRIM's MS224 certification are considered for AP. The importation of scrap tyres for the purpose of other than retreading activities is totally prohibited. Used tyres importers must abide by all existing laws of Malaysia. AP issued carries a validity period of 3 months from the date of issue[5].

F. Malaysian Industrial Development Authority (MIDA)

MIDA assists companies which intend to invest in the manufacturing and services sectors (e.g. tyre manufacturer), as well as facilitates the implementation of their projects.

MIDA administers tax incentives for environmentally friendly projects. Such existing incentives include for example pioneer status, investment tax allowance, import and service tax exemptions for imported equipment and so forth.

[5] *Meeting with Mr. Fahrulrazy Othman, Assistant Director of Woods and Rubber Unit from Ministry of International Trade and Industry (MITI) on 20th April 2011.*

Besides, MIDA offers incentive for companies undertaking waste recycling activities that are high value added and use high technologies by being eligible for Pioneer Status or Investment Tax Allowance. MIDA also provides information on the opportunities for investments, as well as facilitating companies which are looking for joint venture partners.

G. Royal Malaysian Customs Department

Royal Malaysian Custom Department collects taxes and provides custom facilitation to the trade (new tyres/ scrap tyres) and industrial sector and to improve compliance with national legislation in order to protect national economic, social and security interest.

Royal Malaysian Customs Department collects data on exported/ imported tyres and used tyres as well as the prevention of importation of illegal tyres and scrap tyres. Used or scrap tyres/casing imports into the country are subjected to 30% import duty, plus 10 per cent sales tax, regardless of source. In comparison, new tyres imported from Asean Free Trade Area (AFTA) countries are subjected to five per cent import duty, plus 10 per cent sales tax. New tyres imported from non-Afta countries are subjected to 40 per cent import duty and 10 per cent sales tax.[6]

H. Ministry of Energy, Green Technology and Water (KeTTHA)

KeTTHA sets the direction for the energy industry, green technologies and the water industry in line with national development goals.

KeTTHA provides Green Technology Financing Scheme (GTFS), a special financing scheme (soft loan) introduced by the government to promote and support the development of Green Technology in Malaysia. It was announced by the Prime Minister in the Budget 2010 presentation with a total financing scheme amounting to RM1.5 billion. The key incentives includes bank guarantee by the Government through the Credit Guarantee Corporation of Malaysia as well as bearing 2% of the total financing interest or profit.

The types of projects eligible for GTFS include potential scrap tyre treatment and recycling. Among certified GTFS projects are scrap tyre pyrolysis and recycling projects[7].

3.1.1.2 State and Local Level

A. State Governments

The State Governments legislate on land matters. They are responsible for the land use planning and utilization of land-based resources.

The facilities for scrap tyres management, if built on State lands, shall require approvals from the State Governments.

[6] *Bernama, Malaysian National News Agency, Kuala Lumpur; 3th September 2010.*

[7] *Green Technology Financing Scheme Official Website. http://www.gtfs.my/gtfs/list_certified?page=2 (accessed 20 April 2011)*

Furthermore, the local authorities or local government (described below) is also under the purview of the respective State Government.

For Sabah and Sarawak however where Act 672 and Act 673 are not applicable, the respective State Governments enact their own policies and regulatory provisions in the administration of solid waste matters in the two states.

B. Local Authorities

The Local Government (referred to as Local authority) is empowered under the Local Government Act 1976.

Local authority has the power to collect taxes, to create by-laws and rules and to grant licenses and permits for any trade (tyre businesses) in its area of jurisdiction, in addition to providing basic amenities, collecting and managing waste and garbage as well as planning and developing the area under its jurisdiction. The role of a solid waste manager is expected to be taken over by the federal government through NSWMD where SWPCMC, upon the enforcement of the Act 672 mentioned above shall be the implementing agency.

Inspection of tyre shops and workshops are also carried out by the local authorities and health inspectors.

The summary of institutional assessment of governmental agencies with respect to scrap tyres management is presented in the following **Table 3.**

Table 3: The institutional capacity of Malaysian governmental agencies in the management of scrap tyres

No	Stakeholders	Responsibilities/ Capabilities	Facilities/ Funding	Strength/ Weaknesses
Federal				
1	Department of National Solid Waste Management (NSWMD)	The NSWMD is responsible for the enforcement of the Solid Waste And Public Cleansing Management Corporation Act 2007 (Act 672). Currently they do not have any direct role in the management of scrap tyre until the enforcement of Act 672. Under Act 672, NSWMD can set up recovery system for scrap tyres, license and regulate scrap tyre players, impose economic incentives and so forth.	Empowered under the Act 672, NSWMD has necessary legal provisions to encourage the recovery and proper management of scrap tyres in Peninsula Malaysia. Funds available for studies and setting up of scrap tyre management system.	Existence of necessary legal tools to implement scrap tyre recovery and proper management. Federalisation provides opportunity for holistic planning and optimization of facilities. The NSWMD lacks experience in scrap tyre management.
2	Solid Waste and Public Cleansing Management Corporation (SWPCMC)	Similar to NSWMD, the direct role of SWPCMC is pending the enforcement of the Act 672. SWPCMC will have the potential to implement the actions describe above under the NSWMD. Possess manpower and set up for research and development.	Having offices set up at regional and States level, SWPCMC will have the presence and manpower to implement any regulatory roles on scrap tyre management.	SWPCMC has the necessary set up and workforce to implement the regulation on scrap tyre management in future. Lacks experience in scrap tyre management.

No	Stakeholders	Responsibilities/ Capabilities	Facilities/ Funding	Strength/ Weaknesses
3	Malaysian Rubber Board (LGM)	Ensuring a smooth and orderly development and progress of the rubber industry under the regulation of the Malaysian Rubber Board (Incorporation) Act 1996.	Issues permit and licenses to monitor all business activities in the rubber industry including waste rubber products (scrap tyres). Research and development capability.	Already experienced in regulating scrap tyre related businesses and familiar with rubber related industries.
4	Department of Environment (DOE)	The Department's main role is to prevent, control and abate pollution through the enforcement of the Environmental Quality Act, 1974 (Act 127) and its 34 subsidiary legislations made thereunder.	Approval of Environmental Impact Assessment (EIA) on Prescribed Activities (Waste Treatment and Disposal). Control of pollution from treatment facilities, burning of scrap tyres.	Large coverage of areas and activities, limited man power and funding. Focusing on overall aspects of environmental management rather than on specific sectors such as scrap tyre management
5	Ministry of International Trade and Industry (MITI)	Plan, formulate and implement policies on industrial development, international trade and investment. To enhance national productivity and competitiveness in the manufacturing sector. The importation of used tyres is subjected to the application of import license (AP) to be issued by MITI under the six tariff codes.	Issuance of licences for import/ export of items (used tyre) listed in the custom prohibition of import/ export orders under the Customs Act 1967.	Experienced in control of import and export of scrap tyres. Focus is on promotion of international trade, foreign investment and industrial development, not on specific issues such as scrap tyre management.
6	Malaysian Industrial Development Authority (MIDA)	Assists companies which intend to invest in the manufacturing and services sectors (e.g. tyre manufacturer), as well as facilitates the implementation of their projects.	Existing tax incentives for waste recycling activities, including scrap tyre recycling. Tax incentives include pioneer status or investment tax allowance as well as import and service tax	Experienced in tax incentives management. Similar to MITI, MIDA is focused on promotion of industrial development, not on specific issues such as scrap tyre

No	Stakeholders	Responsibilities/ Capabilities	Facilities/ Funding	Strength/ Weaknesses
		Provide tax incentives for waste recycling projects.	exemption for qualified equipment.	management.
7	Royal Malaysian Customs Department	Control of export/imported tyre and used/scrap tyres. Prevents import of illegal tyres and scrap tyres.	Import duty for tyres and scrap / used tyres.	Experienced in import/export of tyres as well as implementation of duty/levy system. Limited power and functions in scrap tyre management within Peninsula Malaysia.
8	Ministry of Energy, Green Technology and Water (KeTTHA)	Setting the direction for the energy industry, green technologies and the water industry in line with national development goals and develop an efficient management system. Provides incentives to promote green technology, including potential treatment and recycling of scrap tyres.	Provide Green Technology Financing Scheme (GTFS), a special financing scheme (soft loan) introduced by the government to support the development of Green Technology in Malaysia.	Funding available to encourage development of scrap tyre recycling businesses. Lack of direct role in managing scrap tyres. Lack of experience in setting up a waste management recycling system.
State				
1	State Government	Legislate on land matters, including approvals of sites such as scrap tyre recycling facilities if State land is involved. Local authorities are under the purview of State Government.	Approval of State land for proper treatment of scrap tyres.	Lack of specific funding to encourage proper management of scrap tyres.

No	Stakeholders	Responsibilities/ Capabilities	Facilities/ Funding	Strength/ Weaknesses
Local				
1	Local Authorities	Provide waste collection and disposal services to ensure cleanliness of their jurisdiction areas. Inspection of tyre workshops by local authorities and health inspectors.	Issuance of licensing and control. Possess data on scrap tyre generators.	Ground experiences and familiarity with tyre generators (tyre workshops). Man power and presence. Lack of funding to encourage proper management of scrap tyres.

All government agencies listed in **Table 3** above, by virtue of their respective functions and jurisdictions, administer different sets of regulatory framework in which one or the other types of tyres and scrap tyre components are defined. As a result there exists various number of scrap tyres definitions, which is not uncommon.

3.1.2 Scrap Tyre Definitions

Terms that are generally used to refer to scrap tyres are as follows. They are used in numerous literatures worldwide and adopted by different governments of the world. These terms are outlined as follows.

- End-of-Life (ELT) tyres
- Used Tyres
- Scrap Tyres (as used in the TOR document of this study)
- Waste Tyres
- Discarded Tyres
- Worn Out Tyres
- Part-worn Tyres

Their various definitions are outlined as follows;

- Scrap tyres are used tyres that can no longer be utilized as tyres, or that contain defects that make them unusable on vehicles[8].
- End-of-life tyre is a used tyre that cannot or is not reused for its originally intended purpose and is not retreaded. Such tyres may have a further use as a raw material

[8] *http://www.epa.gov/osw//nonhaz/define/pdfs/tyres-final.pdf*

for other processes or be destined for final disposal. End-of-life tyres are called "scrap tyres" in the United States[9, 10]

- End of life tyre is a non-reusable tyre in its original form. It enters a waste management system based on product /material recycling, energy recovery or goes to landfill[11]
- The part-worn tyre is a tyre, which is reusable, as a second-hand purchase or re-usable after reprocessing (retreading). It can be reused as it is for its original purpose when a residual tread depth remains, otherwise it can be reprocessed under a procedure whereby new tread is vulcanized on-to the casing and it becomes a retreaded tyre[12]
- Waste tyres are tyres which are no longer capable of being used for its original purpose, but which has been disposed of in such a manner that it cannot be used for any other purpose[13].
- Used Tyre: A tyre removed from a vehicle's rim which cannot be legally described as new, but which is structurally intact and has a tread depth greater than the legal limit. This tyre can be remounted onto another vehicle's rim without repair[14]
- Discarded Tyre A worn or damaged tyre which has been removed from a vehicle[15]
- Worn Tyre: Any tyre which has been removed from a vehicle because of wear or damage. Worn tyres can be retreaded, repaired or scrapped[16].

Based on the above definitions, for the purpose of this study, the term "Scrap Tyre" as adopted by the TOR document of this study may be used interchangeably with other terms such as "End-of-Life" tyres, "Waste tyres", "Used Tyres" and "Discarded Tyres", collectively of which refers to tyres which are removed from the vehicles rim, no longer used for their original intended use and purpose but may remain useful for other processes, activities or even destined for final disposal. They may also be taken from their original rim and discarded irrespective of their original conditions that have led to their removal from their rims.

On the other hand in the context of the Malaysian Customs Tariff (Harmonised System) on Import/Export Duty, Excise Duty, Sales Tax, Import/Export Licence (IL/EL) Regulations and Orders 2011 (Customs Order 2011), list of tyre definitions are provided according to following;

[9] *Ministry for the Environment, New Zealand (2004) End of life tyre management*

[10] *Basel Convention Technical Guidelines on the Identification and Manageent of Used Tyres (1999)*

[11] *BLIC, European Association of the Rubber Industry (2003) Promotion of Responsible Management of used tyres by the Tyre Industry*

[12] *BLIC, European Association of the Rubber Industry (2003) Promotion of Responsible Management of used tyres by the Tyre Industry*

[13] *Glossary of Scrap Tyre Terminology (1994) Scrap Tyre Management Council, US*

[14] *Glossary of Scrap Tyre Terminology (1994) Scrap Tyre Management Council, US*

[15] *Glossary of Scrap Tyre Terminology (1994) Scrap Tyre Management Council, US*

[16] *Glossary of Scrap Tyre Terminology (1994) Scrap Tyre Management Council, US*

- New pneumatic tyres (Heading/Subheading no. 40.11)
- Retreaded or used pneumatic tyres of rubber; solid or cushion tyres, tyre treads and tyre flaps, or rubber (Heading/Subheading no. 40.12)
- Used pneumatic tyres (Heading/Subheading no. 4012.20)
- Other, Solid tyres (Heading/Subheading no. 4012.90
- Inner tubes of rubber (Heading/Subheading no. 40.13)

The classification of tyre definitions under the above Customs Order 2011 are generally based on what those tyres are designed for and where those tyre products are eventually used for, inclusive of what type of industries that the tyres are actually finally used on (a vehicle).

In the above various citations of the Customs Order 2011, tyres are also defined according to their designed characteristics (pneumatic tyres, solid tyres) used e.g. used on motorcars, aircrafts, motorcycles, bicycles or where the tyres are generally used in industry types e.g. agricultural, construction, forestry. The tyres are also categorized for the purpose of the respective tax tariffs based on diameters, rim sizes, width.

For the purpose of this study, class and categorical definitions provided by the Customs Order 2011 above do not generally provide and fulfil the intent and purpose of the TOR document for this study, except where commercial activities derived from the use of scrap tyres are concerned. Definitions and terminologies offered in the Customs Order 2011 remain useful only for the purpose of the (Customs Order 2011) Harmonized System administered by the Royal Customs and Excise Department.

Review into other Malaysian regulations showed that there are no other definitions given under any other acts like Act 672 (in as far as scrap tyres and other variant terms of scrap tyres are concerned). The Environmental Quality Act 1974 and the various subsidiary regulations made under, also does not provide any definitions (or variant of it) on scrap tyres except for corresponding references made to terms and terminologies used as part of the Basel Convention.

3.1.3 Tyre Associations

Malaysian Association of Tyre Retreaders and Dealers Society (MATRDS) is an association at national level for the various industry players, having 12 state members including East Malaysia (Sabah and Sarawak) under the association of at state level, there are more than 2,500 tyre dealers (or commonly known as “tyre shops”) have registered as members of MARTDS, out of approximately 4,000 tyre shops in total in Peninsular Malaysia.[17] The members of MATRDS also include tyres retreading companies (see **Section 4.1.3** below).

[17] *Meeting with Mr. Tan Heong Thong, Deputy President of Malaysian Association of Tyre Retreaders & Dealers Societies on 7th April 2011.*

Regular meetings are held to for coordination purposes and discuss major issues related to tyre businesses, including for example the selling price of new tyres and negotiating with tyre manufacturers, as well as the issues on disposal and retreading of used tyres.

3.1.4 Tyres Businesses

3.1.4.1 Tyre Manufacturers/ Importers

New tyres are either manufactured locally or imported and distributed by tyre dealers to the consumers.

There are three key local tyre manufacturers registered under Federation of Malaysian Manufacturer (FMM) namely:

(i) Goodyear Malaysia Berhad, (located in Shah Alam, Selangor)
(ii) Silverstone Berhad, (located in Taiping, Perak) and
(iii) Sime Continental Tyre (located in Petaling Jaya, Selangor and Alor Setar, Kedah)

At the moment the manufacturers are not directly involved or subscribe to any form of scrap tyre management.

3.1.4.2 Tyre Retreaders

In tyre retreading, the remaining tread is ground away from a tyre to be remoulded and a new tread rubber strip is fused to the old carcass by vulcanization. The economic potential of the process is major advantage and the quality of the products, if not done in accordance to standard, is a disadvantage of retreading.

Retreading companies either received retreadable tyres from the tyre workshops or received them from the scrap tyre collectors/ traders. Besides, some retreading companies have their own transports to collect retreadable tyres. Some retreading companies would import used tyres for retreading.

Most retreading companies in the market are focusing mainly retreading only commercial tyres. E.g. tyres for lorries, busses, tractors and other special vehicles. Whereas, passenger tyres are retreaded especially for overseas market such as Thailand, Vietnam and Philippines[18].

Please refer to **Appendix H** for the list of tyre retreaders in Peninsular Malaysia.

[18] *UPM (2005). Study On Used Tyres in Peninsular Malaysia, Final Report by Mohd Nasir p. 29*

3.1.4.3 Tyre Dealers (Workshops)

Tyre dealers refer to the tyre workshops where consumer discards their scrap tyre in the shop. Therefore, these business premises are the scrap tyres generating sites for collection.

Tyre dealers usually store scrap tyres outside of their shops in order for the collectors to cart the scrap tyres away from their business premises and send them to tyre retreaders or to recycling facilities. Tyre dealers either have their own transports or they would appoint scrap tyre collectors to send them to the nearest landfills.

3.1.5 Scrap Tyres Collectors and Traders

Scrap tyre collectors and traders collect and transport scrap tyres from tyre shops to retreaders, recycling facilities or to the nearest landfill sites. Although collectors charge a fee to discard scrap tyres, it is unknown to what extent these tyres are disposed of in an environmental friendly and legal way. Apart from that, high transportation fees were required when there is undefined coverage of collection.

There are three groups of scrap tyre collectors / traders:-

(i) Collectors that provide disposal service to the tyre shops (paid service). Mainly unwanted tyres that need to be disposed to the nearest landfill.
(ii) Collectors that buy scrap tyres from the tyre shops. Mainly retreadable and reusable tyre (second hand tyres).
(iii) Collectors that voluntarily collect the unwanted used tyres from tyre shops without any charges (free disposal service). The frequency of this collection is usually not fixed. E.g. Once or twice a week collection.

Scrap tyre traders identify and sort scrap tyres according to their usage, either to send them to tyre retreaders or recycling centres. Trader is the middleman who buys retreadable tyres either from collectors or directly from the tyre workshop. These traders then resell retreadable tyres to the retreaders both locally and internationally. While the remaining will go to the scrap tyre treatment facilities or other usage (see below).

3.1.6 Scrap Tyres Treatment and Disposal

3.1.6.1 Scrap Tyre Treatment Facilities

Recycling of Scrap Tyres

Recycling of scrap tyres refers to the recovery of rubber granules / rubber powder and steel wires from the scrap tyres. Scrap tyre recycler, for example **G-Cycle**, located in Sungai Lalang Kedah, recovers rubber granules and steel wires as end products. The rubber granules are sent to Klang and Kuala Lumpur which will then be processed into rubber tiles as secondary products. Whereas, the recovered steel wires are sold to the steel mills. Apart from that, G-Cycle has their own transports for the collection of scrap tyres.

Production of Reclaimed Rubber

Reclaimed rubber production refers to the company that processes tyre buffing and whole tyres into rubber crumbs. This rubber crumb is then further processed into various grades and sold to end products manufacturer such as rubber tiles and rubber mats factory both locally and overseas.

This quality material in crumb form is capable of performing numerous tasks once applied to a variety of end products like rubberized asphalt for road building and building materials, sports surfaces, carpet underlay, noise and vibration insulation, rail crossings, sound barriers, industrial flooring, sealant, carpet pads, shoe soles, playgrounds and rubber matting, pond liners, conveyer belts, recycling bins, oil spill absorber, floating docks, wharf pilings and buffers, agricultural pipes, animal bedding and fencing.

Rubplast Sdn. Bhd., located in Taiping, Perak is a company that recycles scrap tyres and processes rubber crumbs. Rubplast use rubber crumbs to manufacture end products such as rubber tiles and rubber mats in various grades. Another two identified reclaimed rubber producers are Jeng Yuan Reclaimed Rubber Sdn. Bhd. and Yong Fong Rubber Industries Sdn. Bhd., both located in Klang.

Pyrolysis Treatment

Pyrolysis offers an environmentally attractive method to decompose a wide range of wastes, including scrap tyres. In the pyrolysis process, the organic volatile matter of tyres is decomposed to low molecular weight products, liquids or gases, which can be used as fuels or chemicals source. The non-volatile carbon black and the inorganic components remain as solid residues and can be recycled in other applications.

Use of pyrolysis as a method for recycling waste tyre depends on the market for pyrolysis products. For this reason, characterization of pyrolysis products and possibilities of their application in other processes is very important. At present time, the main application for carbon black is its use as active carbon, as reinforcement in rubber industry and as smokeless fuel. The liquid product is used as a fuel, or a source of chemicals, and the gas fraction as a fuel in the pyrolysis process.

Advanced Pyrotech Sdn. Bhd., a subsidiary company of Octagon Consolidated Berhad., has developed and operated a continuous process treatment system for waste tyres by utilizing pyrolysis technology in which the process shall degrade the rubber chips into its original components and allow for the recovery of carbon black, oil, steel wires and non-condensable flammable gases. Besides Advanced Pyrotech Sdn. Bhd., Green Pluslink Sdn. Bhd. and Environmental Protection Technology Sdn. Bhd. are the other two identified pyrolysis plants located in Klang.

NOTE:
From the field survey carried out under this study, it was observed that there are also many informal facilities set up to treat or recycle scrap tyres. However, these facilities were not accessible, hence not covered by this study.

Cement Industry

Cement industry uses scrap tyres as low cost supplementary fuel due to their high calorific value. Therefore, scrap tyres are excellent materials for energy recovery. However, this process can be acceptable from an environmental point of view only in the case of controlled combustion due to the toxic emissions produced during the tyre combustion processes.

For example, cement industry, Lafarge Malayan Cement is paid to accept and burn scrap tyres as fuel in rotary cement kilns. If the company were to use local tyres, they would have to pay for the collection of scrap tyres. Since local sources are unreliable as supplies are inadequate and erratic in the absence of collection system, Lafarge shipped in shredded tyres from Singapore to fuel its cement kiln in Langkawi[19]. YTL Cement is another identified cement industry that uses scrap tyres as supplementary fuels.

The use of tyres directly as fuel in cement kilns has the following advantages, reduced power-production costs, maximum heat recovery and environmentally acceptable process. The disadvantages are, no material recovery, large capital investment, need for flue gas cleaning, carbon dioxide emission and high operating costs. More research works is needed for obtaining environmental impacts for the combustion of scrap tyres, especially from the view of polycyclic aromatic hydrocarbon (PAH) emissions.

3.1.6.2 Scrap Tyre Disposal Facilities

There are no disposal facilities specifically designed for the disposal of scrap tyres in Peninsular Malaysia. Most of the landfill sites in Malaysia receive scrap tyres as mixed waste with normal household waste. However, according to a few landfill operators, the number of scrap tyres received at landfill has reduced significantly in the past few years. Any tyres, if found at the landfills, are motorcycles tyres.

Generally, landfills charge a tipping fee ranges widely from RM10 per truck to RM33 per tonne depending to the landfill operator[20]. High gate fee deter collectors from dumping scrap tyres at landfill which lead them to dumping scrap tyres illegally. Apart from that, the scrap tyres in landfills are usually not segregated from other domestic waste.

Inert waste disposal facility caters specifically to garden wastes, construction and demolition wastes, waste glass, scrap tyres and other dry, non-leachable wastes. Two inert landfills

[19] *http://www.lafarge.com.my/wps/portal/my/7_3 PressCoverage_Detail?WCM_GLOBAL_CONTEXT=/wps/wcm/connectlib_my/Site_my/AllPressCoverage/PressCoverage_ 1279535702387/PressCoverageHeader*

[20] *Study On Used Tyres in Peninsular Malaysia, Final Report by Mohd Nasir p. 35*

were identified in the Central Region of Peninsular Malaysia; they are Dengkil Inert Landfill in Sepang and Kuang Inert Landfill in Sungai Buloh.

Burning of used tyres in landfill fire generate tremendous amount of black smoke and toxic oils that create severe environmental and health hazard. Whole tyres are bulky, taking up valuable landfill space and preventing waste compaction causing uneven settlement, in addition creating breeding grounds for mosquitoes. In any case, tyres do not belong in dump since they are recyclable.

3.2 Inventory

Availability of scrap tyres in the Peninsula Malaysia becomes the crucial central issues that determine whether there are scrap tyres in the market and whether there are sufficient scrap tyres for the stakeholders to sustain their businesses.

Availability of scrap tyres in the Peninsular Malaysia was determined by means of inventorizing the current numbers of tyres in the entire spectrum or classes of it. Notwithstanding there are sectoral data available in the attempt to quantify the current numbers of tyres (and therefore scrap tyres) in the market originating from for example new tyre manufacturers, importers, number of vehicles on the road that are the primary generators of scrap tyres.

3.2.1 Inventories of Scrap Tyres - Methodology

The proposed methodology for the updating of scrap tyres inventories is illustrated in **Figure 3** below:

Existing inventories on scrap tyre have been identified and collected based on the existing information and database available.

The Study at this stage successfully update the inventory (e.g. quantity of tyres and scrap tyres in numbers and tonnes) generated in various categories (e.g. motorcycles, cars, trucks, etc.) including the relative geographical distribution (e.g. in each state). These data were consolidated for an integrated analysis that contributed to the development of a model in scrap tyre management, mass flow as well as feasibility for a suitable processing, recovery plant.

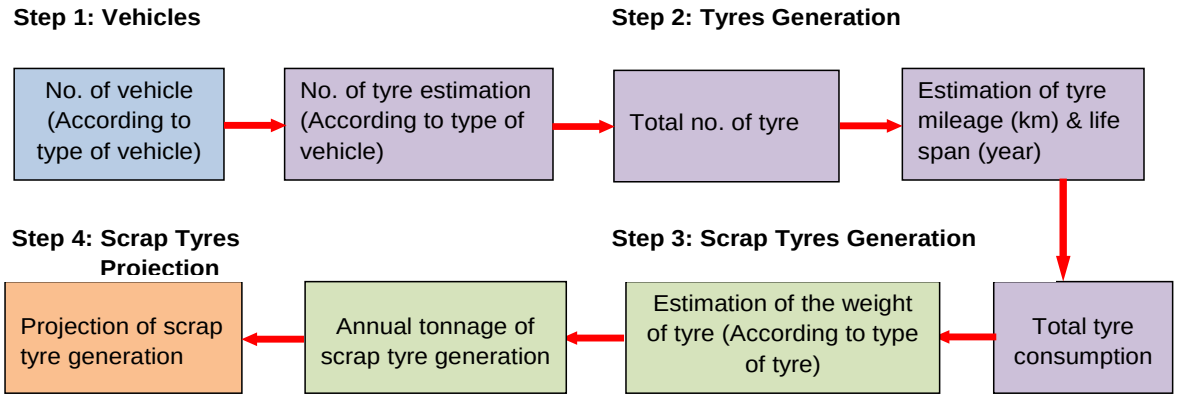


Figure 3 : Methodology for estimation of the generation of tyre by year

Existing inventories and past studies on scrap tyre projections have been identified and collected based on the existing information and database available. The main inventories and past studies referred are:

(i) Malaysia/DANIDA (2003). Economic approaches to sustainable development, demonstration project. Rapid Assessment Survey under the Economic instrument for managing scrap tyres.
(ii) University Putra Malaysia (2005). Study on Waste Tyre Management in Malaysia.
(iii) Ministry of Housing and Local Government/DANIDA (2009). Solid Waste Management Component (2009) Controlled Solid Waste Projection.

The inventory (e.g. amount in numbers and tonnes) of scrap tyres generated in various categories (e.g. motorcycles, cars, trucks, etc.) and geographical distribution (e.g. in each state) were updated and thereafter consolidated for an integrated analysis that will contribute to the development of a model in scrap tyre management, mass flow as well as feasibility for a suitable processing, recovery plant.

Field Survey – Questionnaire and Ground Survey

The flow of scrap tyres can generally be categorised generally into the following groups:

(i) Where there is an existing treatment/ recycling facilities for scrap tyres
(ii) Where there is NO treatment/ recycling facilities for scrap tyres

Field surveys (including questionnaire survey and ground observation/verifications) have been undertaken to identify the quantity and flow of scrap tyres – i.e. quantity of scrap tyres generated at tyre shops, agencies for transportation, and location of scrap tyres treatment and disposal sites. Tracking of scrap tyres collectors however was difficult due to the number of scrap tyre producers and in most instances, tyre collectors are not disclosed in detail by the recyclers.

The overall objective of the field survey is to establish an overview of how tyre is currently handled in Peninsular Malaysia. Surveyed data are crucial as they will reveal the fundamental information required in the development of a scrap tyre management system. Surveyed data provide clues to the underlying needs and requirements of the various stakeholders, determine the actual availability of scrap tyres in the target market. These data then allow an informed evidence based management program be instituted to address the stakeholders' needs and requirements.

The following categories of stakeholders have been identified to the field survey :-

(i) Workshops / Tyre Shops
(ii) Scrap tyres Collectors
(iii) Scrap tyres Traders
(iv) Scrap tyres Treatment / Recycling Facilities
(v) Scrap Tyres Disposal Sites

The tyre shops were further divided into 3 general sub-categories, i.e.

(i) tyre shops for motorcycles
(ii) tyre shops for private cars
(iii) Tyre shops for commercial heavy vehicles (e.g. buses, lorries, trucks, etc.)

No. of samples & locations surveyed

Overall, the survey coverage area in Peninsula Malaysia has been divided into 4 zones as illustrated below in **Figure 4**:

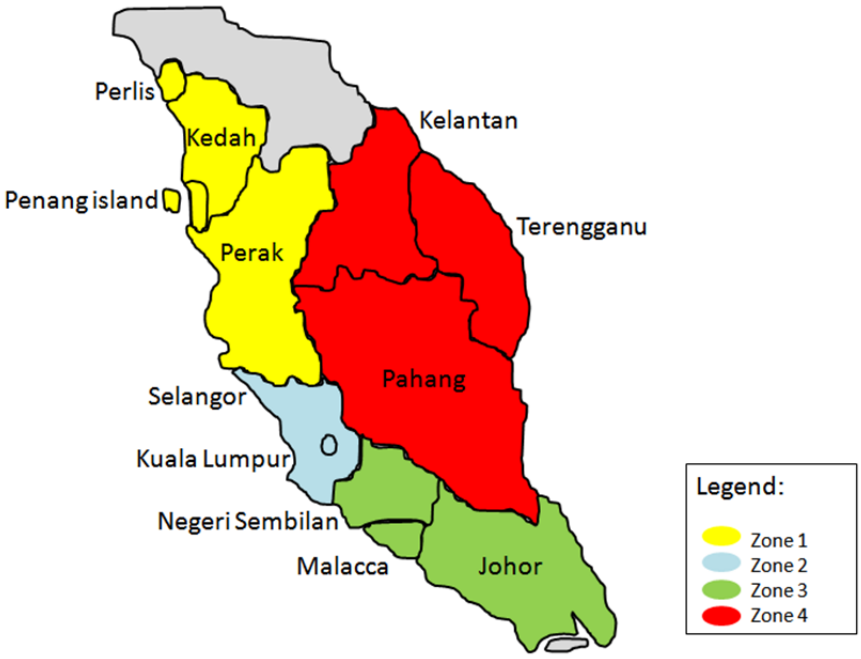


Figure 4 : Zoning of scrap tyre survey areas

The zonation of the survey area allowed a regionalized approach in the management of information and data arising from the planned field interviews, visits and as well as the integration of geo-spatial information with land use information relevant to the tyre and scrap tyre industries. The total number of survey samples is tabulated in **Table 4** below:

Table 4 : Proposed sampling size for tyre industries

No.	Industry	No. of sample
1	Tyre workshops (motorcycles, cars & heavy vehicles), petrol stations & depots	100
2	Scrap tyre processing facilities & transfer stations	10
3	Scrap tyre collectors / transporters	30
4	Disposal sites	10
Total		**150**

This study has been undertaken in a tight timeframe to meet the needs of Government and as a result, comprehensive and expansive consultation with the numerous stakeholders has not been possible. In addition there are other constraints to the analysis that should be recognized,

First the available timeframe and project resources have not allowed the development of a dynamic model to examine changes in the tyre flows over time. Such model could be developed but is outside the scope of this study. In combination with the limited consultation period, this means that the report focuses on current market segments (where information could readily be obtained) and does not provide a depth of analysis relating to the sustainability of future segments.

Secondly there are constraints encountered with respect to accessing appointments and interviews with the required parties due to the available timeframe. Hence there are parties which are not interviewed and the corresponding information was not available.

Thirdly, while the originally proposed number of samples was small, the field surveys managed to double the proposed sampling number by optimizing the available resources.

3.2.2 Inventories of Scrap Tyres

3.2.2.1 Data from Department of Road and Transport (DOT)

Secondary data on the number of registered vehicles according to type of vehicle in Peninsular Malaysia for the past 4 years (2007 – 2010) was obtained from the Department of Road and Transport (DOT) Malaysia as shown in **I.**

The increase of number of vehicles by year for the past 4 years is shown in **Figure 5** below:

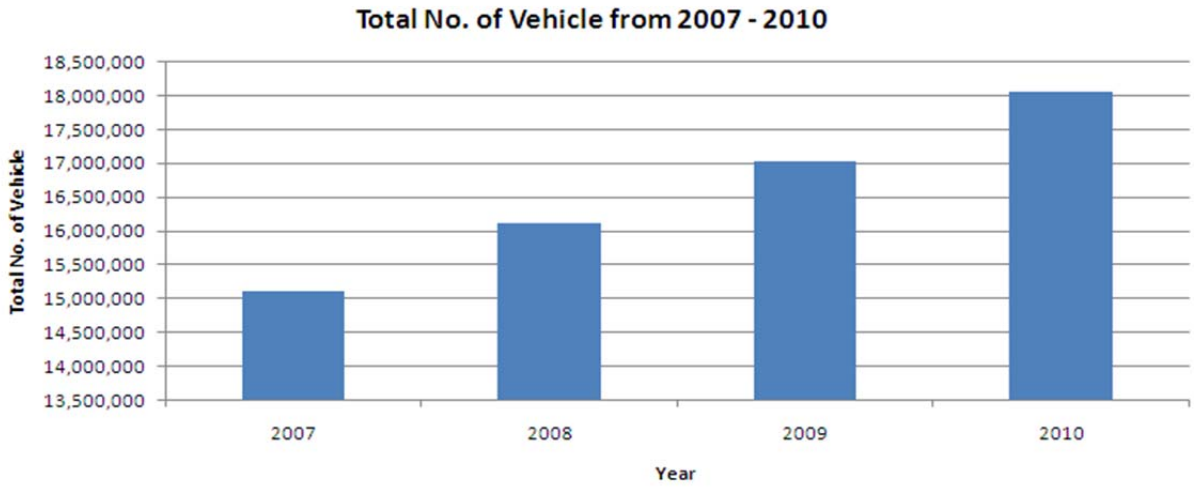


Figure 5: Number of vehicles by year in the Peninsular Malaysia

3.2.2.2 Estimation of Used Tyre Generation

The types of registered vehicles obtained from DOT are categorized according to following types:

(i) Motorcycle
(ii) Motorcar
(iii) Bus
(iv) Taxi
(v) Hire and Drive Car
(vi) Good vehicles
(vii) Other vehicles

The estimation of the scrap tyre generated in Peninsula Malaysia was calculated using the estimation and assumptions from Malaysia/DANIDA-Economic approaches to sustainable development, demonstration project: Economic instrument for managing scrap tyres 2003 and DANIDA/SWMC Controlled Solid Waste Projection 2009.
The assumptions are listed as below:

Group A: Bus
(i) Assuming 21% of public vehicles are minibus
(ii) Assuming 79% of public vehicles are buses

Group B: Good Vehicles
(iii) Assuming 10% of good vehicles are vans
(iv) Assuming 55% of good vehicles are light trucks
(v) Assuming 35% of good vehicles are lorry

Group C: Other Vehicles

(vi) Assuming 90% of other vehicles are light trucks
(vii) Assuming 10% of other vehicles are heavy vehicles

The estimation of the used tyres generated is presented as listed as below:

(i) Estimation of the annual and daily tonnage for scrap tyre generation in year 2010 and categories for the whole Peninsular Malaysia (see **Table 5**)
(ii) Estimation of annual and daily tonnage for scrap tyres generation by categories (Motorcycles, Cars, Trucks, etc.) for the whole Peninsular Malaysia (see **Table 6**)

Estimation of annual and daily tonnage for scrap tyres generation by state for the whole Peninsular Malaysia (see **Table 7**)**.**

Table 5: Estimated annual and daily tonnage for used tyre generation for 2010

Type of vehicles	Total No. Vehicles from DOT 2010[21]	Total No. Vehicles by Type	No. Tyres per Vehicle	Total No. of tyre	Mileage/ year	Tyre Life (km)[22]	Tyre Consumption (total)	Weight/ unit (Kg)	Annual tonnage	Daily tonnage
		A	B	C = A X B	D	E	F = (C X D)/E	G	H = (F X G)/1000	
Motorcycle	8,689,248	8,689,248	2	17,378,496	12,000	20,000	10,427,098	2	20,854	57
Motorcar	8,041,094	8,041,094	4	32,164,376	20,000	40,000	16,082,188	7	112,575	308
Mini Bus	59,221	12,436	4	49,746	40,000	40,000	49,746	7	348	1
Bus		46,785	6	280,708	60,000	90,000	187,138	45	8,421	23
Taxi	77,314	77,314	4	309,256	80,000	40,000	618,512	7	4,330	12
Hire and Drive Car	16,535	16,535	4	66,140	80,000	40,000	132,280	7	926	3
Vans	787,680	78,768	4	315,072	35,000	40,000	275,688	7	1,930	5
Light trucks (<2.5 tonnes, and non-diesel trucks)		433,224	4	1,732,896	35,000	40,000	1,516,284	7	10,614	29
Lorry (>2.5 tonnes), Trailers and Others		275,688	8	2,205,504	60,000	90,000	1,470,336	45	66,165	181
Light truck	384,624	346,162	4	1,384,646	40,000	40,000	1,384,646	7	9,693	27
Heavy vehicles		38,462	8	307,699	60,000	90,000	205,133	45	9,231	25
Total	**18,055,716**	**18,055,716**		**56,194,539**			**32,349,049**		**245,087**	**671**

Note:

- A Road Transport Department, Malaysia
- B Estimate number of tyres per vehicle
- C Number of vehicles multiplied by estimated number of tyres per vehicle
- D Estimated mileage of vehicle per year per kilometres
- E Tyre life in mileage (kilometres)
- F Tyre consumption estimated by multiplying number of tyres and tyre estimated mileage and dividing by tyre life
- G Estimated weight of tyres
- H Estimated annual tonnage of scrap tyre generated

[21] *http://portal.jpj.gov.my*

[22] *Manufacturers estimation; environmental and user factors will vary tyre life*

Table 6: Estimation of annual and daily tonnage for scrap tyres generation by categories (Motorcycles, Cars, Trucks) for the whole Peninsular Malaysia

Type of vehicles	Annual Tonnage				Daily Tonnage			
	2007	2008	2009	2010	2007	2008	2009	2010
Motorcycle	17,667	18,839	19,801	20,854	48	52	54	57
Motorcar	91,945	98,653	105,196	112,575	252	270	288	308
Mini Bus	310	320	334	348	1	1	1	1
Bus	7,494	7,733	8,075	8,421	21	21	22	23
Taxi	3,649	3,796	4,024	4,330	10	10	11	12
Hire and Drive Car	577	764	833	926	2	2	2	3
Goods Vehicle	1,730	1,805	1,862	1,930	5	5	5	5
Light trucks (<2.5 tonnes, and non-diesel trucks)	9,515	9,929	10,240	10,614	26	27	28	29
Lorry (>2.5 tonnes), Trailers and Others	59,315	61,897	63,834	66,165	163	170	175	181
Light truck	8,558	8,950	9,284	9,693	23	25	25	27
Heavy vehicles	8,150	8,523	8,842	9,231	22	23	24	25
Total	**208,911**	**221,209**	**232,325**	**245,087**	**572**	**606**	**637**	**671**

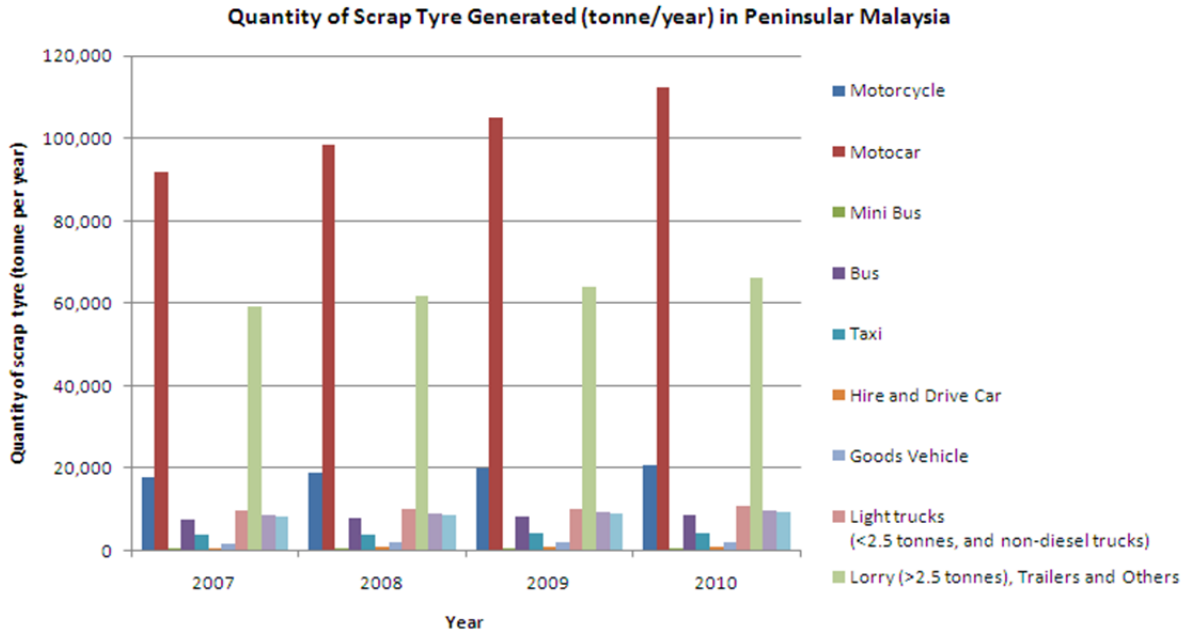


Figure 6: Quantity of scrap tyre generated (tonne/ year) by different categories in Peninsular Malaysia

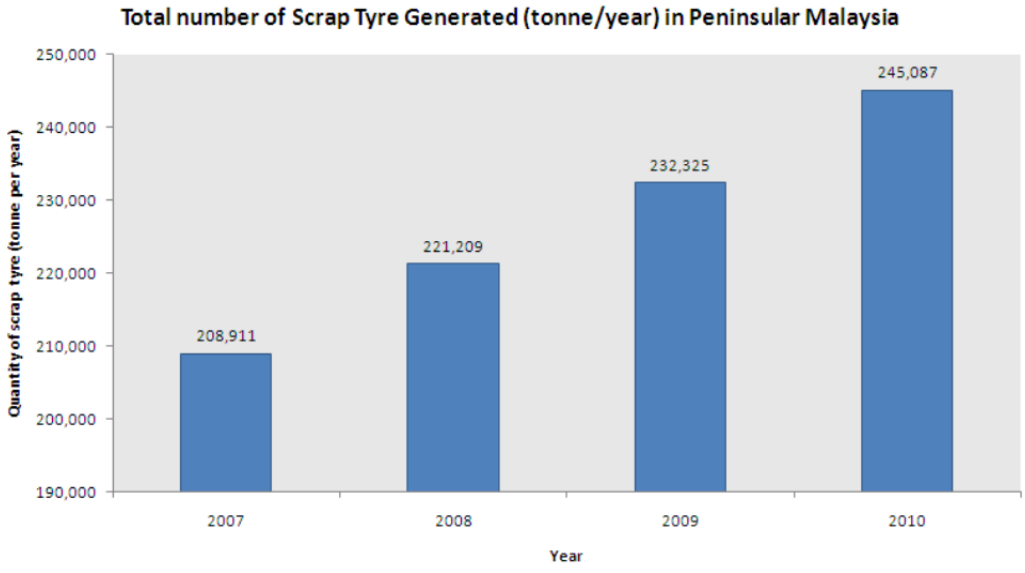


Figure 7: Quantity of scrap tyre generated (tonne/ year) in Peninsular Malaysia

Table 7: Estimation of annual and daily tonnage for scrap tyres generation by state for the whole Peninsular Malaysia

State	Annual Tonnage				Daily Tonnage			
	2007	2008	2009	2010	2007	2008	2009	2010
Perlis	583	620	649	688	2	2	2	2
Kedah	9,148	9,547	9,952	10,409	25	26	27	29
Pulau Pinang	19,804	21,008	22,124	23,493	54	58	61	64
Perak	17,709	18,599	19,419	20,266	49	51	53	56
Selangor	31,366	33,245	34,659	36,368	86	91	95	100
Kuala Lumpur	63,643	67,762	71,774	76,439	174	186	197	209
N. Sembilan	8,796	9,168	9,515	9,899	24	25	26	27
Melaka	6,677	7,072	7,413	7,774	18	19	20	21
Johor	31,172	32,994	34,585	36,403	85	90	95	100
Pahang	8,942	9,462	9,873	10,308	24	26	27	28
Terengganu	4,623	4,905	5,163	5,455	13	13	14	15
Kelantan	6,450	6,828	7,198	7,584	18	19	20	21
Total	**208,911**	**221,209**	**232,325**	**245,087**	**572**	**606**	**637**	**671**

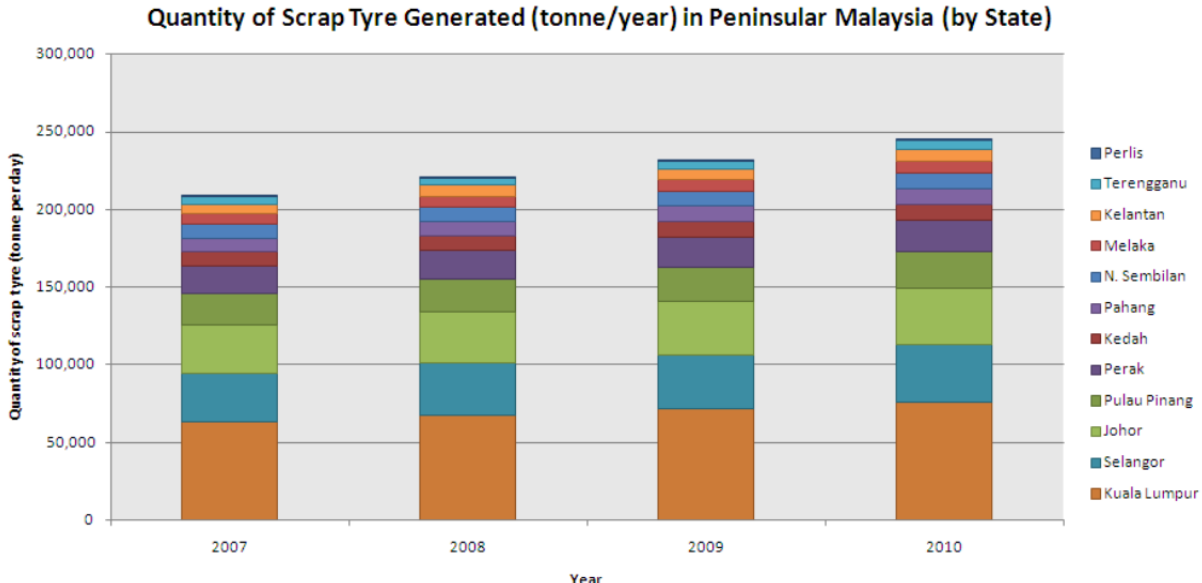


Figure 8: Quantity of scrap tyre generated (tonne/year) in Peninsular Malaysia by state

3.2.2.3 Projection of Scrap Tyre Generated

Based on the SWMC/DANIDA controlled solid waste projection exercise, assuming the growth rate of the increase of vehicle registered is 5%, the projection of the number of vehicles registered from year 2011 until year 2015 is shown in **Table 8**.

Table 8: Projection of number of registered vehicle from 2011 – 2015

Type of vehicles	Total Projection of Vehicle				
	2011	**2012**	**2013**	**2014**	**2015**
Motorcycle	9,095,971	9,550,770	10,028,308	10,529,724	11,056,210
Motorcar	8,284,202	8,698,412	9,133,332	9,589,999	10,069,499
Mini Bus	62,607	65,737	69,024	72,475	76,099
Bus					
Taxi	79,214	83,174	87,333	91,700	96,285
Hire and Drive Car	16,397	17,217	18,078	18,982	19,931
Vans	837,818	879,709	923,695	969,880	1,018,374
Light trucks (<2.5 tonnes, and non-diesel trucks)					
Lorry (>2.5 tonnes), Trailers and Others					
Light truck	406,192	426,501	447,827	470,218	493,729
Heavy vehicles					
Total	**18,782,401**	**19,721,521**	**20,707,597**	**21,742,976**	**22,830,125**

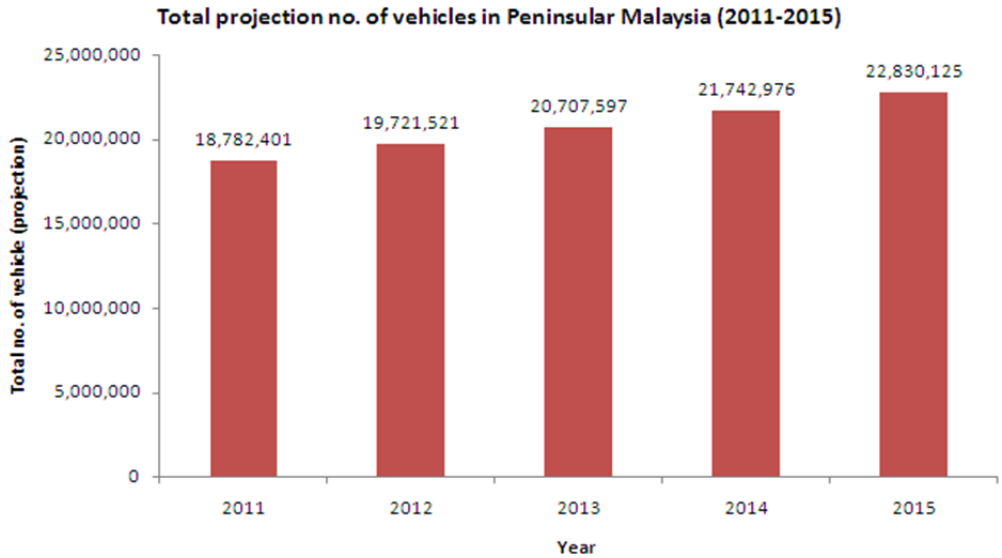


Figure 9: Total projection for number of registered vehicles in Peninsular Malaysia (2011-2015)

Based on the projection figures of the total number of registered vehicles in Peninsular Malaysia, the projection of annual and daily tonnage of scrap tyres generated was projected in **Table 9** below:

Table 9: Projection of annual and daily tonnage of scrap tyres (2011 – 2015)

Type of vehicles	Annual tonnage					Daily tonnage				
	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
Motorcycle	21,830	22,922	24,068	25,271	26,535	60	63	66	69	73
Motorcar	115,979	121,778	127,867	134,260	140,973	318	334	350	368	386
Mini Bus	368	387	406	426	447	1	1	1	1	1
Bus	8,903	9,348	9,815	10,306	10,821	24	26	27	28	30
Taxi	4,436	4,658	4,891	5,135	5,392	12	13	13	14	15
Hire and Drive Car	918	964	1,012	1,063	1,116	3	3	3	3	3
Vans	2,053	2,155	2,263	2,376	2,495	6	6	6	7	7
Light trucks (<2.5 tonnes, and non-diesel trucks)	11,290	11,854	12,447	13,069	13,723	31	32	34	36	38
Lorry (>2.5 tonnes), Trailers and Others	70,377	73,896	77,590	81,470	85,543	193	202	213	223	234
Light truck	10,236	10,748	11,285	11,849	12,442	28	29	31	32	34
Heavy vehicles	9,749	10,236	10,748	11,285	11,849	27	28	29	31	32
Total	**256,138**	**268,945**	**282,392**	**296,512**	**311,337**	**702**	**737**	**774**	**812**	**853**

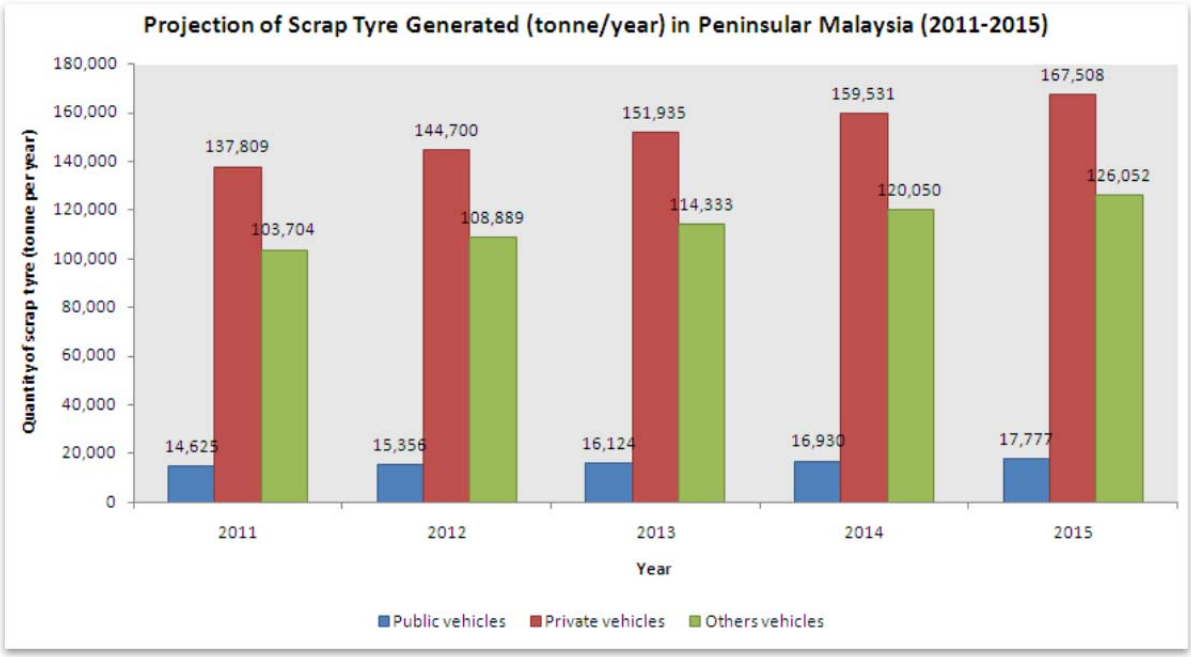


Figure 10: Total projection of scrap tyre generated (tonne/year) in Peninsular Malaysia (2011-2015)

3.2.3 Inventories of Scrap Tyres - Mass Flow Models

The mass flow models for scrap tyres movement in Peninsula Malaysia, from their point of generations in the tyre shops, transportation to the final treatment and disposal was developed using the following methodology:

(i) Interviews with key personnel for specific data and information retrieval over tyres and scrap tyres data
(ii) Focused group discussion for operational information of tyres and scrap tyres trade and commerce at field
(iii) Literature reviews for Peninsular Malaysia's general, municipality and administrative data, including legal and policy framework over the tyres and scrap tyres management in Peninsular Malaysia
(iv) Field surveys – on site interviews

Existing information gathered from the authorities, particularly information about the existing tyre management practices, including storage, collection, transportation and disposal.

In summary, the process of developing the mass flow model is illustrated in **Figure 11** below

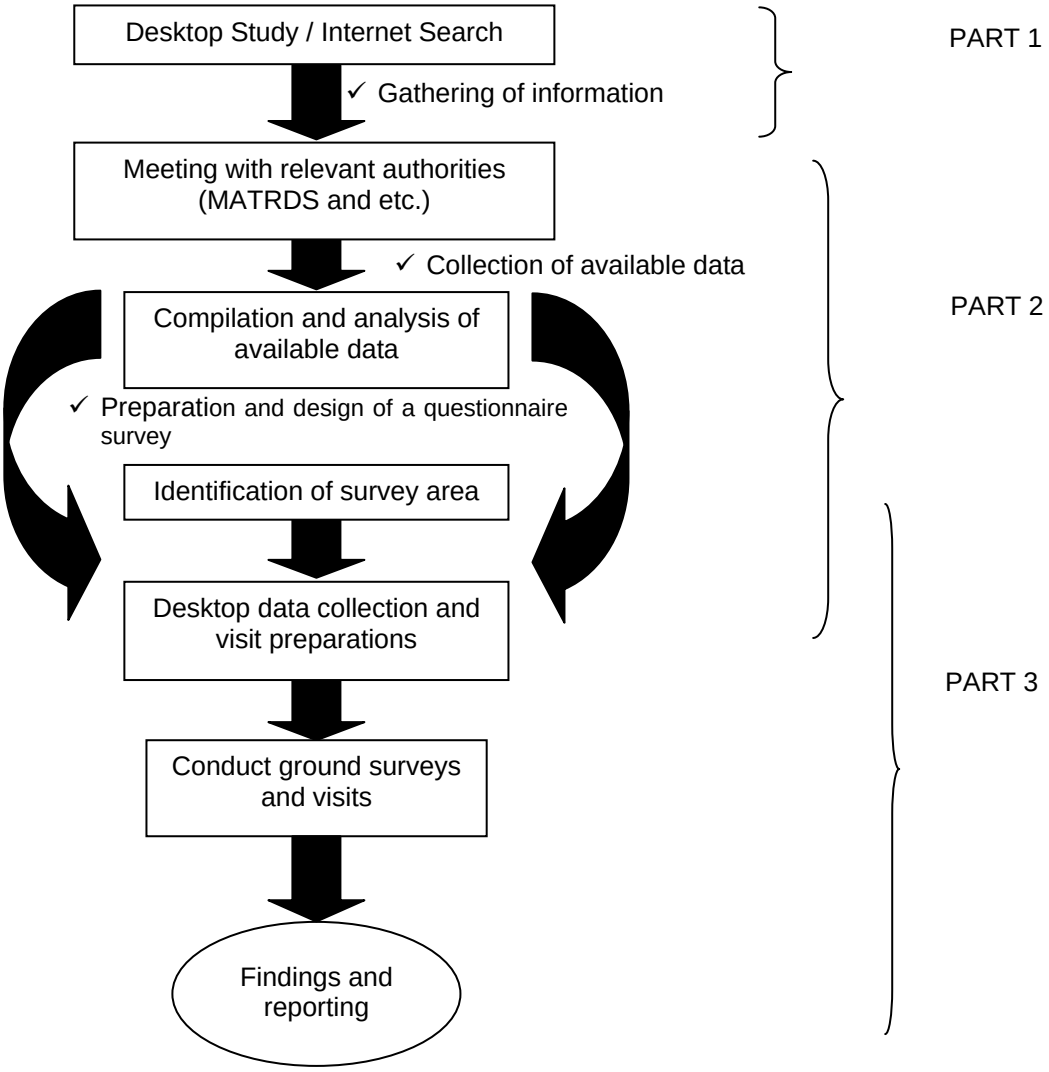


Figure 11 : Proposed developmental methodologies for mass flow development

3.2.3.1 Qualitative Findings, Feedbacks and Ground Observations

The surveyors have interviewed a number of stakeholders during the survey period. The details of the meeting are tabulated as follow. The total number of survey samples is tabulated in **Table 10** below:

Table 10: Total number of survey samples

No.	Industry	No. of sample
1.	Consumers of Tyres	87
2.	Tyre shops for motorcycles	6
3.	Tyre shops for private cars/ commercial heavy vehicles	196
4.	Tyre Retreading workshop	6
5.	Tyre Depot	3
6.	Scrap tyre processing facilities	6
7.	Scrap tyre collectors/transporters/traders/exporters	16
8.	Disposal sites	3
Total		**323**

The primary survey period was carried out from 11 Apr 2011 until 15 Apr 2011, whilst follow up surveys were conducted on multiple dates in June (Marang and Setiu in Terengganu) and July (Kuala Lumpur) 2011. Site observations, findings from the surveys were recorded into the survey forms.

Analysis of questionnaires

During the primary survey period, a total of 293 questionnaire survey forms were collected, including the surveys on tyre shops, workshops, retreading workshops, collectors, customers, recycling facilities, landfills and others. The remaining additional 30 samples were obtained through simplified interviews mainly on the information concerning estimation on quantities of scrap tyres managed by the workshops, fate of scrap tyres (who collected the scrap tyres, where were the scrap tyres brought to, does the workshops have to pay for the removal of the scrap tyres from their workshops) The findings obtained from the surveys are summarised in the following tables and figures:

Surveys on customer

Table 11: Total number of interviewees according to state

Summary of total no of customer interviewed according to state			
No	**State**	**No of Sample**	**%**
1	Perlis	5	4.2
2	Kedah	14	11.9
3	Pulau Pinang	8	6.8
4	Perak	14	11.9
5	Pahang	1	0.8
6	Kelantan	5	4.2
7	Terengganu	26	22.2
8	Johor	1	0.8
9	Melaka	2	1.7
10	Negeri Sembilan	5	4.2
11	Selangor	21	17.9
12	Kuala Lumpur	15	12.8
	Total	**117**	**100.0**

Table 12: List of Local Authorities interviewed

Location	Name of location
Local Authority	1. Majlis Perbandaran Kangar (MPK) 2. Majlis Perbandaran Pulau Pinang (MPPP) 3. Majlis Daerah Kampar (MDK) 4. Majlis Perbandaran Kota Bharu (MPKB) 5. Majlis Perbandaran Kuantan (MPK) 6. Majlis Daerah Pekan (MDP)

Discussions with Local Authority

A total of 3 Local Authorities have been interviewed in the study. Short descriptions of the interviews are as provided below. For more information on the interviews, please refer to **Appendix J**.

1. Majlis Perbandaran Kangar (MPK)

MPK manages the Padang Siding landfill which is the only landfill in Perlis. It is an open dump and receives about 180 tonnes of waste per day. The landfill did not specifically receive tyre waste but whenever tyres were collected during the domestic waste collection, they will not be segregated but will be disposed of at the landfill.

2. Majlis Perbandaran Pulau Pinang (MPPP)

MPPP manages the Batu Maung Transfer Station which is located in Penang Island. The transfer station did not specifically receive tyre waste unless sometimes when a few tyres which were collected during the normal domestic waste collection.

3. Majlis Daerah Kampar (MDK)

MDK manages the Sungai Siput Selatan landfill. Similar to the above, the landfill did not specifically receive tyre waste and there was no segregation of scrap tyres if collected by the domestic waste trucks.

Scrap tyre management in MDK

The local council officers will change the tyres of the government vehicles in the 'panel' workshops or tyre shops. The changed tyres will be brought back to the local council and kept in store. An auditor (Jawatankuasa Penilai) will then audit and check on the condition of the tyres and select the tyres which are still in good condition to be retreaded. The other tyres left behind will then be auctioned (lelong) to the collectors.

4. Majlis Perbandaran Kota Bharu (MPKB)

MPKB manages the Bachok landfill. According to MPKB, there was no segregation of tyres in the landfill. They are mixed with household waste. They charged RM20 for less than 5T and RM40 for more than 5T lorry load as tipping fees.

5. Majlis Perbandaran Kuantan (MPK)

MPK manages the Jabor Jerangau landfill. MPK informed that there is no segregation of scrap tyres with other domestic waste in the landfill as it is costly and require large area (bulky). They charged RM18 for 1T of domestic waste as tipping fees. MPK informed that scrap tyres in landfill affected the performance of compactor thus affected the structure of landfill. Moreover, scrap tyres in landfill obstruct drilling process and caused the collection of rain water.

6. Majlis Daerah Pekan (MDP)

MDP manages the Keledang landfill. Similar to other landfill practice, the landfill did not specifically receive tyre waste and there was no segregation of scrap tyres if collected by the domestic waste trucks.

Figure 12: JKR Depot

Figure 13: Used tyre at JKR Depot

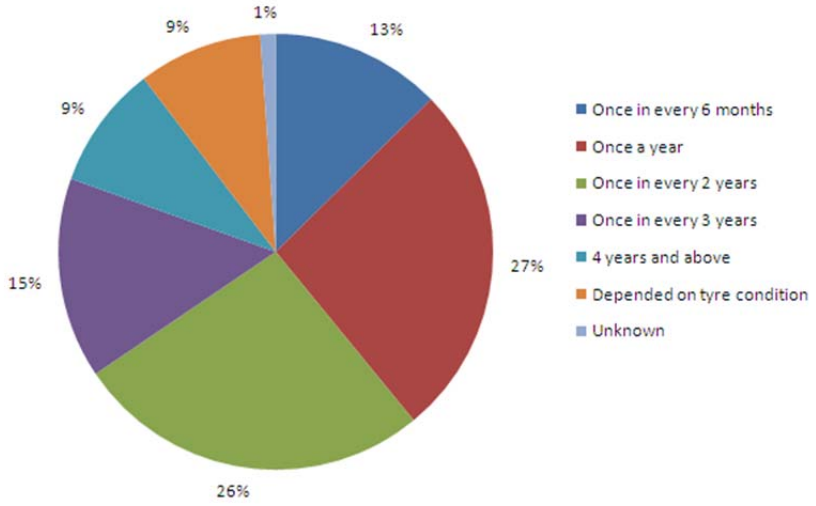


Figure 14: Summary of frequency of tyre change

From the surveys, it was observed that 8% of the respondents who changed their tyres once in every 6 months were taxi drivers. According to the consumers, if they purchased and used second-hand tyres, the tyres will normally only last for 3 months.

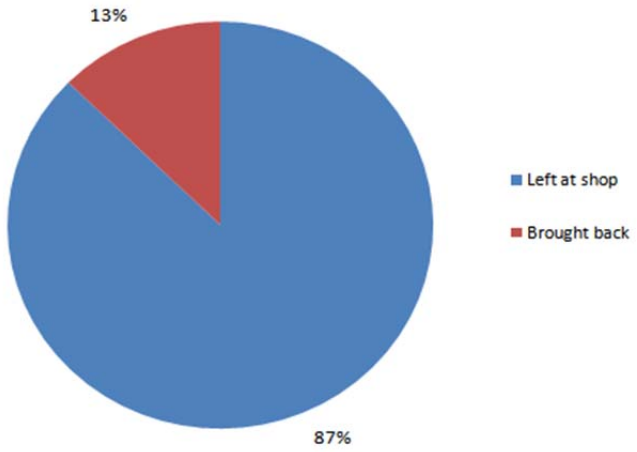


Figure 15: Summary of used / scrap tyre management

Only 13% of the customers brought back the used tyres for landscaping, burning, used as spare tyres etc.

Figure 16: Scrap tyres brought back by the customers for the purpose of landscaping

Figure 17: Interviewing a customer in a tyre shop

Survey on workshop

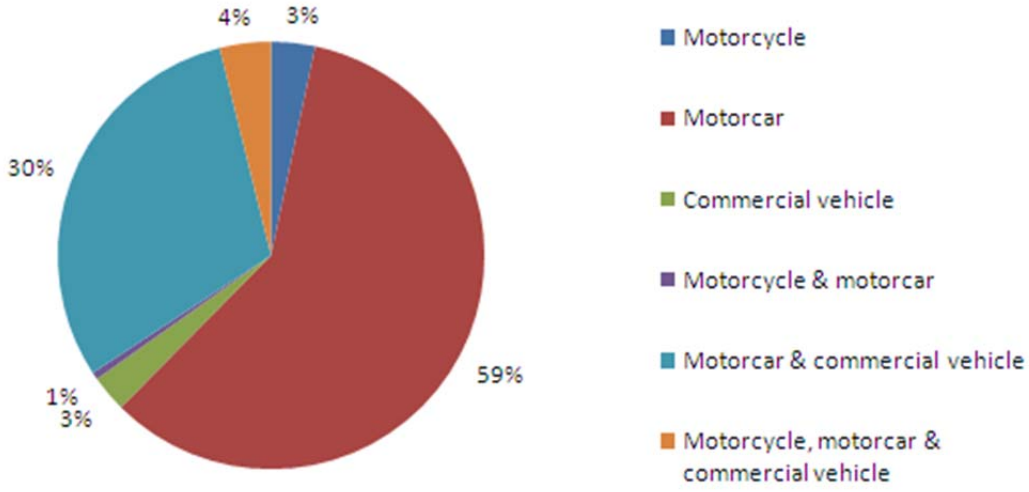


Figure 18: Type of vehicles serviced in the tyre shop / workshop / depot

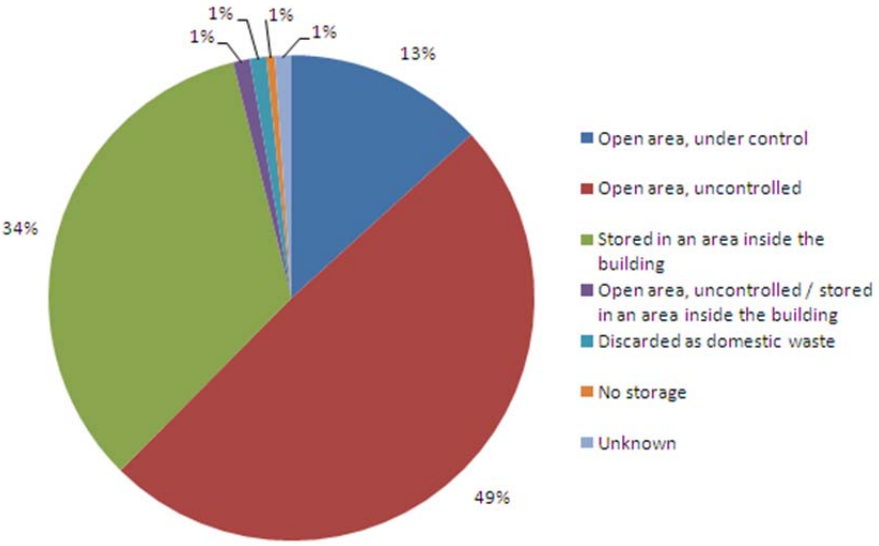


Figure 19: Method of storage of scrap tyre

1% of the respondents did not store the scrap tyres. Two respondents (1%) of the respondents discarded the scrap tyres as domestic waste while another 1% did not provide the surveyors with an answer.

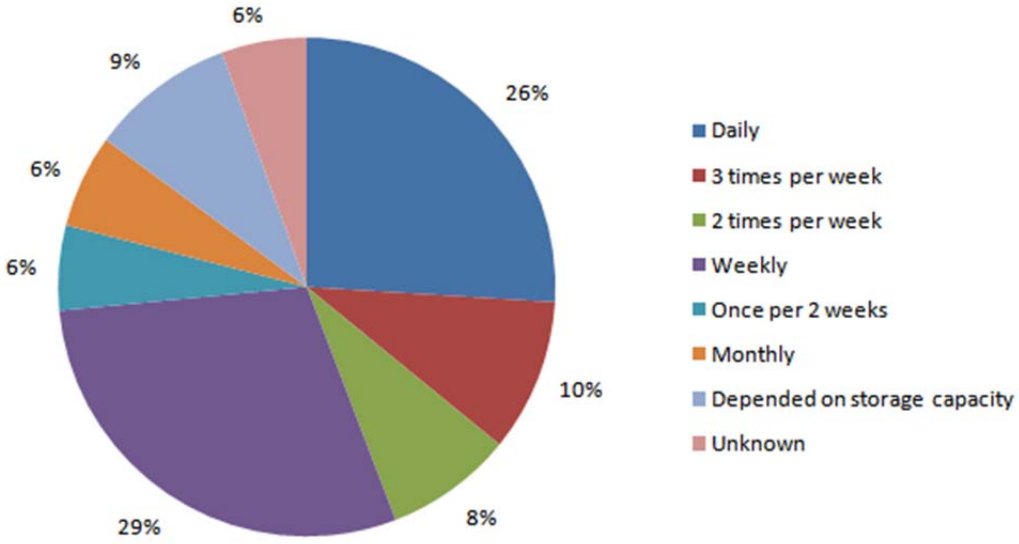


Figure 20: Frequency of the scrap tyre collection

6% of the respondents did not provide the surveyors with an answer.

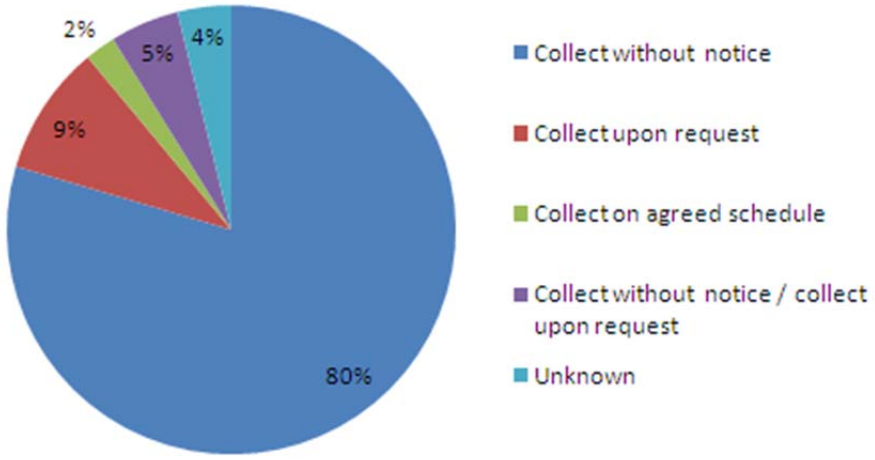


Figure 21: Type of collection of scrap tyre

4% of the respondents did not provide the surveyors with an answer.

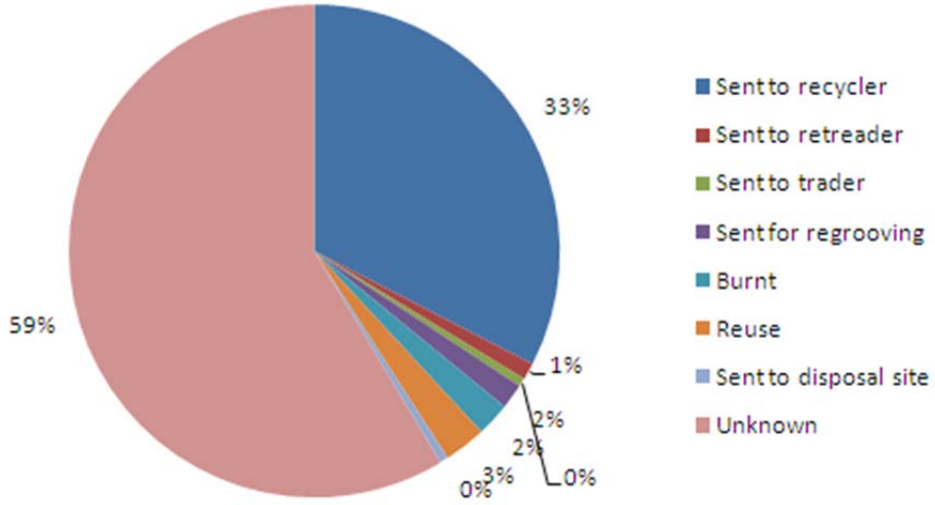


Figure 22: Management of scrap tyre after collection

59% of the workshops claimed that they do not know where the tyre ended up. Among this, 9 respondents did not provide the surveyors with an answer.

Figure 23 : Interviewing the worker in the tyre shop

Figure 24 Interviewing the owner in the tyre shop

Survey on collector

During the survey period, the surveyor only managed to interview 16 collectors. The summary of number of collector interviewed is tabulated as below:

Table 13: Total number of scrap tyres collectors interviewed

No	State	No. of collector interviewed
1	Penang	2
2	Perak	2
3	Kedah	2
4	Selangor	3
5	Kuala Lumpur	2
6	Pahang	2
7	Terengganu	1
8	Melaka	1
9	Johor	1
Total		**16**

Generally there are 3 different types of used tyre collectors which are listed as below:

i) Collector that provide disposal service to the tyre shop (with charges)
ii) Collector that voluntary collect the used tyre from tyre shop (without charges)
iii) Collector that buy used tyre from the tyre shop

Among 16 collectors interviewed, 69% of the collector falls into type iii, which they buy the used tyre from tyre shop. 31% of the collector voluntary collected the used tyre without charges. The collector claimed nowadays the tyre shop not paid the collector to collect the used tyre.

The results showing that collector paid for the re-treadable tyres price is higher compare to passenger car tyre which varies from RM 3 – 10 per tyre. The price of passenger car tyre is varies from RM 0.1 – 0.7 per tyre.

One of the tyre shop informed that there is a situation that the goods truck sending the goods to Kelantan from Kuala Lumpur, instead of coming back with empty truck, they will collect the used tyre from workshop. Similar information was also obtained based on interviews conducted in Terengganu (Marang and Setiu, around Kuala Terengganu).

Figure 25 and **Figure 26** below show the analysis of the collector information obtained from interview.

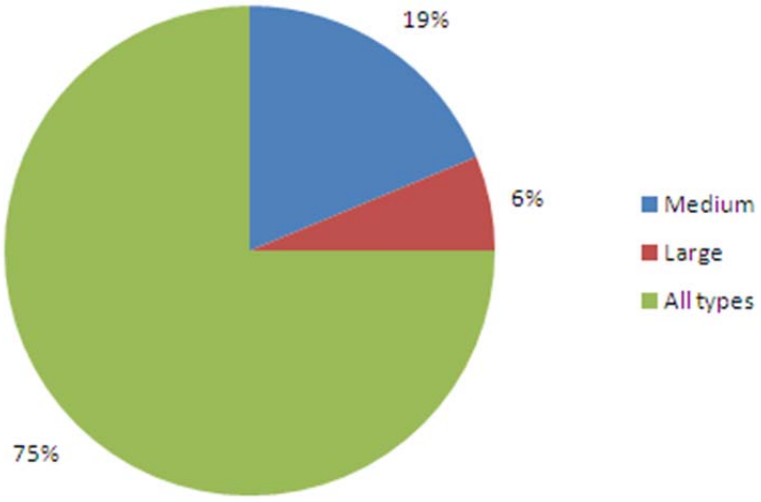


Figure 25: Type of used tyre collected

Medium size of the tyre consisted of passenger car tyre; large consisted of heavy vehicle tyre such as lorry, or truck. Most (75%) of the collector collected the used tyre range from medium size to large size.

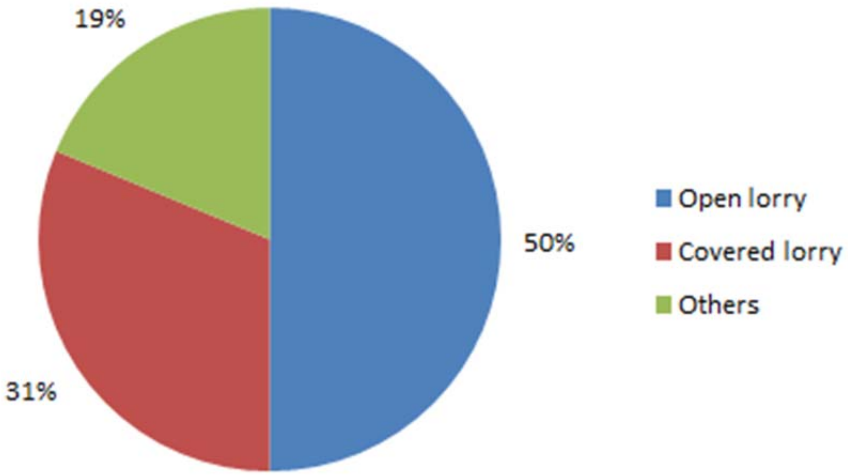


Figure 26: Type of vehicle used for collection

19% of the collectors interviewed did not disclose the type of vehicles used during their collection. The number of vehicles owned by the collectors was reportedly between 1 to 2 lorries as most of the collector interviewed is individual collector and not owned a company.
The collected used tyres that are retreadable (6%) will be sold to used tyre traders, or directly to the retread workshop. On the other hand, the scrap tyre collected will be sold to recycler, or recycling factory (94%).

Figure 27: Retreadable tyres collected by the collector (Penang)

Survey on treatment facilities

The surveyor has interviewed a number of treatment facilities during the survey period. The details of the locations surveyed are as follow:

Table 14: Type of treatment facilities visited

No	Type of treatment	Name of location
1	Pyrolysis	TR3 TR4 TR5
2	Recycling	TR1
3	Reclaim	TR2 TR6

7 treatment facilities which were identified during the inception phase were found no longer in the business of processing scrap tyre services (TR7 – TR13).

The locations of the treatment facilities are shown in the map below:

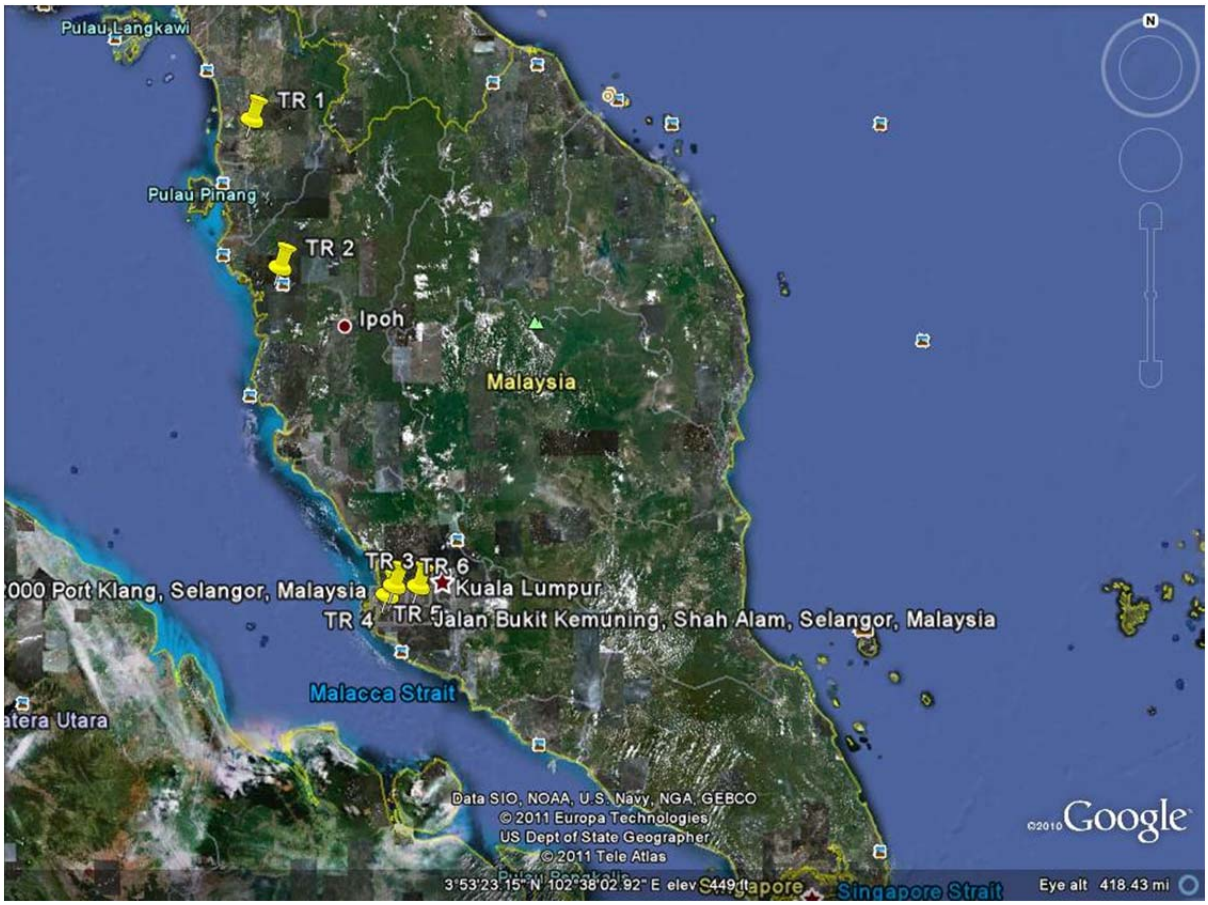


Figure 28: Location of treatment facilities

TR1

TR1 was founded in 1971 as a small retailer of tyres, wheels, batteries and wheel alignment servicing in Kedah. In 2005, TR1 entered the tyre recycling business. Their plant has an area about 25,000ft^2. The plant receives and treats about 200 large scrap tyres per day from all around Kedah and Seberang Perai and other places in the northern part which were within 100km radius from their plant. TR1 produces rubber powder and recovers steel from the tyres.

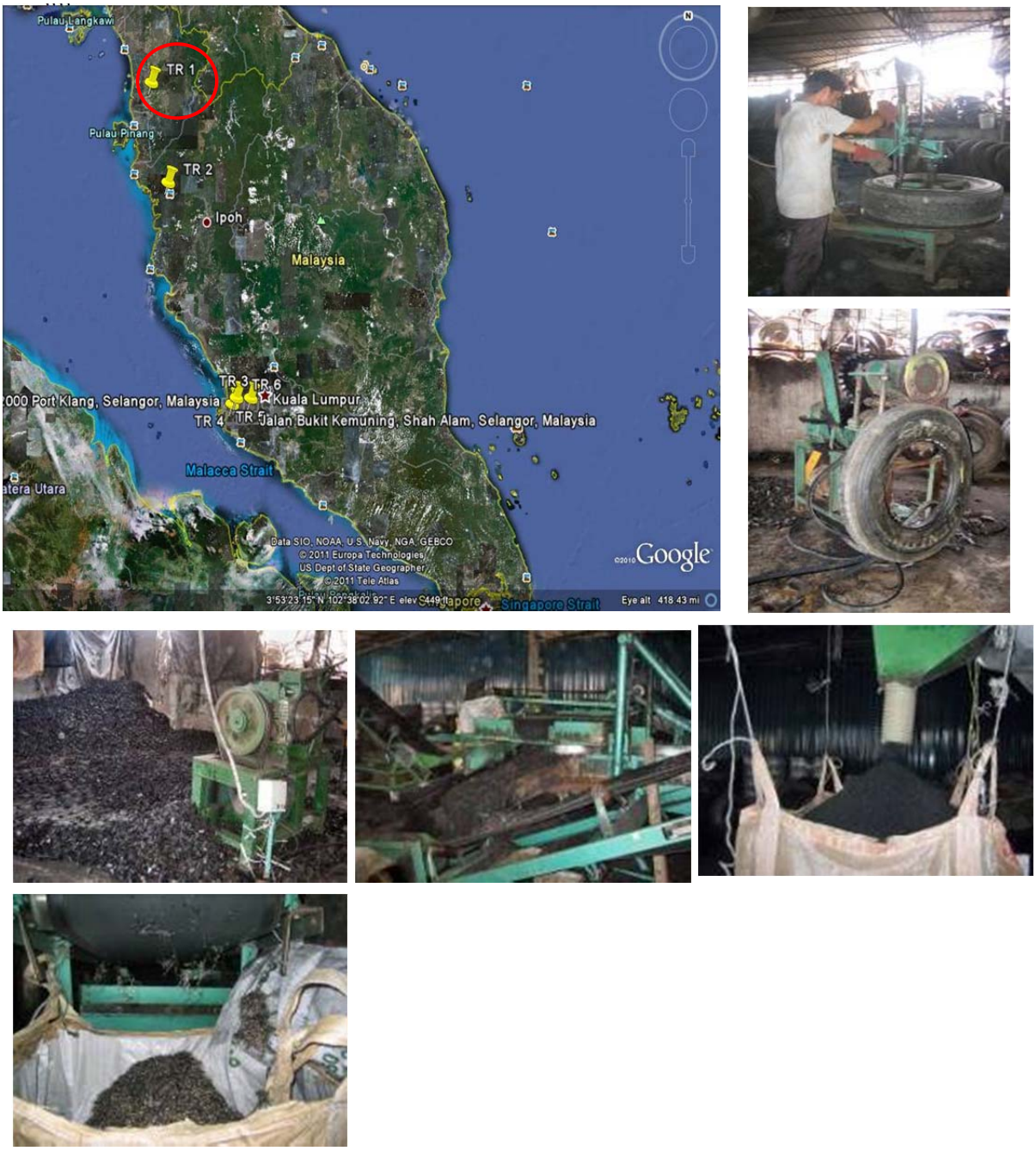
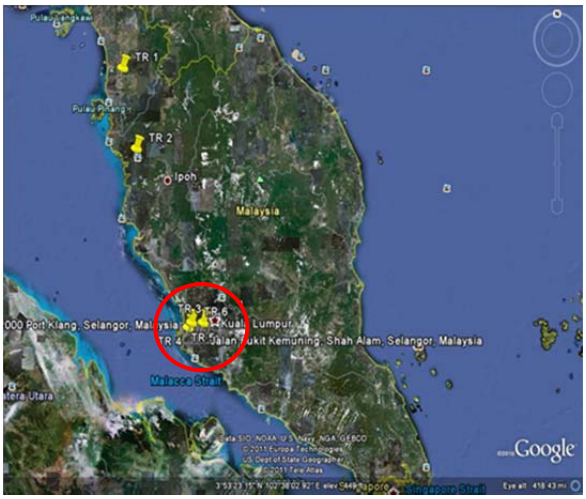


Figure 29: Tyre Recycle Premise 1 (TR1) Scrap Tyre Recycling Process

TR2

TR2 is a pioneer reclaim manufacturer in Malaysia. Currently, the plant houses about 200 tonnes of tyres. The plant collects rubber waste and produced a variety of end products from the reclaim processes such as Rubplas GRV, tyre reclaim, tyre dust, glove reclaim and tube reclaim. Besides producing reclaim, the environmental-friendly plant also recovers steel to be sold and used the oil extracted from burning the rubber waste as a fuel to run the plant.

Figure 30: Photo from the visit to TR2



TR6

TR6 received the raw materials as shredded tyres, rubber crumb and powder usually as by-products or unwanted materials from tyre retreading company. In addition, TR6 does not possess infrastructure with the capabilities to treat, e.g. shredding in their facility and rely on the raw materials which are wastes from the retreading company or directly from tyre recyclers who can provide the raw materials in shredded form or powder form. According to General Manager, the raw materials however must come specifically from the truck tyres. The tyre of passenger car and other smaller types of tyres are not favourable as their production raw materials. The capacity of facility is 10,000 tons/year. The product is usually sold to mainly Southeast Asian countries for use as raw materials in manufacturing tyres, rubber sole, automotive rubber products, inner tube, rubber sheeting and conveyor belt.

TR3; A plant that develops and enhances a technology for waste tyre pyrolysis. The plant receives scrap tyres either as a whole or shredded from both local and overseas. In a day, the plant treats about 10 tonnes of scrap tyres. The end products are recovered oil, carbon black, syn gas and steel. The oil will be sold to oil traders which will then be exported while carbon black, as a raw material will then be sent to local factories to be processed into fuel / activated carbon before being sold. As for the steel, they will be recovered and sold to steel mills.

TR4; A carbon black manufacturer and the pyrolysis plant have an area of 8,000ft^2. The plant has been in operation since year 2004 and was licensed by both the Department of Environment (DOE) and Department of Occupational Safety and Health (DOSH). However, the plant has not been operating for a year due to upgrading purpose and will start their operation in May 2011 .Previously, the plant treats about 700 tonnes of scrap tyres which will then be processed into carbon black, fuel oil and steel in a month. The plant received scrap tyres from collectors within the area of Klang Valley which is not more than 30km radius.

TR5; A demo plant that can process 20ton/day (non-continuous; each full chamber processes approximately 4 hours. Paying RM 50/ton for rejected scrap tyre (truck) from tyre retreading company (maximum RM 80/ton for scrap tyre in better condition) in order to keep up the supply. The plant will take shredded tyres, waste rubber/plastic which will be used as supplement to pyrolysis process. The end product consists of metal wire, carbon black, oil, and carbon ball (waste gas is produced slightly and recycled in the system for combustion.

Figure 31 : Visits to various TR stations

The detail information on the summary from the survey is attached in **Appendix K**.

Disposal of used tyres to landfill

The survey team interviewed the officer in charge for landfills, transfer station and conducted site visit to selected landfill. The detail information on the landfill and transfer station as listed in **Table 15** below:

Table 15: List of landfill and transfer station visited

Location	Name of location
Landfill / Transfer Station	**Visited**
	1. Jabor Jerangau landfill, MP Kuantan 2. Sungai Siput Selatan landfill, MD Kampar 3. Sungai Ikan landfill, MD Kuala Terengganu 4. Kuang Inert Waste landfill, Worldwide Landfills
	Not Visited (only interview the officer in charge)
	5. Padang Siding landfill, MP Kangar 6. Batu Maung Transfer Station, MP Pulau Pinang 7. Keledang landfill, MD Pekan 8. Bachok landfill, MP Kota Bharu

Most of the landfill only received the motorcycle tyre which is mixed with the domestic waste.

Jabor Jerangau Landfill

Only Jabor Jerangau Landfill in Kuantan received scrap tyres. According to Hj. Mohd. Fadzli bin Darus (Landfill Engineer) apart from the 500 tonnes of waste receive daily, 1% of the waste are rubber waste (mostly motorcycle scrap tyres). There is no segregation of scrap tyres with other domestic waste in the landfill as it is costly and requires large area (bulky). Besides, he informed that most of the scrap tyres sent in were from the government agencies (e.g. Malaysia Maritime Academy) and workshops.

Kuang Landfill

According to En. Imran, the declining trend of tyres disposal was started since 2004. By the setup of Kuang Inert Landfill, the tyres were received less than 50 tons each year from 2007. By 2010, the tyres disposed at the landfill were barely 1 ton. He has not seen tyres being sent in truck load since the beginning of 2011 other than one or two tyres mixed with garden/construction debris and shredded pieces of tyres.

The detail information on the summary from the survey is attached in **L,** while the summary of total samples collected by state is in **Appendix M.**

Figure 32: Use of scrap tyres at car racing track

There are some other reuses of used tyres that are found out from the respondent which includes:

i) Used in mining industry as protection ground
ii) Used in oil palm plantation to protect the palm oil seedling from wild boars
iii) Used for landscaping and burning purposes

3.2.4 Limitations and Assumptions for Mass Flow Model

Most of the collector information is obtained from the workshop. Out of 181 workshops interviewed by the surveyor, only 12% of the workshops can provide the information on the collector. The surveyor managed to interview 16 collectors. The samples size for the collector is limited.

The collector interviewed not willing to provide information needed for analysis, some of the information obtained questionable.

3.2.5 Flow Analysis of Scrap Tyres (from tyre shops to disposal sites)

In general, there are 3 types of existing tyre mass flow, which are small scale, medium scale and large scale tyre flow which presented in **Figure 33**, **Figure 34** and **Figure 35** below:

The classification of tyre sizes is presented as below:

(i) Small scale tyre; Small-sized tyres refer to bicycles and motorcycles tyres
(ii) Medium scale tyre; Medium-sized tyres refer to tyres which are used in cars and light trucks such as passenger cars or motorcars, taxis, multi-purpose vehicles (MPVs), mini vans, sport utility vehicles (SUVs), mini trucks and pick-up trucks
(iii) Large scale tyre; Large-sized tyres refer to tyres which are used in medium and heavy trucks such as buses, tractors, trucks and heavy haulers

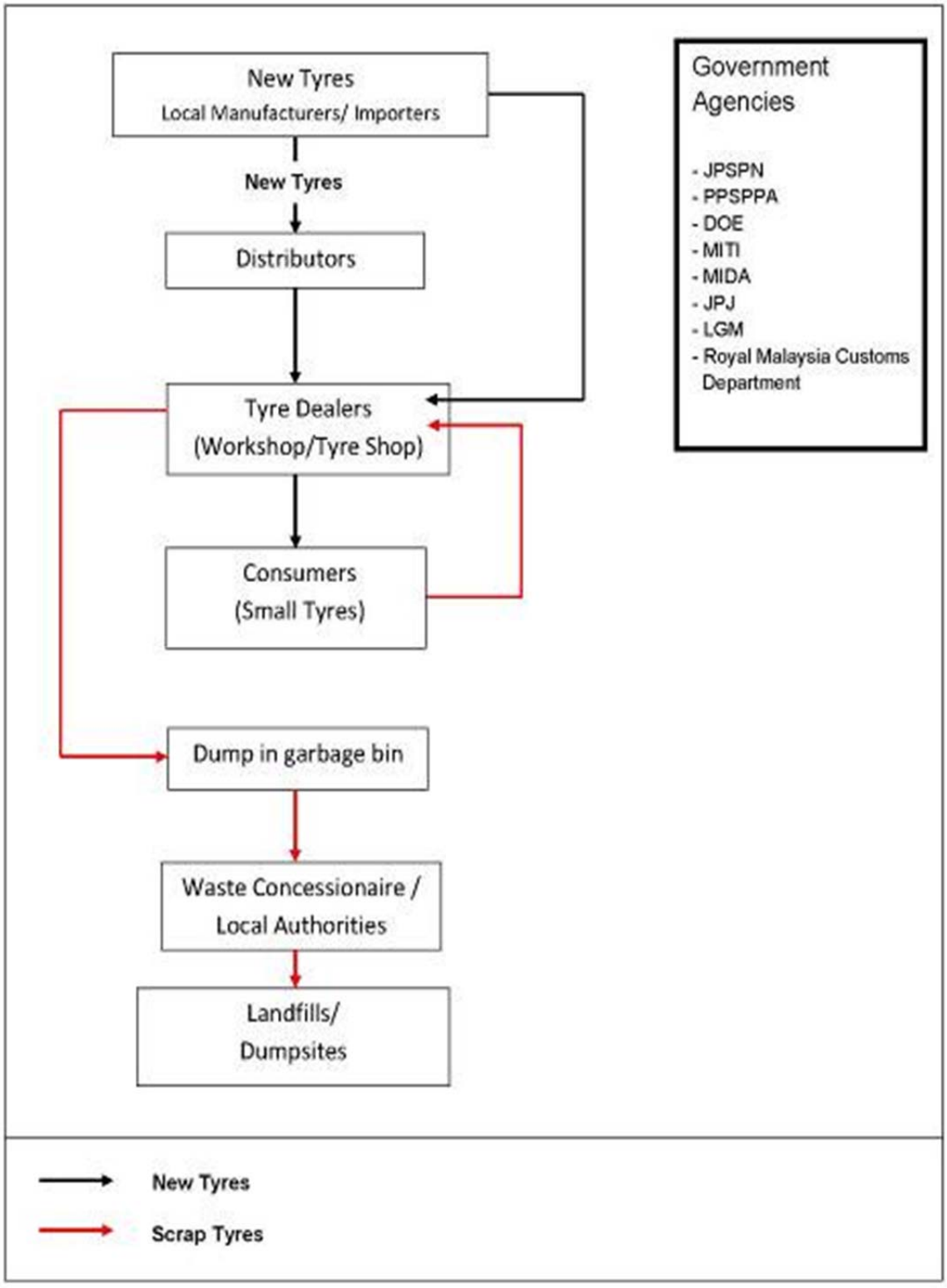


Figure 33: Flow chart for motorcycle tyre

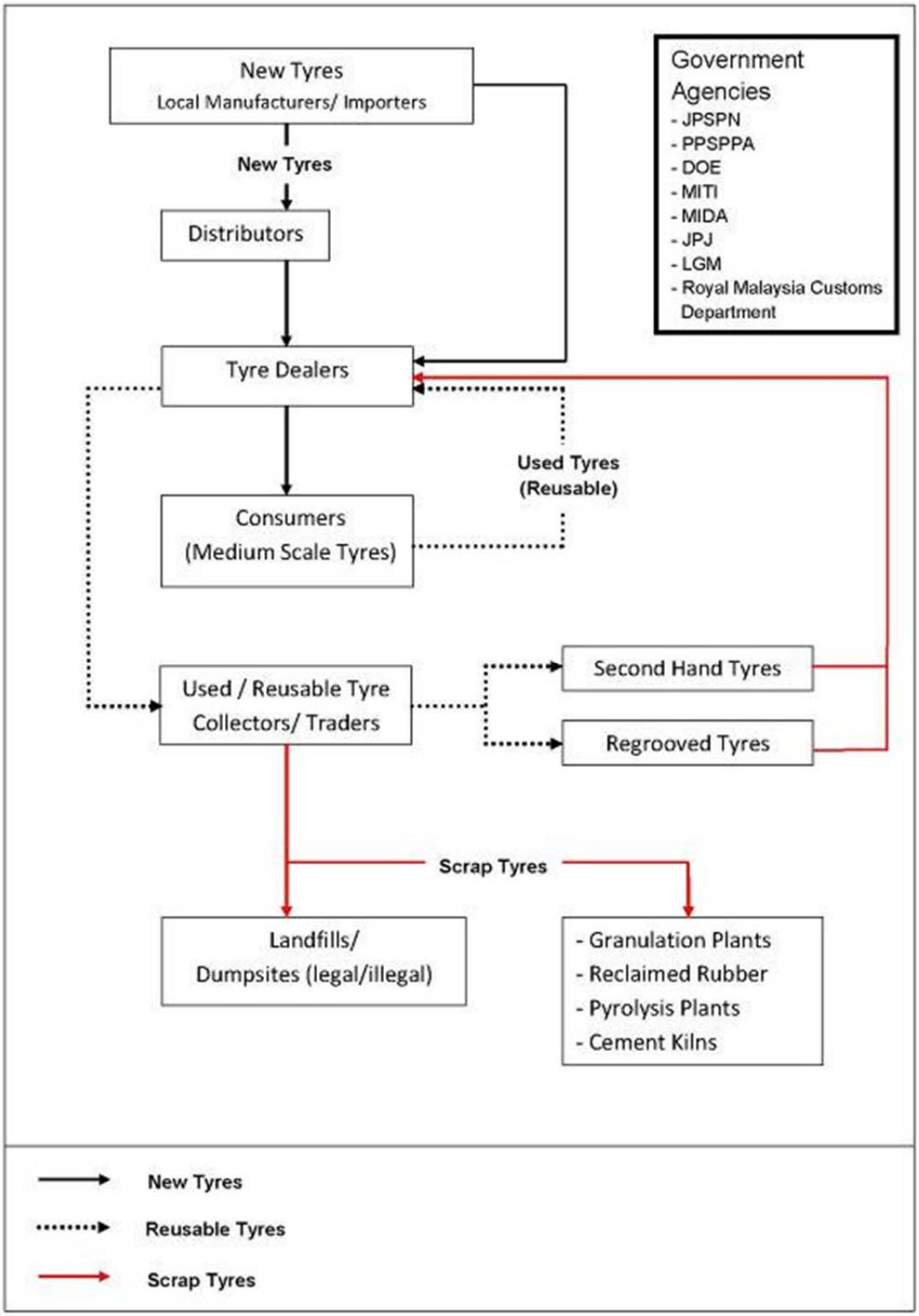


Figure 34: Flow chart for medium scale tyre

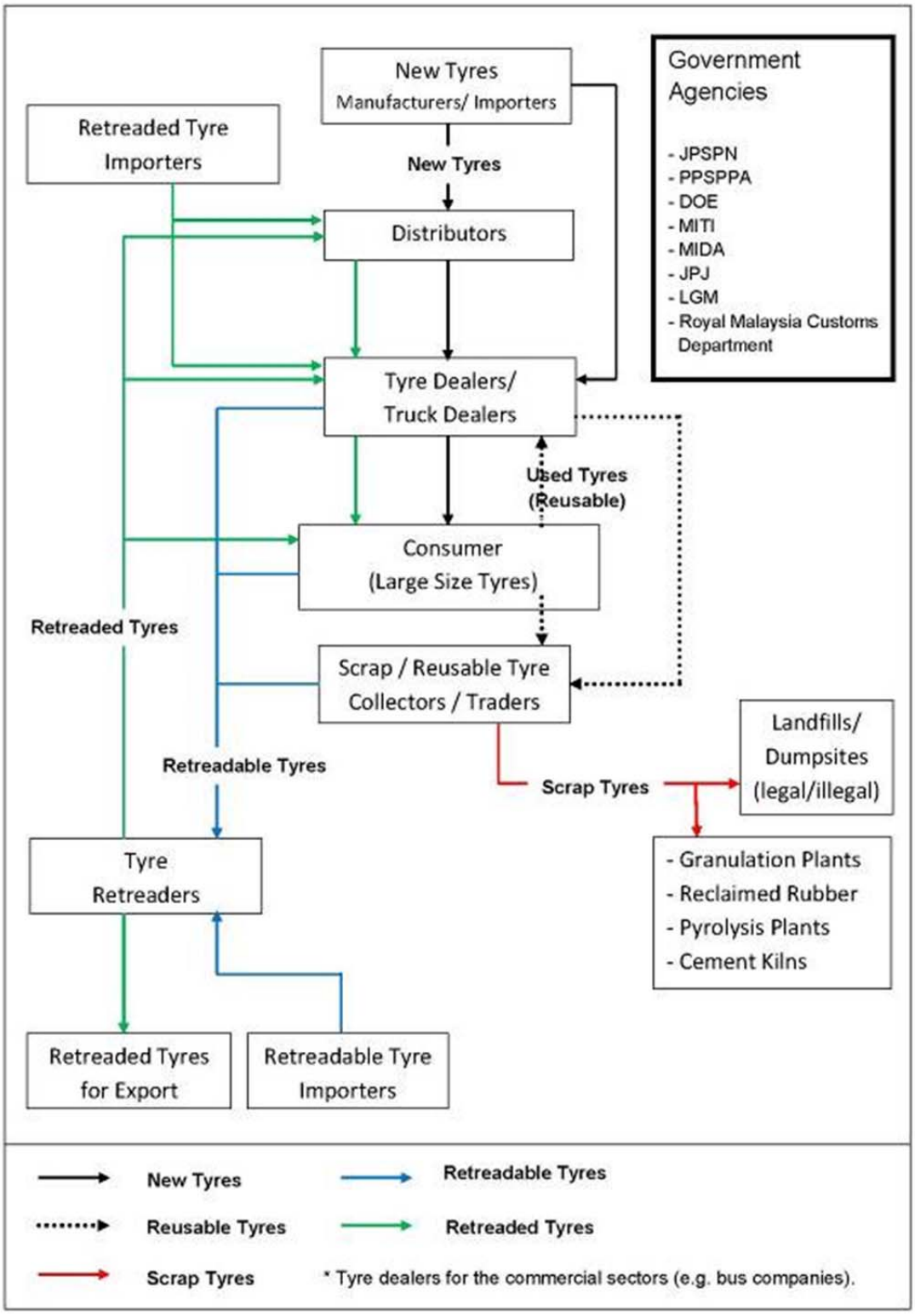


Figure 35: Flow chart for large scale tyre

Summary for activity 3.2

The flow of scrap tyres can generally be categorised generally into the following groups:

(i) Where there is an existing treatment/ recycling facilities for scrap tyres
(ii) Where there is NO treatment/ recycling facilities for scrap tyres

The findings from the survey were used as the basis for deriving the flow of scrap tyre within the surveyed areas.

The general findings applied to derive the overall scrap tyre waste flow are:

- Majority of the scrap tyres generated are collected by private collectors. From the survey, it was found that almost all (99%) of the passenger and commercial tyres are collected. These collected tyres are mainly sent for reclaim or retreading. Only approximately 1% of the tyre shops claimed that they discarded on their own to registered landfill;

- Most of the scrap tyres from motorcycles end up in disposal sites. There is no recycling of these tyres. The surveyed workshops claimed that the scrap tyres were dumped into the garbage bins which were mixed with domestic waste. The waste was collected by contractors appointed by the local councils. From our site visits to the landfills, it was also discovered that most of the scrap tyres received were motorcycle scrap tyres, mixed with domestic waste. Insignificant amount of scrap tyres were exported as whole tyres. This was supported by the interviews with the MATRDS as well as from the data provided by MITI[23]. The data from MITI indicates those exported amounts are mainly processed scrap tyre products such as rubber granules or powder;

- The amount of scrap tyres used for other purposes such as landscaping, impact protection and illegally dumped or burnt is insignificant as compared the overall amount;

- Scrap tyres used in cement industries as fuel are 100% imported from overseas. No local generated tyres are reported to be used from the survey;

- From the surveys conducted, the total capacities for the 4 main treatment plants were reported to be around 170 tonnes/day. From Activity 3.1, the amount of scrap passenger tyres generated per day was estimated to be about 329 tonnes/day. This suggests that the remaining scrap tyres sent for recycling ends up in other smaller scrap tyre recycling facilities observed during the survey in various locations.

[23] *Communication with En. Fahrulrazy Othman, Assistant Director, Wood and Rubber Unit, Sectoral Policy II Section Ministry of International Trade and Industry (MITI), Kuala Lumpur,Malaysia.30th May 2011*

From the survey conducted, the surveyor observed and found out that the flow of scrap tyres where the location with or without an existing treatment facilities are the same. Generally the overall mass flow for the tyre presented in **Figure 36** below:

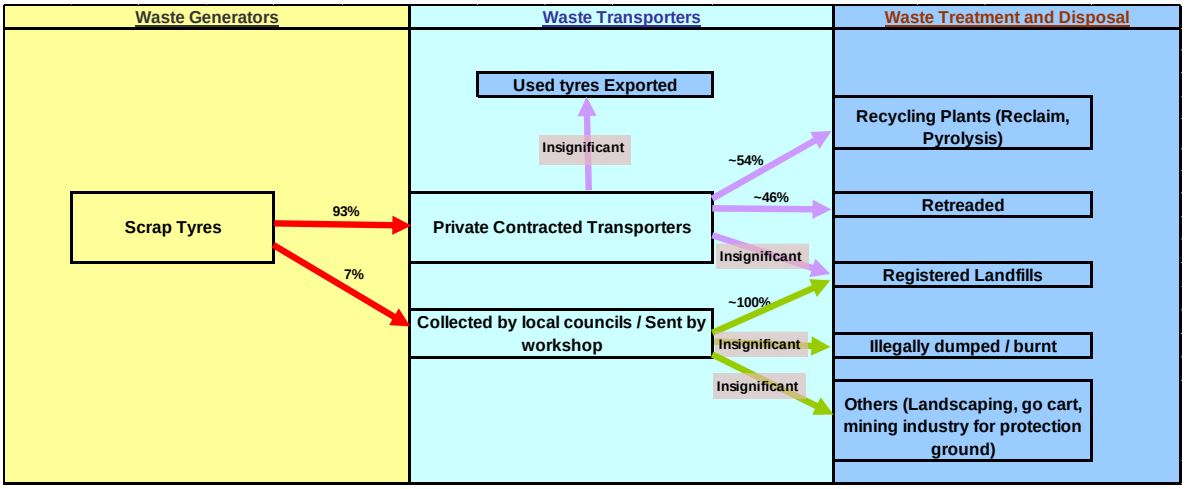


Figure 36: Overall mass flow of scrap tyres in the Peninsular Malaysia

From the survey conducted in the area with existing treatment and recycling facilities, 3% of the scrap tyre was not collected or sent by the workshop. These 3% of the scrap tyre was generated from motorcycle workshops. All of them claimed that the scrap tyres were dumped into the garbage bin which is mixed together with domestic waste. The waste will be collected by the contractor appointed by the council. From the site visit to landfills also discovered that most of the scrap tyre received are motorcycle scrap tyres and mixed with domestic waste.

29% of the workshop claimed that the scrap tyre was collected either with payment of without payment were sent to treatment facilities. 63% of the tyre collected from the tyre shop, workshop and etc. are unknown sent to where.

From the surveys conducted, the total capacities for the 4 treatment plants are around 170 tonne/day. In average, the capacity of each of the treatment plant is estimated to be about 40 tonne/day.

The estimation from **Section 3.1** above indicated that 670 tonne/day of scrap tyre was generated in Peninsular Malaysia for year 2010. The surveys showed that only 170 tonnes of the scrap tyres were sent to the treatment plants. The remaining 500 tonnes of the scrap tyre was assumed to be sent to small scale or illegal treatment plants in Peninsular Malaysia. This assumption is further supported by the findings from our surveys that all the scrap tyres collected by collectors were not sent to the landfills.

3.3 Treatment and Recycling Options[24]

3.3.1 Components of a tyre

The challenge of scrap tyre management arises mainly from the technical and commercial issues relating to tyres both as a product and as a waste. Tyres are made of materials including synthetic and natural rubber, textiles, steel, carbon black, aromatic extender oils and various chemical additives, which are "vulcanised" at a high temperature during the manufacturing process. The main components of car and truck tyres are as shown in **Figure 37** and **Table 16.** The result is a particularly stable product that requires a great energy to properly break the material down to useful product.

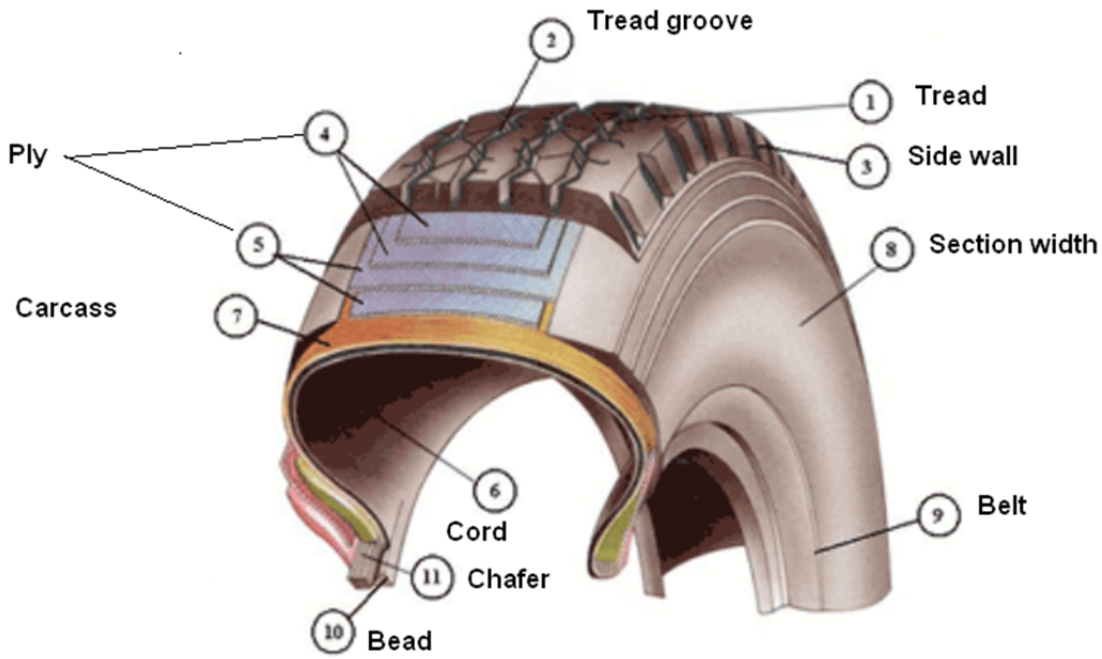


Figure 37: Components of a tyre[25]

[24] *Activity 4 of TOR document*

[25] *Source: Revised Technical Guidelines on Environmentally Sound Management of Used Tyres, UNEP 30th November 2008*

Table 16 : Components of a tyre, legends and definitions[26]

Legend No.	Components	Definitions
1	Tread	part of a pneumatic-tyre that is designed to come into contact with the ground
2	Tread groove	space between the adjacent ribs or blocks in the tread pattern
3	Sidewall	part of a pneumatic-tyre between the tread and the area designed to be covered by the rim flange
4	Ply	layer of "rubber" coated parallel cords, In the radial tyre, it has the purpose of stabilizing the tyre
5	Ply	layer of "rubber" coated parallel cords, In the radial tyre, it has the purpose of stabilizing the tyre
6	Cord	strands forming the fabric of the plies in the pneumatic tyre
7	Carcass	structural part of a pneumatic tyre other than the tread and outemost "rubber" of the sidewalls which when inflated supports the loads
8	Section width	linear distance between the outside of the sidewalls of an inflated pneumatic tyre, when fitted to the specified measuring rim, but excluding elevations due to t labeling (marking), decoration or protective bands or ribs
9	Belt	radial ply or bias belted tyre and means a layer or layers or material or materials underneath the tread, laid substantially in the direction of the centre line of the tread to restrict the carcass in a circumferential direction
10	Bead	part of a pneumatic tyre that is of such shape and structure as to fit the rim and hold the tyre onto it
11	Chafer	material in the bead area to protect the carcass against chafing or abrasion

Table 17: Percentage of main components of car and truck tyres[27]

Material	% of tyre components in a given vehicle type	
	Automobile	Trucks
Rubber / Elastomers	45	42
Carbon black and silica	23	24
Metal	16	25
Textile	6	
Zinc Oxide	1	2
Sulphur	1	1
Additives	8	

(- LCA[28] and personal communication from tyre manufactures for truck tyre)

[26] *Source: Revised Technical Guidelines on Environmentally Sound Management of Used Tyres, by UNEP, 30, November 2008*

[27] *Source: Automobile tyres: European Tyre & Rubber Manufacturer Association (ETRMA)*

From the above table it is obvious that other than rubber or elastomers (synthetic rubber) a tyre is made up of considerably large percentage of other non-rubber materials for the purpose to increase the tyre's strength and durability on the road. These additional components in a tyre have made the recycling process to be anything but straight forward. For instance, tyre are more difficult to combust than conventional fuels (even though the energy content is higher than that of most coals and similar to that of natural gas), and therefore tyres require higher temperatures and/or longer residence times to promote a complete breakdown of the hydrocarbon content into carbon dioxide and water. A significant amount of energy is also needed to mechanically reduce the size of tyres, in order to produce materials that are suitable to be recycling into marketable engineering, commercial or industrial products. So while tyres represent a feedstock with high energy content, which contain potentially valuable constituents such as carbon black, organic oils and steel, extracting these materials is not only complicated, time consuming but also economically taxing

Used tyres are among the largest and most problematic sources of waste in Malaysia due to the large volume produced and their durability**. Table 18** outlined the typical weightage of the few general types of tyres used in the country. From the survey done, the estimated quantity of tyre generated in the country is approximately 180,000 units per annum. Hence the total weightage of tyres generated in the country totalled to a staggering amount of 1,800 tonnes per annum (based on normal passenger car's tyre weightage).

Table 18: Weightage of Different Type of Tyres

Type of tyre	Average weight (kg)	Units / ton
Passenger car	6.5 – 1.0	154
Utility (including 4 x 4)	11.0	91
Truck	52.5	19

(Source: Hylands and Shulman, 2003)

3.3.2 End-of-Life Tyre (ELT)

End of Life Tyre (ELT) is defined as the phase of which a tyre can no longer be used on vehicles (after having being re-treaded or re-grooved) anymore. All tyres from all type of transport vehicles including passenger cars, trucks, airplane, two-wheel or off-road vehicles will generate ELT. Developed countries generated most of the ELTs in the world as they have a greater number of vehicles in use. However, in the last 15 years too that developed countries has shown dramatic increase in the recovery rates of ELTs and the recycling cost has significantly decreased due to the improved efficiency in management structures and recovery routes.

[28] *Lifecycle Assessment of an average European Cartype. Preconsult for ETRMA, 2001*

While high recycling/recovery rates are achieved in major developed countries, the same is not true for many developing countries like Malaysia, Indonesia, Philippine or Thailand where land-use and disposal regulations are still weak and infrastructure for recycling is still very much at its early stage. To worsen the problem, many areas even receive imported ELTs that further add to the already problematic stockpiles of ELTs from local sources.

In the current perspective, it comes out that the general criteria normally applied to the waste management problem is to firstly encourage the minimisation of waste production during manufacturing process, secondly reusing in the original form, recycling the materials and energy recovery with disposal as to be the last and final choice. The treatment and recycling of ELTs is always associated with diverse potential environmental impacts and to some extend affect human health as well.

It is therefore, the scope of this section to evaluate and compare the recycling options of ELT in association with environmental impacts and the economic viability in terms of transport, operation and the supply and demand chain to be applicable in local scenario.

3.3.3 The Recycling and Treatment System for ELT

There are many recycling and treatment technology available in the world for ELT. Particularly in industrialised countries, where a higher car density caused the problem of how to dispose of used car tyres much earlier and to a greater extent, industrial and research facilities tried to develop concepts for the recycling of tyres during the past few decades. Although a fair number of concepts and processes have been introduced, none is without its limitations and shortcomings. Depending on existing technological facilities, environmental legislation, availability of money for environmental activities and public awareness, some of these concepts were successful to a certain extent. Nevertheless, a general breakthrough has yet to be achieved.

Some of the available technologies available in the world for recycling and treating ELT are as listed below:

Table 19: ELT's treatment and recycling technology

No.	Technology / Application	Description
1	Devulcanization	the process of breaking down and recycling rubber) methods including thermal, mechanical, ultrasound and bacterial such that it can be used to make molded rubber products from the ELTs, this technology is usually cost prohibitive
2	Road surfacing	In or pavement where recovered rubber from ELTs is used in a pavement surface treatment consisting of a sprayed film of bituminous binder covered with aggregates. This technology is prohibitive in some countries including Malaysia as main road contracts are mostly based on 'technical specification' and ELTs in roads applications has yet to be accepted widely
3	Shredding and granulation	recovery of secondary raw material from ELT
4	Thermal decomposition	pyrolysis process to recover secondary raw material such as steel, oil and cabon black from ELT
5	Energy recovery	tyres as alternative fuels in power plants, cement kilns or factories which is energy intensive
6	Civil engineering	weights for silage cover sheets; erosion protection for walls and steep slopes; shoreline protection as breakwaters; harbours and docks, as dock bumpers and ship fenders
7	Agriculture	protections for saplings (especially in oil palm plantations); fishing industry, as artificial reefs for fish breeding
8	Household and communities	as bumpers in garages and playground equipment

It is noted that Civil engineering application can only offer very limited outlet for the thousands of scrap tyres generated every year in Malaysia. This is further impacted by the irregular demand for such application, hence rendering this recycling option to be not economically viable locally.

3.3.4 Economic Evaluation of Technology Methodology

In analysing the economics of tyre recycling and treatment options, it is useful to consider each situation where cost data are available in terms of the profit per tyre. Entrepreneurs will most likely launch a tyre processing facility only if the ***potential profit per tyre is high enough***. The profit per tyre may be computed based on the equation below:

$$P = F + R - C - T - D$$

Where;

P = profit per tyre
F = tipping fee collected per tyre by the recycling facility
R = revenue received per processed tyre
C = processing cost per tyre for operating the facility
T = transportation cost to bring in the tyre
D = disposal cost for waste products

Clearly, for entrepreneurs to invest into a technology there must be a positive profit per tyre for any feasible utilization method. If the equation yields a negative value (a loss) then the private sector will be very unlikely to invest in the said technology. Not only must there be a profit, but it must be high enough to give a good return on the invested capital to build a plant or to purchase new equipment. A rough method of analysing the return is to calculate the simple payback period using the equation below:

$$Payback\ Period = Capital\ Invested / Annual\ Profit$$

The equation basically tells how many years it will take for the capital invested in the plant and equipment will be paid back. Generally, as a rule of thumb, most investors will demand a payback period of **(3) three years** or less before they are willing to risk their money. This will be a benchmark used in the analysis for the economic feasibility of each technology selected in this chapter.

3.3.5 The Recycling System Under Evaluation

Four different technologies for recovery and recycling of used tyres were selected for analysis in this study namely:

(i) Incineration of used tyres for energy production
(ii) Pyrolysis
(iii) Shredding and Granulation

These technologies are selected for feasibility exploration based on the following advantages over the other technologies namely:

- They are existing technologies which already have been proven to be workable and is used in commercial scale to certain extent in foreign countries;
- They have already been introduced into local market and is known and generally accepted by the local community;
- They give the possibility of retrofitting some of the existing facilities (for example clinker plants and power plants) in the country to help reduce the high cost of setting up new

facility and at the same time provide a wide spread reception facility at strategic locations for recycling ELTs in the shortest time possible;
- They can provide a long term solution to the ELTs problem in the country and not merely ad-hoc solutions which offer limited or inconsistent outlet to the huge quantity of ELTs.

The will be explored in terms of the following factors namely:

- Environmental impacts;
- Acceptability by the local market and the people;
- Economic feasibility;
- The locality existing establishments or the simplicity to establish new facility which can accommodate the huge amount of ELTs from different regions of the country.

3.3.6 Incineration of used tyres for energy production

Scrap tyre as alternative fuel or Tyre-Derived Fuel (TDF) is currently the largest single market for scrap tyre management in the world. It has occupied approximately 82% of overall scrap tyre recycling. Two major combustion facilities for TDF used in the world which may be applicable to Malaysia are:

(i). Cement kilns; and
(ii). Power plants

As an energy source, TDF has good potential compared to other fuel source alternatives. TDF has high fuel value of approximately 12,000 to 16,000 BTU per pound compared to coal (12,000 BTU per pound) and wood (5000 BTU per pound). The other advantages of TDF are a compact and consistent composition and a low moisture content which are the important properties for combustion facilities. However, the problem of low combustion point of tyres poses a great obstacle for them to be used as widely as other solid fuel in any industrial application.

A major technological consideration of TDF application is related to emission control from the combustion facilities. Provided that quality and supply can be maintained, TDF can be incorporated into long term planning such that significant economic advantages can be obtained.

What is TDF?

Tyre Derived Fuel (TDF) is an umbrella word, which describes tyres in different shape and sizes (usually means chopped up tyres, tyre chips and crumb rubber) to be used as fuel source. TDF is classified into several grades. Tyres contain about 30% of metal wire and fabric, and removal of the wire involves an expensive process, which requires fine shredding and the use of powerful magnets. Wire-free TDF is a considerably higher grade but the process of fully removing the entire steel component is tedious and expensive, hence most shredded tyres used as TDF still contain a considerable amount of steel in it.

To recover the energy of used tyres they can be either directly incinerated in appropriate energy-from-waste plants or the tyres are transformed into combustible products (gas, liquid hydrocarbons and soot) via pyrolysis process. Since tyre consists of 80% carbon and hydrogen[29], they can be used effectively as fuel for industrial processes or to produce energy. According to US EPA Research Paper, Air Emissions from Scrap Tyres Combustion, Tyres also are known to have high energy content and Tyre Derived Fuel (TDF) is an equal or better source of energy than other fuel as shown in **Table 20** below:

Table 20: Calorific value and Emission Rate of tyres in comparison to other types of fuel[30]

Fuel	Energy (Gigajoule/ tonnes)	Emission	
		Kg of CO2 / tonnes	Kg of CO2 / Gigajoule
Tyres (TDF)	32.0	2,270	85
Coal	27.0	2,430	90
Pet coke	32.4	3,240	100
Diesel Oil	46.0	3,220	70
Natural Gas	39.0	1,989	51
Wood	10.2	1,122	110

As shown in the above table, TDF CO_2 emissions, when tyres are burned in controlled environment, are no greater than those produced by other fuels. The carbon content per unit energy is less than coal and petroleum coke, offering potential reductions in greenhouse gas emissions. Moreover the added advantage is that the cost of TDF is significantly lower than that of fossil fuels such as natural gas, coal and petroleum coke, especially when exploration, development and transport cost of virgin materials are taken into account.

Provided that quality and supply can be maintained, users can incorporate TDF into long term planning such that significant economic advantages can be obtained. However, on the downside, reportedly, polychlorinated dibenzodioxins, furans and other toxins such as NOx, SOx and heavy metals are produced in some combustion process of TDF. The presence of heavy metals such as iron, zinc, chromium and lead from the steel component of the tyre in the ash residual of the combustion process is also another environmental concern of TDF. These environmental controversies have prevented the wide application of TDF. The Study will attempt to assess these environmental concerns and the availability of pollution control technology in abating the pollution potential of TDF.

In the recent years, the utilization of scrap tyres as alternative fuel or TDF has been steadily increasing in the application of power plants, cement kilns and pulp and paper production in

[29] *Dr.-Ing Heino Vest, 1996, revised in 2000. Technical Information W13e*

[30] *Source: Greenhouse Gas Protocol Initiative, WBCSD CSI CO2, Emission Inventory Protocol, Version 2.0*

the world. These applications have demonstrated the capability to extract energy value from scrap tyres in an environmentally acceptable manner, while at the same time alleviating scrap tyres disposal problems in the communities. Scrap tyres make an excellent fuel source as they have energy value higher than coal and they represent a potential energy source of about 7,840,000 Gigajoule per year, since about 33 million (245,000 tonnes) scrap tyres were produce in the Peninsula Malaysia yearly. This is equivalent to about 1,285,245 million barrel of crude oil. (1 barrel of crude oil 42 US gallons is equivalent to about 6.1GJ of energy[31]). As such, scrap tyres can compete with other solid fuels such as coal, petroleum coke or wood in the market.

In the sections below, the use of scrap tyres as TDF in various combustion facilities is discussed further:

In Power Plants

Currently in Malaysia, there are no power plants that are in operation use TDF as their alternative fuel to However, power plants in the United States have been reported to have a few tyre-burning power plant projects and they are tabulated in **Table 21** below.

Table 21: List of power plants in the US that use tyre derived fuel (TDF)[32]

No	Power Plant	Rating (MW)	Consumption (x106 tyre / yr)	Remarks
1	Power Plant in Modesto California	14	4.9	Operation since 1987. Assessment has shown that the plant was operating within the permitted emission levels for all criteria. All the by-products are recycled including steel slag for cement production or road base, zinc oxide for zinc production and gypsum used for wallboard production or soil conditioner.
2	Sterling, Connecticut	26	9-10	Begin commercial production in 1991
3	Erie Power Plant, Lackawanna, New York (under planning)	30	10	Not constructed so far as the plan is under considerations with two other waste projects that were proposed at the same site.
4	Nevada Power Plant, Moapa near Las Vegas (under planning)	45 MV	16	The Public Service Commission Of Nevada has denied the power purchase contract due to availability of adequate tyre supply given the increasing demand in the paving and cement industries.

[31] *Source: Wikipedia "Barrel of Oil Equivalent"*
[32] *Source: Markets for Scrap Tyres, October 1991 by USEPA, Office of Solid Waste*

The typical technology used in power plants (as in the one used in Modesto Power Plant) is shown in **Figure 38.** The combustion system operates at temperature over 980 degrees Celsius. There are two tyre incinerators, each with an associated boiler. During combustion, the tyres are supported on a reciprocating stoker grate. The grate is made of bars of high temperature metal which can survive continued operation in the extreme heat. These high temperatures provide for complete combustion of tyres, while minimizing emissions of dioxins and furans. The grate configurations provide for air flow above and below, which aids combustion and helps to keep the grate cool. The grate also allows the slags and ash to filter down to a conveyor system which takes them to hoppers for by-product sales to off-site users.

The hot combustion gases rise to enter the boiler, producing superheated steam. Each incinerator has its own boiler, and they both feed steam to the same turbine generator. The system also includes a full pollution control system with flue gas desulfurization, thermal de-NO_x and a fabric filter bag house to control the emission gases from the incineration process.

The integration of scrap tyre feeding into the existing power plant boiler requires large scale modification to the boiler fuel burning system and not all boilers are designed to burn tyres effective. It is also noted that additional pollution control equipment is required for certain plants as the emission from burning tyres can be more polluting than the emission of burning coal.

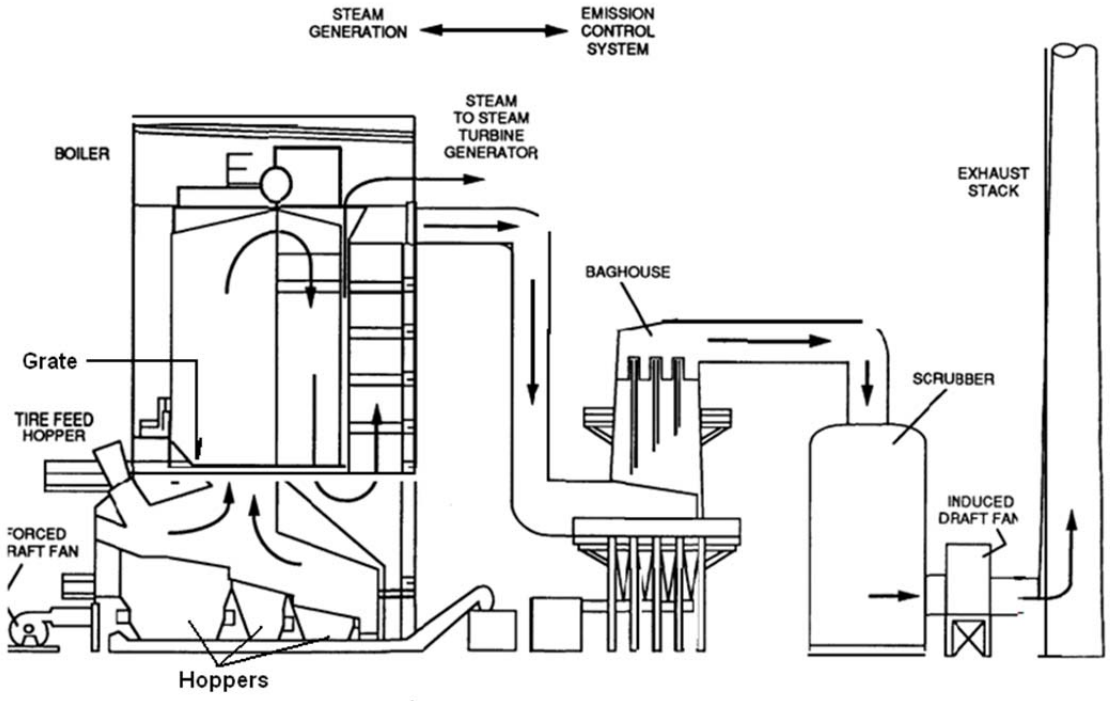


Figure 38: Typical Technology use in Power Plant for Incinerating Tyres

Technology Evaluations

Advantage of the recycling option**:**

Usually shredded tyres are used as supplemental fuel in electricity generating facilities. One tyre contains approximately enough fuel to generate more than a day's supply of electricity for an average residential customer[33]. Further with the increasing of global coal price (in the year 2011, the global coal price is expected to be approximately US 110 per metric tons), the possibility of using scrap tyres to replace coal is very appealing to the power provider.

The conversion of even 10 - 20 % of the fuel use in a power plant into TDF will greatly reduce the running cost and provide some buffer to local energy provide to cushion the uncertain coal price in the world market.
Disadvantage of the recycling option**:**

However there are greater challenges to successfully use scrap tyres or ELT as fuel supplement in electric power plants. Specifically, the tyres need to be correctly sized to fit into the fuel conveyors and mixed well to ensure proper combustion. In addition, the steel contained in tyres can cause operational difficulties. The effect of burning tyres on air emissions in coal burning utilities also varies by pollutant and the overall effect need to be evaluated on a case by case basis (Hughes, 1993).

For scrap tyres to be fed into the existing coal fired power plants (either as a whole tyre or shredded materials) requires a separate process to prepare the scrap tyre to suitable sizes for the combustion process. Moreover, many existing combustion system in coal fired power plants are tailored made to fit only for certain type of coal and not robust enough to handle a change of fuel type, let alone scrap tyres. This is further hindered by plant owners do not have the obligations to convert their facility to be suitable for scrap tyres which will easily cost more than RM 100 million and be faced with new pollution issues generated by burning tyres. Further issues which hampered the use of scrap tyres as energy source in power plants are:

(i) Large facilities and area are required to stockpile the tyres prior to the combustion process. Improper stockpiling in open yards will cause environmental problems and become breeding ground for mosquitoes and rats;
(ii) The unavailability of a secure source of scrap tyres locally for the power plant to adapt to this new alternative fuel;
(iii) The limitation of local market to make use of the by products from the incineration plant of scrap tyre like the steel slags, zinc and gypsum by products;
(iv) Low utility buy back rate and lack of incentive system for power plant to generate electricity using alternative fuel;

[33] *Waste Tyre Managemetn Plan, Sept, 1994 by Div of Env Protection, Nevada*

(v) Emission of dioxin and furan can be a problem and some power plant boilers may not operate at a temperature high enough to totally eliminate the noxious gas rendering additional investment in pollution control equipment.

Economic Evaluation of TDF for Power Plant:

Using the economic evaluation equation:

$$P = F + R - C - T - D$$

Where;

P = profit per tyre
F = tipping fee collected per tyre by the recycling facility
R = revenue received per processed tyre
C = processing cost per tyre for operating the facility
T = transportation cost to bring in the tyre
D = disposal cost for waste products

Hence,

1. Assuming that Each tyre = 8 kg (average of passenger car)
2. Based on the energy content of tyre = 32 GJ/tonne
3. Therefore Each tyre = approximately 0.256 GJ
4. Electricity tariff = 20 cents/kwhr (lowest for range of 20 – 30 cents for domestic, commercial and industrial tariff)

   Where 1 kwhr = 0.0036 GJ
   Electricity tariff = RM 0.2 /0.0036GJ = RM 55.5/GJ

5. Considering 50% of the energy from tyre burning is converted to electricity energy; each tyre generates = 0.128 GJ electricity energy

   Each tyre generate return, R = RM 5.93

6. Assuming that F = 0; no tipping fee for tyre deliver to power plant;

   C = RM 2.00; processing cost per tyre for operation, maintenance, labour and materials.
   T = RM 2.00 per tyre for sending tyre from source to the facility
   D = RM 0.30 per tyre for disposing of bottom ash (taking into account the sales of the ash to other industry ex cement plant)

   Hence , given $P = F + R - C - T - D$
   P = 0 + 5.93 -2 -2-0.3 = RM 1.63 per tyre

7. Consider that the power plant can recycle 30,000 Tonnes of tyres per year equivalent to 6.25 million tyres per year (based on 8 kg/ tyre).

   Hence, P = RM 1.63 x 6.25 million tyre = RM 10.2 million/year

8. Assuming that the investment to retrofit the boiler and feed in system together with the enhance pollution system in the plant = RM 100 million (Modesto Power Plant cost USD 38 million for the boiler, feed in system and the pollution control system)

Given, $Payback\ Period = Capital\ Invested / Annual\ Profit$
= RM 100 mil / RM 10.2 mil yr
= 9.8

The payback period estimated above shows that the venture is not very favourable for the investor as even with green technology incentives investor in power plants generally requires payback period of 7 years or less.

Summary of TDF viability in Coal Fired Power Plant

There are a total of four (4) coal fired power plants in Peninsular Malaysia as listed below in **Table 22**:

Table 22 : Coal-Fired Power Plants in Peninsular Malaysia

No	Plants	State	Coordinates	MW	Type[34]	Owner
1	Jimah Power Plant	Lukut, Negeri Sembilan	2o 55' 11"N 110o 43' 21" E	1,400	Thermal (2 ST)	Jimah Energy Ventures Sdn Bhd
2	Manjung Power Station	Manjung, Perak	4o 9' 44" N 110o 38' 48" E	2,295	Thermal (3 ST)	TNB Janamanjung Sdn Bhd
3	Sultan Slahuddin Abdul Aziz Shah Power Station	Kapar, Selangor	3o 7' 1" N 110o 19' 1"E	2,420	Thermal (6ST) open cycle (2 GT) with natural gas / coal with oil back up	Kapar Energy Ventures Sdn Bhd
4	Tanjung Bin Power Stations	Pontian, Johor	1o 20' 3" N 103o 32' 55" E	2,100	Thermal (3 ST)	Tanjung Bin Power Sdn Bhd

[34] *ST = Steam Turbine, GT = Gas Turbine*

The existing location of the power plants are strategically located at the Western and Southern regions of Peninsular Malaysia, if they are to be converted to ELTs reception facilities, a centralise collection centre is needed to collect and distribute tyres from the northern and eastern regions to these facilities. However, with the unfavourable profit margin and also the environmental, health and safety concern, this technology is most probably not favourable to be implemented in Malaysia.

TDF in Cement Kilns

Scrap tyres are frequently a low cost fuel source for cement kilns as this industry is able to use either whole or shredded tyres. Cement kilns appear to be very suitable for disposing of ELT because these furnaces operate at very high temperatures and have long residence times. Kiln temperatures are typically around 1400 degree Celsius.

High temperatures, long residence times and an adequate supply of oxygen assure complete burnout of organics, minimizes the formation of dioxins and furans. In addition, the cement production process can utilise the iron contained in the tyre's steel bead and belts.

The steel basically does not change the quality of the cement product, since large quantities of iron ore are already present as one of the main ingredients. With an average sulphur content of 0.5 -1.5%, the scrap tyre chip is on par or less than most coals and pet cokes. In terms of substitution, when co-processing scrap tyre chips, a kiln operator can reduce coal by approximately 1.25 tonnes for every tonne of tyre chips used[35]. As far as emissions are concern, scrap tyre chips can help to reduce the NOx levels up to 30% if injected at the right spot under optimised conditions. The rule of thumb of chip size and percentage of substitutions of scrap tyres in cement kiln is as shown in **Figure 39.** From the process perspective, certain constrain needs to be taken into account to ensure successful application of scrap tyre chips in cement kilns namely:

(i) The smaller the chip size the higher the substitution rate can be. However, it needs to be noted that a 25 x 25 mm chip size is about the smallest chip that can be produced efficiently and economically by shredder,
(ii) Via the main flame, the temperature, oxygen, micro mixing and time are far in excess of what is needed for complete combustion, even with the strong organic bonds, the hydrocarbon chains in the scrap tyres are similar to the ones in coal, hence as easy to break and volatize.
(iii) For long kilns, the chips need to be blown to the back of the burning zone to minimize impact on quality and SO3 cycle. Ideally, the injection pipe should be located above the main burner, at a 5-10 degree angle so the main flame can carry the chips further and start the volatization prior to the chips striking the load. Injection velocity of 50 m/s is preferable.
(iv) In the precalciner application, injecting the chips in the vessel over the main flame is preferred. For a preheater on the other hand, application at the main burner is preferred.

[35] *Kaytee Moran, CM-Columbus McKinnon Corp & Frederick De Raedt, ALterros.*

(v) In summary, a careful kiln assessment needs to be conducted in order to determine the pyro condition in the kiln which determines the optimum injection method of the tyre chips into the burner.

In the world, scrap tyres have been used extensively as fuel in cement plants for many years. In particular, cement plants in West Germany, Austria, Greece and Japan routinely burn tyres. The slower adaption of this means of tyre disposal in Malaysia is probably due to the relatively low fuel price; slow pace in the government in permitting the plants to burn tyres as well as lack of experience of local cement players in dealing with TDF.

A few examples of successful implementation of cement kilns in the world in integrating TDF into their process are as outlined in **Table 23** and **Figure 39** illustrates the growing trend of TDF use in cement industries in the U.S.

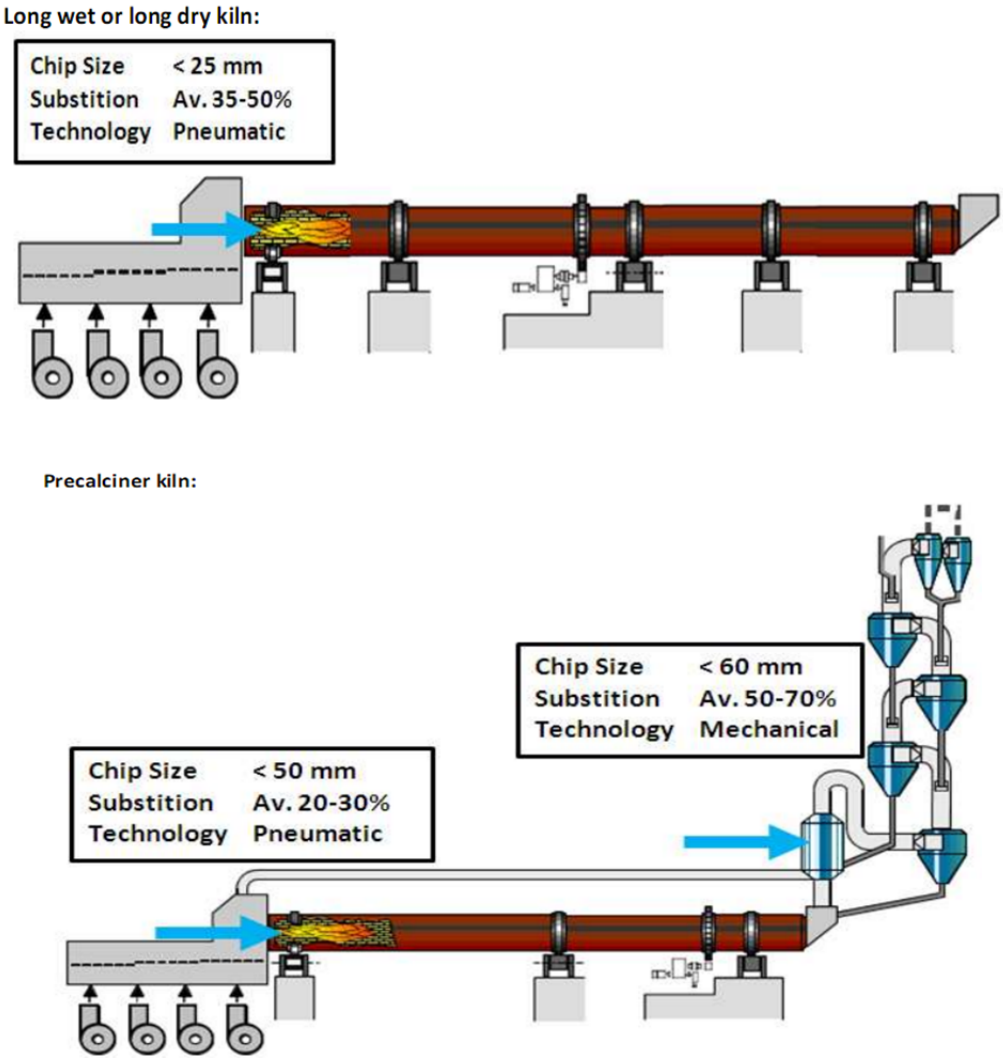


Figure 39: Typical chip size of TDF in Different Cement kiln System

Table 23: Examples of Successful TDF Application in Cement Kilns in Foreign Countries

No	Company	Consumption	Remarks
1	Heidelberger Zement in West Germany	50,000 metric tons of tyres per year in six plants	In general, the tyre substitution percentage of fuel is kept below 20 percents to optimised kiln performance and for kiln stability.
2	Genstar Cement Company in Redding California Arizona	65 tons of TDF per day.	The TDF averages about 25 percent of power consumed by the plant with the reminder to be coal. The plant meets the stringent EPA emission standards with SO2 emissions far below the limit of 243 pounds per hour.
3	Portland Cement plant in Rillito, Arizona	Approximately 1 million scrap tyres per year.	Use a mechanical feed system which is able to double their TDF feed capacity in running 4 tons per hour resulting in considerable fuel cost savings.

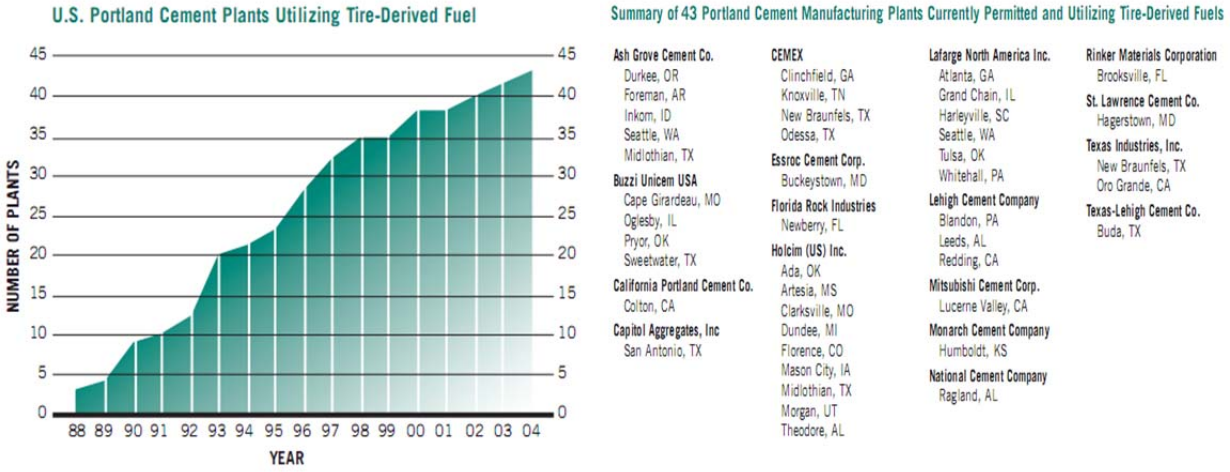


Figure 40: Trend of Cement Plants in the U.S. using TDF (1988 – 2004) & The Number of Cement Manufacturing Plants Currently Using TDF in the US[36]

[36] *Source: Tyre Derived Fuel, Portland Cement Association Sustainable Manufacturing Fact Sheet, May 2008*

Technology Evaluations

Advantage of the recycling option:

Co-incineration of scrap tyres in a cement kiln is attractive because steel and other heavy metal components which become an environmental concern for the application in power plant are absorbed by the process due to the extremely high temperature generated in the kiln. Scrap tyres is successfully proven in many cement kilns around the world as a effective fuel supplement provided the tyres are properly prepared and injected at the right location according to the kiln's design. With an optimised pyro-process, co-incineration of scrap tyres does not make any negative impact on the quality of clinker. The main characteristics of clinker, such as binding, taking and strength are sustained. The only properties that are observed to have changed are a darker colour of the clinker and better granulation (Inga Silverstravciute, Inga Karaliunaite). The implementation of co-incineration of scrap tyres in an existing cement kiln is expected to require less modification work and therefore more cost effective compared to a power plant. Almost all existing cement kilns are supposed to be able to handle scrap tyres but the feeding system may have to be different to optimise the combustion process or minimised clogging problem based on different burner systems.

Co-processing of TDF as an alternative energy source at cement kiln facility not only lowers the operational cost in a sustainable manner, but will have a direct benefit to the community. Unsightly tyre piles are a known fire hazard and can becomes the breeding ground for mosquitoes can be significantly reduced if the tyres are being sourced to be used in cement kilns as alternative fuel.

Disadvantage of the recycling option**:**

The only barrier in preventing this technology from being adapted widely in Malaysia is the lack of a steady supply chain of scrap tyres in the market. Cement kilns prefer to accept TDF in shredded forms to optimise the combustion process. The lack of such a facility which is close to the cement plant may be a reason which could have driven the cost in obtaining the material to be high as some has to be sourced from overseas to meet the demand.

The use of TDF in cement kilns faces some noneconomic barrier especially when a plant is first considering switching to TDF, at this point approval from DOE is generally required due to the changes of fuel source. And this usually requires test burns with air pollution measurements, air pollution monitoring system etc. leading to expenditures and additional time for testing. Many plant operators just would rather not bother with the disruption on the production and delay.

Economic Evaluation:

Using the economic evaluation equation:

P = F + R – C –T- D

Where;

P = profit per tyre
F = tipping fee collected per tyre by the recycling facility
R = revenue received per processed tyre
C = processing cost per tyre for operating the facility
T = transportation cost to bring in the tyre
D = disposal cost for waste products

Hence,

1. F = 0; no tipping fee for tyre deliver to clinker plant;
2. C = RM 0.50; basically very little increment in operation cost in labour for feeding the kiln with TDF instead of coal and clinker plant can accept whole tyre hence no shredding cost will incur;
3. T = RM 2.00 per tyre for sending tyre from source to the facility
4. D = RM 0 ; there is no disposal cost since the steel wire in the TDF becomes iron oxide in the clinker product
5. R = The current coal cost RM 400 / tonnes, which 1 tonnes of coal is equivalent to 0.84 tonnes of tyre (based on energy conversion 1 tonnes x 27/32 = 0.84) and if the clinker plant can receive 30,000 tonnes of tyre per year (approximately 3.5 million tyre), the saving is 35,700 tonnes of coal per year.
6. Hence, the profit = 37,700 tonnes of coal x RM 400/ton
7. Profit = RM 15.08 Millions / 3.5 million tyre
8. R = RM 4.30

   Hence, given $P = F + R - C - T - D$
   P = 0 + 4.30 -0.5 -2- 0 = RM 1.8 per tyre

   Consider the cement plant has to make capital investment of RM 5 million to setup the feed system for TDF (average set up investment cost for the clinker plant in U.S is USD 1.5 million)

   Given, $Payback\ Period = Capital\ Invested / Annual\ Profit$
   = RM 6 mil / RM 1.8 mil yr
   = 3.33 years

9. Since the payback period is just slightly above three years, this technology looks fairly attractive investment for cement operator. Furthermore with some green

technology tax incentive provided by the government for pollution control equipment it is likely the investment cost can be brought down further.

Summary of TDF viability in Cement Kiln

In summary, cement kilns appear to offer an attractive market for TDF in local market but transportation costs and lack of steady supply could be the main barrier for this technology to be widely adopted. At present there are at least 8 clinker and cement plants in Peninsular Malaysia as listed in the **Table 24** below. The locality of the clinker and cement plants shows a rather balance spread across Peninsular Malaysia covering the Northern, Central and Southern Region. The only missing coverage is the Eastern Region for the states of Terengganu, Pahang and Kelantan. This wide spread locations of clinker and cement plants can be a strategic locations if all the clinker plants are being converted to scrap tyre recycling facility, optimising transportation and delivery cost from source to the recycling centre. A storage and collection centre can very well be proposed to effectively collect the scrap tyres from the Eastern Region of Peninsular Malaysia for them to be delivered to the nearest recycling facility.

Table 24: Cement Kilns Operational in Peninsular Malaysia[37]

No	Group of Company	Plant	Address / Contact number	Plant Capacity
1	CIMA (Cement Industries of Malaysia Bhd)	Negeri Sembilan Cement Industries S/B (NSCI)	Bukit Ketri, Mukim of Chuping, 02450, Kangsar, Perlis, Malaysia 04-936 7100	Clinker – 1.6 million tonnes/yr Cement – 2 million tonnes/yr
2		NSCI Bahau Plant	Lot 3323, Mukim Kepis, K. Jelai, 72100, Bahau, N. Sembilan. 06-453 2030	Clinker – 1.3 million tonnes/yr Cement – 1.43 million tonnes/yr
3	Aolborg Portland Malaysia Sdn Bhd (APMSB))	Perak	Lot 754244, Pinji Estate, P.O. Box 428, 30750, Ipoh, Perak	White clinker – 190,000 tonnes .year White cement – 210,000 tonnes / year
4	Lafarge Malayan Cement Bhd (LMCB) Group	Associated Pan Malaysia Cement Sdn Bhd (APMC)	Rawang Works, 48000, Rawang, Selangor. 03-609 16711	Clinker – 1.7 million tonnes /yr Cement – 2.6 million tonnes /yr
5			Kanthan Works 13, ½ Miles, Jln Kuala Kangsar, 31200, Chemor Perak 05-201 1202	Clinker – 3.2 million tonnes/year Cement – 4.2 million tonnes/year
6		Lafarge Cement Sdn Bhd (LCSB)	Langkawi Works, Teluk Ewa, Mukim Air Hangat, 07000, Pulan Langkawi, Kedah 04-950 8000	Clinker – 3.3 million tonnes/ yr Cement – 5.4 million tonnes/yr
7	YTL	Perak, Hanjoong Simen Sdn Bhd	Padang Rengas, 33700, Perak 05-759 6000	Clinker – 3 million tonnes /yr
8	Tasek Corp Bhd (TCB)	Sg Buloh	Lot 1552, Kg Jaya Industrial Estate, Off Jln Hospital, 47000, Sg Buloh, Selangor. 03-615 6818	Clinker – 2.3 million tonnes / yr Cement – 2.3 million tonnes/yr

[37] *Source: The Cement and Concrete Association of Malaysia*

Pyrolysis

Waste tyre pyrolysis involves the thermal degradation in the absence of oxygen to derive various products such as oil and carbon black. During the pyrolysis process tyres will be heated in an oxygen free sealed chamber. As they decompose they will give off gas, then oil and finally leave a mix of char and steel. This will then be separated into steel, oil, gas and carbon black (carbon black is used as a pigment and reinforcement in rubber and plastic products).The benefit of this application is the conversion of waste tyres into value-added products such as olefins, chemicals and surface-activated carbon. The environmental impacts from pyrolysis process are considered to be minimal as it generates very little effluent or emission gases.

General Process of Tyre Pyrolysis

Configurations differ slightly between different facilities, but the basic tyre pyrolysis process is common. Pyrolysis involves the application of superheat steam (400 – 500 ^{o}C) and a high pressure to break down the organic component of the rubber into its original monomers or constituent chemicals; medium calorific power gases (gas fuel), high calorific carbon residue and synthetic oils (liquid fuel).

The scrap tyres (without pre-treatment) are loaded into the special wagons and are transported into the pre-heating chamber (Temperature of 60 -100 ^{o}C). Warm up tyres are then fed into the pyrolysis oven (temperature of 300 -500 ^{o}C, with pressure at 1 – 1.2 atm). The superheated steam is continuously supplied to the reactor in order to reduce pressure and to remove volatile hydrocarbons. Volatile hydrocarbons together with steam are directed to the condenser where part of the volatile hydrocarbon (up to 80 – 85%) and steam condensate at a temperature below 100 ^{o}C and are collected in the precipitator. The condensate of steam is separated from the liquid fraction of hydrocarbons and after filtration is returned to the steam generator. The remaining volatile products from the condenser are recycled back to the heater to produce water steam.

The pyrolysis process may continue from 1 up to 3 hours. In the end of the process, wagons are cooled down to 70 -80 ^{o}C in a special cooling chamber and removed from the technological line. Carbon residues are then separated from the metal remains. The flow chart showing the pyrolysis process is as shown in **Figure 41**.

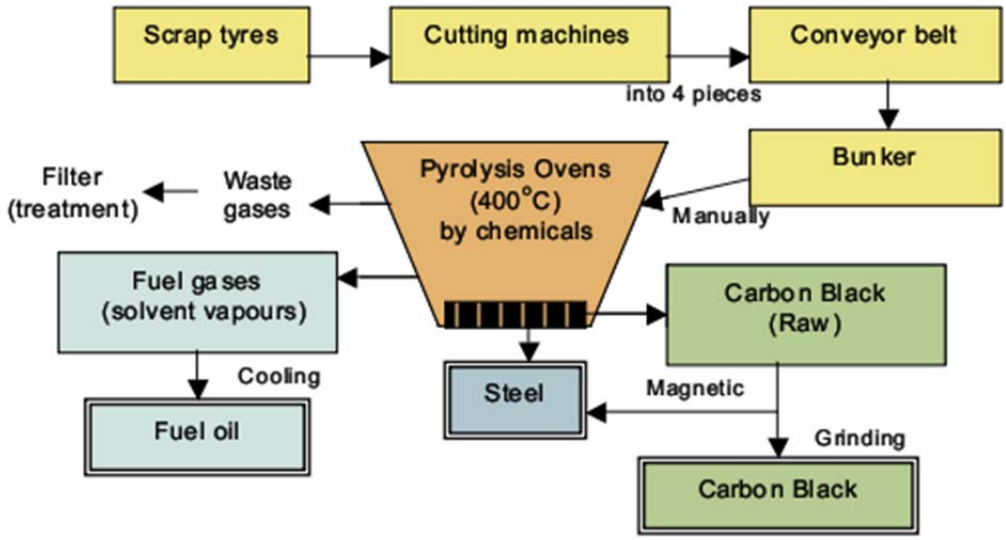


Figure 41: Flow Chart Showing the Pyrolysis Process[38]

Products

The lists of products generated as a result of the pyrolysis of tyres are as follows.

Table 25 : Products of scrap tyre pyrolysis

No.	Primary Products	wt.%	Content	Secondary Products
1	Pyro-gas	10 - 30	Hydrogen, CO2, CO Methane, Ethane, Propane, Propene, Butane, Other hydrocarbons, app. 1% of Sulfur	
2	Oil	38 - 55	High aromatic Mw 300 - 400 Low in sulfur (0.3 - 1.0%) Aromatics, Alkanes, Alkenes, Ketones, Aldehydes	Carbon Black
3	Char	33 - 38	>15 % of Ash (ZnO) 3 -5 % of Sulfur	Activated carbon

Currently, the primary barriers for this application are both economic and technical issues. The capital cost is high and the products from Pyrolysis do not have sufficient value to compete with commodity material. There are currently a few new emerging technologies to

[38] *Source: DOE IMPAK Magazine issue 2, Year 2006*

counter these problems to make pyrolysis process to be more economical and yield competitive products.

New technologies

There are two technological approaches to the problems discussed above.

Higher Value Products from Pyrolysis (high molecular weight olefins)

The production of significant quantities of valuable high molecular weight olefins to obtain curable and mouldable olefins (Mw > 15,000) would overcome current economic barriers. These are typically produced in small quantities because the process temperature is high. At high temperature, vulcanized rubbers are quickly decomposed to low molecular weight olefins (Mw 300 - 400). High molecular weight compounds can be generated by low temperature pyrolysis.

However, lower temperature will require longer process times. New technological breakthroughs will be necessary for the commercialization of low temperature pyrolysis. Four new technologies are being developed.

Microwave pyrolysis**:**

Microwaves can heat objects more uniformly than conventional heating methods. Microwave heating requires shorter heating times. Microwave pyrolysis will result in relatively high molecular weight olefins and a high proportion of valuable products such as ethylene, propylene, butene, aromatics, etc. The short process time also contributes to a reduction in the process cost. Moreover, for microwave heating, the shape of the tyre chip is less important compared to the requirements of conventional heating. Whole tyres or larger chips can be processed using microwave pyrolysis, which greatly reduces pre-processing cost.

Ultrasonic devulcanization*:*

Isayev has patented a method which minimizes heating and uses sonic energy to break down sulfur-carbon chemical bonds in tyres. Chipped tyres are heated to about 398 ^{o}C, and then subjected to 20,000 cycles per second of ultrasonic energy (just above the highest frequency the human ear can discern) at pressures up to several thousand pounds per square inch. The rubber is transformed from a solid to a highly viscous fluid within milliseconds. With additional curative agents the viscous material can be molded into new products. A prototype machine is proven to be able to handle approximately 50 pounds of tyres per hour.

Supercritical fluid depolymerization*:*

Supercritical water can be used to controllably depolymerize the rubber compounds. This approach requires lower temperatures (approx. 398 ^{o}C) and shorter processing times. Tyre

compounds are decomposed to high molecular weight olefins (Mw 1,000 - 10,000), or oils (Max. 90 %).

The technique is being developed and has been tested only in an experimental scale. Because of the expensive supercritical water equipment, this application would require a relatively large initial cost.

Use of special catalysts:

Use of catalysts can reduce processing temperature or time. As shown in the above applications, reduced temperature and time can result in either higher molecular weight olefins or an increasing proportion of valuable substances. The advantage of catalysts is that no new equipment or knowledge is required. Therefore cost estimation and scale-up would be easy. Some research and pilot scale experiments have been conducted recently, but the types of catalysts are highly proprietary.

- Lower process cost.

  Surface active carbon and high quality carbon black are high value-added products. The relative process cost is the only barrier for commercial success. One approach to reduce processing cost is to operate at a high process temperature with the use of a special catalyst. Approximately 3.2 % of zinc-oxide is added to tyre compounds, and the zinc-oxide remains in the char. To produce surface active carbon, the remaining zinc must be removed from the surface, and high temperature processing is able to facilitate this.

  Currently there is very few large commercial scale pyrolysis plant in the world. The few operational or pyrolysis plants in planning currently are:

  - Pyrolysis plants owned by Shanghai Greenman ECO in both Shanghai, China and Taiwan with each plant's capacity in processing scrap tyre up to 8,000 tons per year.
  - A few commercial pyrolysis facilities have been established by Kouei, Japan starting in year 2000 with each plant capable of processing up to 16 tons of scrap tyre per day.
  - A large scale commercial closed loop tyre pyrolysis facility is currently under planning for construction in Tees Valley South Tees Eco Park, UK by Pyreco. The planned facility is capable of processing up to 60,000 tonnes of tyre per year (or equivalent of 7.5 million tyres per year). The plant is estimated to produce quarter million barrel of oil equivalent per year and carbon black of up to 20,000 tonnes / annum.

  Huge investment cost and extensive technological requirement have so far hampered the pyrolysis industry from fully being implemented in the world. The low quality product generated in the process has not looked profitable for major players to undertake the technology and refine the process for better yield of the products.

Technology Evaluations

Advantage of the recycling option

The environmental effect of the pyrolysis process is substantial – pyrolysis plant has the capability to reduce large amount of tyre from going to landfill or being burned which resulted emission of greenhouse gases into the atmosphere. From it valuable carbon black, steel and oil will be produced which can be put back into manufacturing cycle of other products. It is in the three arenas of CO2 emissions, recycling and energy conservation that pyrolysis process makes the biggest impact.

Among some of the environmental advantages that pyrolysis plant delivers are:

(i) The production of Carbon Black by a more energy/emission efficient process. A tonne of conventional black requires approximately 1.32 tonnes of Oil to be burnt in its creation. Pyrolysis recycles.
(ii) The pyrolysis process liberates considerable quantities of excess energy. Electricity generation capacity can be achieved through the combustion of pyro gas and oil.
(iii) Pyrolysis process produces virtually no runaway emissions.
(iv) The reuse of pyrolysis carbon black will displace the need to burn significant quantities of oil.

Disadvantage of the recycling option

More than 30 major pyrolysis projects have been proposed, designed, patented, licensed or built over the past decade but very few have been commercially successful. The success of any tyre process technology depends on two key criteria namely sound environmental performance (emissions) and profitable process economics. Pyrolysis process basically triumphs over the first criteria but fails in the later. Two most important factors affecting the process economics are the low product price and the high process cost as described below:

(i) Low Product Price: The primary products from any tyre pyrolysis process are essentially low molecular weight olefins and char

(ii) Olefins: The pyro-gas prices are low in the current market. Other chemicals from the pyrolysis process can be more valuable, but the yield is low. High quality carbon black is also valuable but there is no particular price advantage for the same quality carbon from traditional processes.

(iii) Char: Surface activated carbon is a valuable product, but there is no cost advantage compared to alternative methods (normal surface activated carbon manufacturing).

(iv) High Process Cost**:** The valuable chemicals from pyro-gas or oil, are generally high molecular weight substances. The purification of high molecular weight substances is expensive.

Economic Evaluation:

Using the economic evaluation equation:

P = F + R – C –T- D

Where;

P = profit per tyre
F = tipping fee collected per tyre by the recycling facility
R = revenue received per processed tyre
C = processing cost per tyre for operating the facility
T = transportation cost to bring in the tyre
D = disposal cost for waste products

Hence,

1. F = RM 0.50; consider RM 0.50 tipping fee for tyre deliver to the pyrolysis plant;
2. C = RM 5; the labour, electricity and maintenance cost is rather high for pyrolysis plant (Yeung-chen, 2008 based on 2 pyrolysis plant one in Shanghai another in Taiwan with capacity of 10,000 tonnes of tyre per year)
3. T = RM 2.00 per tyre for sending tyre from source to the facility
4. D = RM 0 ; there is no disposal cost since most final product from pyrolysis plant is marketable.
5. R = The profit from product are as shown in **Table 26** below:

Table 26: Economic analysis of pyrolytic products from scrap tyres[39]

No.	Product	Selling price (RM/tonne)	Production/ (tonnes/year)	Production capacity (tyre)	Profit per tyre (RM)
1	Oil Sales	1,600	4,500	10,000 tons or 1.25 mil tyres	RM 5.76
2	Carbon Sales	1,200	3,500	10,000 tons or 1.25 mil tyres	RM 3.36
3	Steel Sales	600	1,000	10,000 tons or 1.25 mil tyres	RM 0.48
				TOTAL	**RM 9.60**

Hence, given ***P = F + R – C –T- D***
P = 0.50 + 9.60 -5 -2- 0 = RM 3.10 per tyre

[39] *Source: Yeung-chen, 2008 & Peters et al, 2003: Pyrolysis plant in Shanghai & Taiwan*

Consider the pyrolysis plant has the same capacity as the one in Shanghai and Taiwan plant which the processing capacity is 10,000 tonnes of tyre per year or 1.25 million tyres per year. Hence per year the gross profit generated is RM 3.10 x 1.25 million tyres = RM 3.88 million per year. The investment for a pyrolysis plant is as shown in the **Table 27** below:

Table 27: Investment cost for a pyrolysis plant[40]

Item	Investment Amount (RM)
Equipment	12 million
Other direct cost	4.5 million
Working capital	2 million
Contingency	1.6 million
Total	20.1 million

Given, *Payback Period* = *Capital Invested / Annual Profit*
= RM 20.1 mil / RM 3.88 mil yr
= 5.18 years

Summary

It is concluded that the pyrolysis plant's payback period although is not highly attractive but it triumphs in the aspects of low environmental impacts, low health hazards and it produces useful recycled material of tyre pyrolysis oil, carbon black and steel. The return on investment is largely dependent on the price obtainable for the oil and carbon products; conservatively with the increase in oil selling price as crude oil, pyrolysis plant may see a shorter payback period which may make it favourable to investors.

In terms of strategic location-wise, there is basically very few pyrolysis plants in Peninsular Malaysia. During the survey of this Study, only one large scale commercial pyrolysis plant (120 tonnes /day) is identified which is located in Port Klang (Octagon Consolidated Bhd) while a few small scale pyrolysis plants (20 - 30 tonnes/day) are located sparsely in some heavy industrial zones in Peninsular Malaysia.

To facilitate a more effective recycling of ELTs from the whole Peninsular Malaysia using this technology a centralised collection system has to be established to consolidate all the ELTs to be delivered to this plant. Alternatively, this plant would have to work in celebration with other facility like the cement clinker plant and shredding plant to cater for the large volume of ELTs generated over a vast number of sources to optimise the transportation route.

[40] *Source: Yeung-chen, 2008 & Peters et al, 2003: Pyrolysis plant in Shanghai & Taiwan*

3.3.7 Shredding and Granulation

Scrap tyre can be used to produce crumb rubber in a wide range of particle size and quality levels from the shredding and granulation process. In this process, scrap tyres initially undergo shredding process followed by granulation process to reduce the tyre chips to a size of less than 10 mm while liberating most of steel and fibre from rubber granules. The steel component of the tyres and the fibre fraction is removed. Most grinding plants involve a number of consecutive steps to produce fine granulate or rubber powder of a proper size.

Tyre shreds are usually described or measured by mesh or inch and are generally defined as rubber that is reduced to a particle size of 3/8 inches or less. It possesses interesting technical properties that could be beneficially used in civil engineering applications or to be combined with other material to form plastic products. Some characteristic of tyre shred materials are the low density, high elasticity, low stiffness, high drainage capacity and high thermal insulation capacity.

One obvious rule of thumb for the process of tyre shredding and granulation is that the production cost and selling price are in reverse relation to the crumb size. The smaller the crumb size, the higher the investment cost and operating costs.

Tyre Shredding and Granulation Process

Tyre shreds are fragmented end-of-life tyres, mainly from passenger cars but also from heavy vehicles. The fragmentation is performed by a shredder. Primary tyres are shredded for volume reduction before transportation to recovery or disposal processes. The size of the individual shreds is controlled by sieving and re-shredding of course shreds.

The first pass usually results in 100 – 300 mm large tyre shreds, the second pass results in 100 – 150 mm and fine tyre shreds are re-processed until the material passes the desired sieve size. The results are disc shaped tyre shreds with protruding steel cord. The product of tyre shreds is usually used as TDF for energy recovery.

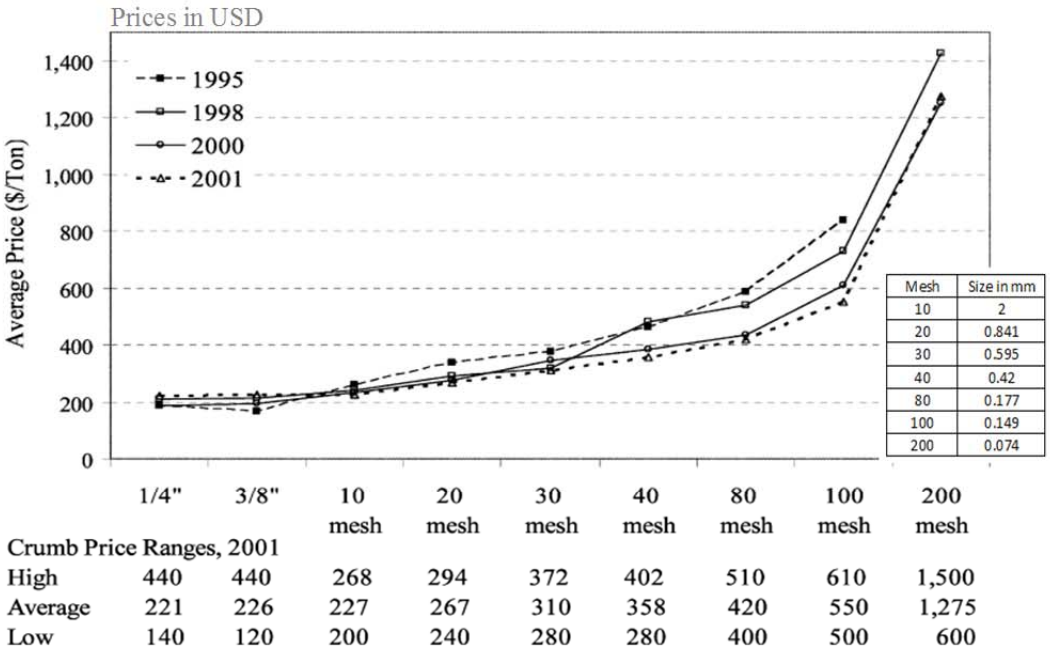


Figure 42 : Annual variation in tyre crumbs mesh size and price range[41]

Generally, crumb rubber is produced by reducing scrap tyres from tyre shreds further down to sizes ranging from 3/8" to 40 mesh (0.42mm size) particles and removing 99 % or more of the steel and fabric from the scrap tyres. There are several processes for manufacturing crumb rubber. Two of the most common are ambient grinding and cryogenic processing. A third technology-the wet grind process-is also in use in the U.S. to produce finer mesh crumb rubber ranging from 40 mesh (0.42 mm size) to 200 mesh (0.074 mm size). The end products are tyre crumbs which are of high value compared to tyre shreds suitable to be manufactured into marketable rubber moulded products.

Figure 43 illustrates how different stages of shredded tyres and crumb tyres looks like.

Figure 43: Picture of different shredded tyre sizes[42]

[41] *Source: Recycling Research Institute, USA*

[42] *Source: CM Tyre recycling News (Quarterly Report from CM Sarasota operations) Winter Edition 2010, Vol III*

Ambient Process

Ambient grinding can be accomplished in two ways: granulation or cracker mills. In an ambient system, the rubber, tyres or other feedstock remain at room temperature as they enter the cracker mill or granulator. Ambient grinding is conducive to any size particle, including whole tyres

Ambient grinding is a multi-step processing technology that uses a series of machines (usually three) to separate the rubber, metal, and fabric components of the tyre. Whether using granulation equipment or cracker mills, the first processing step typically reduces the original feedstock to small chips. The second machine in the series will grind the chips to separate the rubber from the metal and fabric. Then a finishing mill will grind the material to the required product specification. After each processing step, the material is classified by sifting screens that return oversize pieces to the granulator or mill for further processing. Magnets are used throughout the processing stages to remove wire and other metal contaminants. In the final stage, fabric is removed by air separators. Uses for the crumb rubber or granulate produced in this process include safety and cushioning surfaces for playgrounds, horse arenas and walking/jogging paths.

Cracker mills - primary, secondary or finishing mills - are all very similar and operate on basically the same principle: they use two large rotating rollers with serrations cut in one or both of them. The roll configurations are what make them different. These rollers operate face-to-face in close tolerance at different speeds. Product size is controlled by the clearance between the rollers. Cracker mills are low speed machines operating at about 30-50 RPM. The rubber usually passes through two to three mills to achieve various particle size reductions and further liberate the steel and fibre components.

These mills do not have screens built into the mill and as such the mill itself does not control the final particle. A stand-alone screening system will separate “sized” particles from oversize granules following the mill and re-circulate the oversize products. The crumb rubber particles produced by the cracker mill are typically long and narrow in shape and have a high surface area. Crumb or ground rubber produced in this process is used in the manufacture of numerous rubber products. These include mats for domestic, commercial, recreational, industrial and agricultural use; rubber wheels for carts and lawnmowers; insulation products; lumber and other construction products.

Cryogenic Process

Cryogenic processing refers to the use of liquid nitrogen or other materials/methods to freeze tyre chips or rubber particles prior to size reduction. Most rubber becomes embrittled or "glass-like" at temperatures below -80°C. The use of cryogenic temperatures can be applied at any stage of size reduction of scrap tyres. Typically, the size of the feed material is a nominal 2 inch chip or smaller.

The material can be cooled in a tunnel style chamber, immersed in a "bath" of liquid nitrogen, or sprayed with liquid nitrogen to reduce the temperature of the rubber or tyre chip. The cooled rubber is ground in an impact type reduction unit, usually a hammer mill. This process reduces the rubber to particles ranging from 1/4 inch minus to 30 mesh, with the majority of the particle distribution between 1/4 inch minus and 20 mesh. A typical throughput is 4,000 to 6,000 pounds per hour. Cryogenic grinding avoids heat degradation of the rubber and produces a high yield of product that is free of almost all fibre or steel, which is liberated during the process.

For scrap tyre derived rubber, the steel is separated out of the product by the use of magnets. The fibre is removed by aspiration and screening. The resulting material appears shiny, has clean, fractured surfaces and low steel and fibre content. The final product has a range of particle sizes, which can be used as is or further size-reduced. Production of finer (40 to 60 mesh) and very fine crumb rubber (60 minus and smaller mesh) requires a secondary high intensity grinding stage.

Fine Grind - Ambient Method

Micro milling, also called wet grinding, is a processing technology used to manufacture crumb rubber that is 40 mesh and finer. The wet grind process mixes partially refined crumb rubber particles with water creating a slurry. This slurry is then conveyed through size reduction and classification equipment. When the desired size is achieved, the slurry is conveyed to equipment for removing the majority of the water and then drying. Aside from the use of water, the same basic principles that are used in an ambient process are utilized in a wet grinding process.

The major advantage for a wet grind process is the ability to create fine mesh crumb rubber. While products as coarse as 40 mesh are produced, the majority of the particles are 60 mesh and finer. A percentage of the overall throughput is finer than 200 mesh. Another advantage for a wet grind process is the cleanliness and consistency of the crumb rubber produced. The process literally “washes” the crumb rubber particles. The wet process removes the fine particles of fibre from the crumb rubber making a very clean product. The wet process also produces a unique morphology in the particles making the end products to be suitable in the manufacturing of several goods used in automotive applications and in certain moulded goods. **Figure 44** illustrates the summary tyre shredding and granulation process.

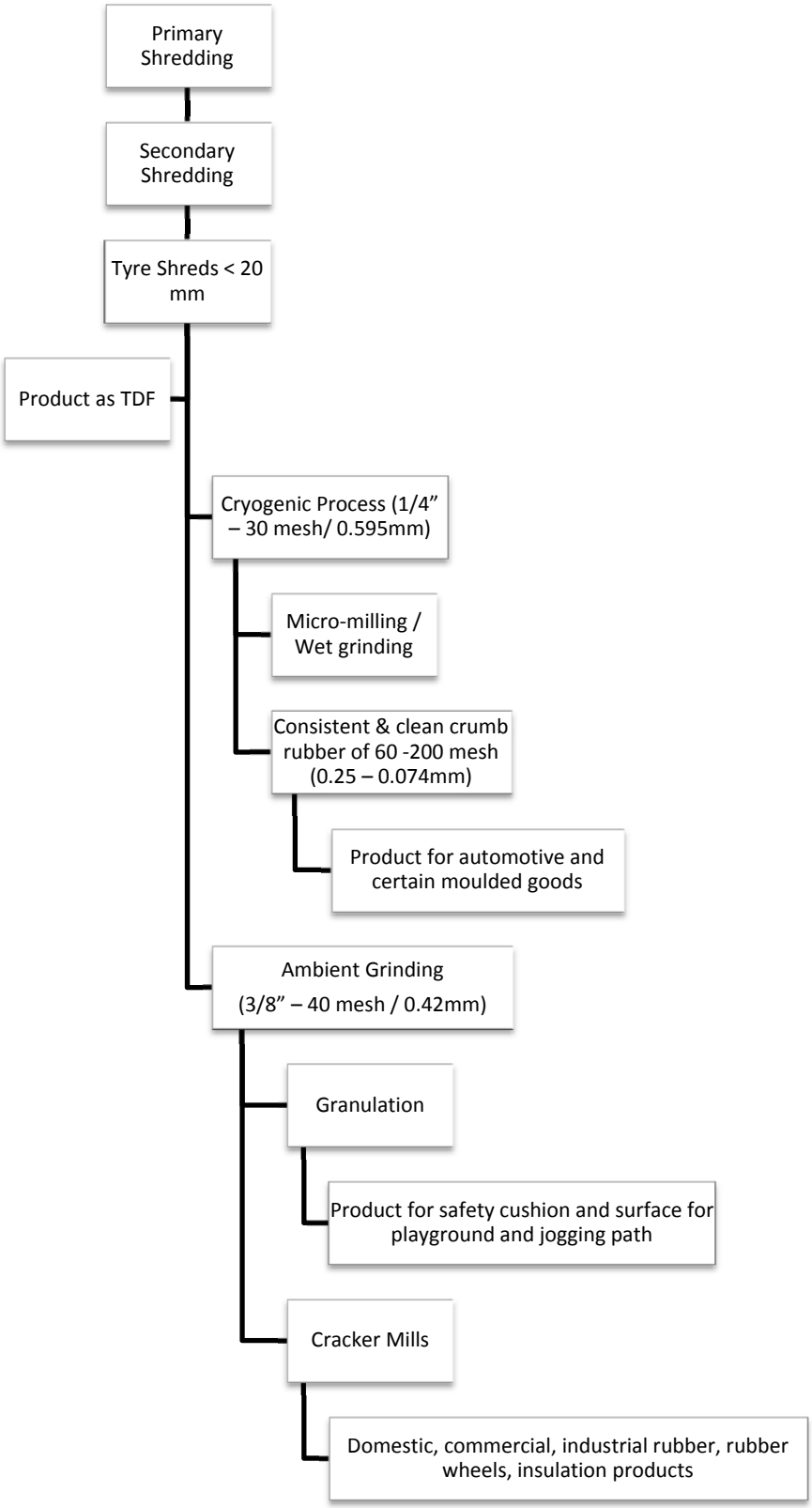


Figure 44: Flow Path of Tyre Shredding and Granulation Process

Waste tyre shredding and granulation is practised widely around the world. There appear to be many potential niche markets for crumb tyres and the future of markets that use shredded tyre pieces will grow with the introduction of new technologies and breakthroughs. Listed in **Table 28** are some of the current uses of crumb tyres of different mesh sizes.

Table 28: Uses of Crumb Tyres of Different Mesh Sizes

Market	Mesh Sizes
Molded and Extruded Products	4 - 100 mesh
Asphalt Modification	16 - 40 mesh
Sport Surfacing	1/4" - 40 mesh
Automotive Products	10 - 40 mesh
Tyres	80 - 100 mesh
Rubber and Plastic Blends	10 - 40 mesh
Construction	10 - 40 mesh

Advantages of Tyre Shredding and Granulation

Questions are often asked about potential environmental risks associated with scrap tyre materials. The most cited concerns probably are related to civil engineering application and the effect of tyre materials on water quality. As long as tyre shreds are placed above the water table, they appear to pose no significant, known health or environmental risks (Nongnard Sunthonpagasit 2002). There is no evidence that tyre shreds increases the concentration of metals of concern in meeting a 'primary' drinking water standard (DWS). Hence, tyre shredded recycled material in general is considered environmental friendly as long as it is not immersed in water for prolong period of time.

The technology of tyre shredding is also more straightforward as compared to the rest of the recycling technology and required lower investment which enable the accommodations of small scale establishments. Unlike the process of pyrolysis or energy recovery from tyre, tyre shredding and granulation does not depends on the operation of a heater or furnace system which can be costly and complicated in operation. Furthermore the shredding process basically emits almost no gaseous emission or effluent discharge except for some dust and washing water of the tyres which can be easily handled with good housekeeping. Other significant advantages of tyre shredding and granulation process are as follows:

(i) With a secure supply of scrap tyre supply tyre shredding business can be easily established by entrepreneurs at strategic locations to cut down transportation costs of scrap tyres from respective sources;
(ii) Less energy intense except for the power of shredding machineries as it does not requires any furnaces or burner systems;

(iii) In terms of TDF, it can be a upstream industry which acts as a collection centre as well as offering pre-treatment process of scrap tyres to supply shredded tyres or rubber crumbs for downstream users for clinker kilns or pyrolysis process;
(iv) In terms of material recovery, this industry offer products which can be used in multiple plastic and rubber industry, for instance foot ware products, floorings, carpet underlays and automotive parts.
(v) Demands from overseas markets for crumbed rubber are high as there is a global shortage of rubber and crumb.

Disadvantages of Tyre Shredding and Granulation

Some of the known barriers of this technology are:

(i) The profitability of the facility is sensitive to crumb rubber prices, operating costs and scrap tyre availability. Recyclers need to be near the raw material sources to decrease transportation costs and guarantee procurement.
(ii) There is a lack of standards for processing crumb rubber from tyres which is a barrier to the maturation of a market for recycled crumb as commodity material. Almost every industrial player has its own unique system to produce crumb rubber and quality varies widely from operation to operation;
(iii) The quality of recycled rubber from tyres is in general lower that virgin (natural and synthetic rubber) products and may not be suitable for some high end rubber products without undergoing expensive pretreatment, therefore recycled rubber can easily lose its competitive edge when the world's rubber price is low;

Economic Evaluation:

The economic evaluation considers a nominal 15,000 tonnes (approximately 1.8 million tyres) per annum scrap tyre shredding and grinding facility.

Using the economic evaluation equation:

$$P = F + R - C - T - D$$

Where;

P = profit per tyre
F = tipping fee collected per tyre by the recycling facility
R = revenue received per processed tyre
C = processing cost per tyre for operating the facility
T = transportation cost to bring in the tyre
D = disposal cost for waste products

Hence,

1. F = RM 0.50; consider RM 0.50 tipping fee for tyre deliver to the pyrolysis plant;
2. C = RM 1.80 per tyre ; including labour and O&M and electricity on the plant, based on labour cost of approx. RM 16 and other variable cost of RM 200 per tons of tyre process; (Nongnard Sunthonpagasit, Michael R Duffey, 2003)
3. T = RM 2.00 per tyre for sending tyre from source to the facility
4. D = RM 0.40 per tyre; consider for the disposal costs to treat the washing water and disposal of dust from the shredding activity, (Nongnard Sunthonpagasit, Michael R Duffey, 2003)
5. R = RM 6.40 per tyre for 0.1 – 1mm size nominal crumbs which fetch a price of RM 800 /tonne of crumbs (Sourced from http://www.tootoo.com/d-rp2673925-Crumb_Rubber_And_Tyre_Buffing/).

Hence, given $\boldsymbol{P = F + R – C –T- D}$

P = 0.50 + 6.40 -1.80 -2- 0.40 = RM 2.70 per tyre

Consider the tyre shredding and granulation plant has to make capital investment of RM 15 million to setup the facility and to purchase the shredding equipment (this is based on the average set up investment cost for a 15,000 tons/year production facility in U.S is USD 3.8 million or RM 15 million).

Given, *Payback Period* = *Capital Invested / Annual Profit*
= RM 15 mil / RM 4.9 mil yr
= 3.06 years

Since the payback period is about three years, this technology offers very attractive investment to tyre recycling players. Further enhanced by green technology tax incentive and loan scheme offered by Malaysian financial set-ups this technology is one of the few preferable ones in local industry.

Summary of Tyre Shredding and Granulation Technology

Scrap tyre shredding and granulation industry appears to be a commercial and environmental sustainable facility in local market. However, there still exist some uncertainty in the market due to insecure supply of tyres and the competition of other end users of scrap tyres especially from clinker industry for the tyre to be used as TDF. Also, for a shredding and granulation plant to be economically viable it requires a minimum supply of 800,000 tyres per year and the sources of tyre supply must be within 250km distance from the facility.

3.3.8 Planning Analyses of Recycling Plants

Based on the surveys conducted by the Consulting Team, there are already a number of established operators of recycling plants in the Peninsula Malaysia. There are particularly higher concentrations of recycling plants within the Klang Valley / Port Klang area.

Essentially, there are few factors to be considered in the planning analyses for the recycling plants. These include the following:

- The minimum size for the different types of recycling technologies (ton/year treated) to be technical and economical viable will be described

- The optimal geographical allocation of facilities and scale of operation of the facilities for future scrap tyre recycling system will be described, taking into consideration the presence existing facilities for recycling of scrap tyres; and

- A correlation between the existing recycling plants in every zone and the amount of scrap tyres generated are determined to assess the option of either expanding the existing recycling plants or to put in new plants to handle the huge quantity of tyres generated yearly by each zone.

In order to determine the optimum configurations for the proposed recycling facilities, it will be imperative that the associated factors that contribute to a sustainable scrap tyres recycling be investigated in parallel.

Table 29 below showed the various economic variations as a function of the various technology options in scrap tyre recycling.

Table 29 : Economic evaluations of various technology options in tyre recycling, reprocessing

	F	R	C	T	D	P, per tyre	T, tyres (tonnes)	T, tyres (x106 pcs)	P, Total (mil/yr)	Payback (yrs)	Capital (mil)
TDF											
Coal Fired Power plant	0.00	5.93	2.00	2.00	0.30	1.63	30,000	6.25	10.20	9.80	100.00
Cement Kiln	0.00	4.30	0.50	2.00	0.00	1.80	30,000	3.50	15.08	3.33	5.00
Pyrolysis	0.50	9.60	5.00	2.00	0.00	3.10	30,000	3.75	3.88	5.18	20.10
TDP											
Shredding, Granulation	0.50	6.40	1.80	2.00	0.40	2.70	15,000	1.80	4.90	3.06	15.00

The economic evaluation in **Table 29** above is derived from the following relationship and has been discussed in detail in Section 4.3 of this report. The above was evaluated based on the following simple economic relationships.

P = F + R – C –T- D

Where;

P	= profit per tyre
F	= tipping fee collected per tyre by the recycling facility
R	= revenue received per processed tyre
C	= processing cost per tyre for operating the facility
T	= transportation cost to bring in the tyre
D	= disposal cost for waste products
T, tyres (tonnes)	= Total tyres used or processed in tonnes
T, tyres ($x10^6$ pcs)	= Total tyres used or processed in pcs
P, Total (mil/yr)	= Total Profit per year in million RM
Payback period (yrs)	= Estimated payback time of capital investment calculated using ***Payback Period = Capital Invested / Annual Profit***
Capital (mil)	= Capital Investment necessitated for reuse of tyres in the different technology options.
	TDF = Tyre Derived Fuel
	TDP = Tyre Derived Products

Based on this relationship, it can be corroborated that the profit per tyre (P) is directly proportional to the collected revenues received per processed tyre as well as the fees received as a result of receiving those tyres. These two components are directly in response to market demands especially where scrap tyres are processed based on tyre derived products – mainly for secondary fuel oil, rubber crumbs and steel products. The tipping fees shall be in direct response to the user preference or in response to the market demands. When the market demand is weak, the tipping fees may not be in place and when the market demands improve, tipping fees may be imposable that the imposition does not amount to hindering the profitability per processed tyre.

3.4 Incentive System

Based on the findings derived from the estimation on scrap tyres tonnage generation in the Peninsular Malaysia in Section (4.2) of this Report, a potential 700 tonnes of scrap tyres are generated daily in the Peninsula Malaysia in the year 2011. The breakdown of this finding is as follows in **Table 30**.

Table 30: Projected annual variation of scrap tyres generation in the Peninsular Malaysia

Year	Generation	Recycled / Treated	Gaps
	(tonnes/day)	(tonnes/day)	(tonnes/day)
2010	670	170	500
2011	702	170	532
2012	737	170	567
2013	774	170	603
2014	812	170	641
2015	853	170	682

There is a gap of about 500 metric tonnes per day starting from the year 2010 and increases to about 700 tonnes in the year 2015. These gaps are not currently quantitatively accountable and have been **assumed** to be used, sent to small scale illegal / informal treatment plants in the Peninsular Malaysia. In addition, part of the tonnage could be diverted to illegal dumping in various illegal dump sites, despite there are probably minimal numbers of scrap tyres end up in designated open dumpsites. Some of the tyres may be used (in smaller numbers) in ancillary industries and activities – art crafts, horticultures, dockyards, riverine embankments as well small nurseries.

Based on the field survey's findings, considering the various economic factors that influence the choice of technologies employed in scrap tyres recycling, the (current) growth or expansion rate of scrap tyres facilities in the Peninsular Malaysia may not be able to absorb and consume these additional tonnages. The facility operators surveyed are notably cautious in their expansion plans. They are particularly sensitive to the availability of scrap tyres supplies that they could obtained.

This is despite the fact that based on communications from the representatives of MITI, DOE and RMC, which have pointed out that large industrial users in clinker and cement manufacturing business uses large tonnages of scrap tyres imported from overseas of up to 60,000 metric tonnes per annum. Large scrap tyres consumers however may continue to rely on their current streams of supplies instead of accessing the locally generated scrap tyre volumes due to the absence of proper logistical systems, which are (equally) commonly cited by the small and medium size scrap tyre facilities. Logistical problems in accessing local scrap tyres have been singled out as the most prominent problems among the formal and informal industry players.

The loss in this opportunity tonnages, can be summarized and attributed to (largely) the following factors (among other factors that may be part of the problems, but are insignificant)

(i) Absence of suitable logistics systems that are able to access the generators of these scrap tyres
(ii) Absence of suitable collection systems that are able to access and locate the generators of these scrap tyres
(iii) Absence of suitably strong market demand for these scrap tyres (current strong demands are only seen in areas close to the locations where there are current operators of scrap tyres recycling and treatment facilities)
(iv) Absence of regulatory framework that addresses the unaccounted tonnage gaps in scrap tyres generation
(v) Absence of governmental agencies or suitable agencies empowered to manage the scrap tyres generation
(vi) Absence of coordinated data acquisition on the scrap tyres generation themselves

Based on these observations, especially deriving from the fact that there are economic gains that can be obtained from scrap tyres recycling and treatment that has yet to be harnessed due to the above factors, there is a strong need to have in place a financial driver in order to ensure that scrap tyres do not end up as litters, instead salvaged for the purpose of economic gains. In addition, market demands for commodities like fuel and steel may generate short term interests by irresponsible parties that may resort into illegal activities of attempting to extract these materials from scrap tyres in crude manners that eventually caused further impacts to the environmental settings within which these illegal operators ply their short term activities

Environmental impacts due to uncoordinated management of scrap tyres are quite established, especially in the proliferation of vector borne diseases, contamination of water resources and affecting proper land use management. These are not discussed in detail in this report.

3.4.1 Perspectives in Scrap Tyre Management Incentives

In developing the proposed scrap tyres incentive system for the Peninsular Malaysia, other incentive systems available in the Malaysia as well as other countries in the region and the world has been explored during this study, in order to ensure that all options in a scrap tyre management are considered and evaluated. The primary components of the incentive system investigated have been

(i) The responsible agency (or agencies) that will oversee the implementation of the incentive system
(ii) The incentive options to include among others legal and regulatory requirements on the various logistical setup in the handling and transportation of scrap tyres, fees and subsidies including penalties
(iii) Sustainability of the system that will eventually be expected to support the tyre recycling industries

Particular reference to the information and experiences from the system implemented in Sarawak have been taken into account due to the reportedly early implementation of the system, geographical proximity of the state of Sarawak operating framework as well as the generally shared institutions and legal frameworks in the management and administration of environmental aspects of the state to the Peninsular Malaysia.

Prevailing issues around the projected incentive system deliberated have been among others as follows,

(i) The most appropriate business model for the scrap tyre management; The TOR document questions whether a concessionaire(s) model (is) suitable, given the current existence of multiple collectors and operators, the availability status of the current collection, transportation, storage and treatment or scrap tyres respectively
(ii) The need and feasibility for the introduction of common financial instrument (e.g. tax, levies, subsidies) on the sustainability of the scrap tyres management. Should the need is established how are these financial instrument(s) determined, what is the size of levy, tax, subsidies on scrap tyres is required
(iii) The consequential needs in the management and regulation of the levy vis-à-vis availability of legal framework, legal agencies etc.

3.4.2 The Sarawak Used Tyre Economic Instrument

The development of the Sarawak's economic instrument in the management of used tyres was spearheaded by a working group (WG) led by the Natural Resources and Environment Board (NREB) (EPU, 2004). Members of the WG comprised representatives of:

(i) Natural Resources and Environment Board, Sarawak (Chair);
(ii) Regional Economics and Environment Section, EPU;
(iii) Kuching North City Hall (DBKU);
(iv) Kuching City South Council (MBKS);
(v) Malaysian Industrial Development Authority (MIDA), Sarawak
(vi) State Attorney General;
(vii) State Financial Secretary;
(viii) Sarawak Tyre Dealers Association;
(ix) Chemsain Konsultant Sdn Bhd; and
(x) EPU-DANIDA project team

The Kuching's sustainable urban development (SUD) project, required the state government to outline a policy that could put in place a sustainable collection and disposal system for used tyres, with the emphasis of developing an economic approach that generate revenue to meet the used tyres management system cost (NREB/DANCED, 2001). The project has determined that the collection and treatment system of used tyres are the core components that need to be put in place in order to ensure that used tyres are properly accounted for in

their collection, transportation and delivered at premises duly approved by the state authorities. .

There have been no proper used tyre collection system exist in Sarawak then although there have been a comprehensive integrated solid waste management system commissioned and implemented for Kuching in the collection, transportation, treatment and disposal of municipal solid waste since June 2000.

Options of the economic instrument

The handbook of economic instrument reported that the project team (EPU/Danida, 2001) for the Sarawak's scrap tyre system has been requested to determine the nature of the product charge or tax and estimate the cost of the subsidy required to implement the collection system

In designing the economic instrument for the State, the project team examined an option on a sales tax on tyres to finance the cost of improving the system of collection and disposal, refer to **Table 31** below. This tax was to be paid into a proposed Sarawak Scrap Tyre Fund, which would provide private firms with a subsidy to meet the cost of the tyre recycling system. The project team attempted to provide insights into two key economic questions:

(i) Nature of the tax instrument; and
(ii) Whether the improved system can be self-financing

Table 31: Options for tax on new tyres in Sarawak (EPU, 2001)

Options	Consideration
Product charge	The method for implementation could either be based on type of vehicle, or on weight or volume displaced. The former method would be simpler administratively while the latter would be more accurate as weight and volume are closely related to potential environmental harm. The charge should also cover the unit administrative costs of running the scheme
Scrap tyre auction	Might not be suitable in Sarawak at present in view of the limited size of the market and small number of potential bidders
Government direct refund of scrap tyre subsidy	Private sector retailers are reimbursed from a State scrap tyre fund for buyback payments or refunds issued to consumers returning used tyres. The government needs to determine the retailer's programme administration cost and profit, and also oversee the system to minimize fraud.

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The project team finally then recommended and concluded a product charge was the most feasible option if the polluter-pays-principle and sustainability were to be applied. A sales tax was proposed as the instrument of collection.

The handbook further establishes that an estimated RM2.9 million a year could potentially be raised if unit charges of RM3 a tyre for passenger cars and RM18 a tyre for trucks were imposed. An additional revenue of RM1.5 million could be obtained by selling recycled items from the tyres such as crumb rubber (RM1.1 million), steel (RM0.3 million), and canvas/textile (RM0.09 million). The estimated revenue, from the tax and other revenues, was about RM4.4million.The final recommendation was for the product charge to be pegged at RM450 a tonne.

The impact of the economic instrument was analyzed at two levels, the first being the distribution between private vehicles and commercial vehicles, and the second was that of a more detailed impact on private vehicles. The handbook however did not elaborate further on the impacts details.

The handbook establishes information on the distribution of sales tax impact. It was determined by the WG that the product charge on used tyres would be higher than the present cost of disposal to the sanitary landfill (about RM200 per tonne), thus allowing for a safe and more appropriate method of disposal. The additional cost to road users was estimated to be about RM2 million per year. Of this amount, RM1 million would be charged to users of private vehicles, and RM1 million would be charged to truck and bus owners. This was considered to be negligible.

It is worth noting that by the time the economic instrument analysis was conducted, only an open controlled-tipping dumpsite was available in Kuching for the disposal of solid waste, including a designated cell/area for the emplacement of used tyre, thus contributing to the cost of disposal of about RM 200 per tonne). The Kuching Integrated Waste Management Park (KIWMP) was only operational by the end of 2004 and the facility did not allow any reception of used tyre in the sanitary landfill

The handbook further reported that the impact on road users due to the additional charge on tyres was small compared to other road use charges. This was based on the assumption that an average car owner changed tyres every three to four years, thus providing the annual tyre charge at an estimated cost of about RM3.50 compared to RM10 for stamp duty on insurance cover of RM10, and RM200 to RM300 a year for road tax.

3.4.3 Options in Economic Instrument – International Experiences

Malaysia

The Malaysian Handbook of Economic Instrument for Environmental Management (EPU/DANIDA, 2001) outlines that the application of an economic instrument depends on

the legal framework, and its suitability and relevance with respect to managing an environmental problem. The types of economic instruments described in the handbook:

(i) Taxes, charges and cess;
(ii) Subsidies, fiscal incentives and grants;
(iii) Deposit refund (D-R) system;
(iv) Performance bonds;
(v) Market creation instruments; and
(vi) Voluntary initiatives.

The handbook establishes that the basis for applying economic instruments is “property rights”. If rights cannot be assigned or allocated, it is difficult to implement an economic instrument. Economic instruments are designed to influence those who exercise rights to use property or services (eg. in terms of consumption, production method, action towards environmental conservation, etc.) in a sustainable manner

International Practices

The World Business Council for Sustainable Development (WBCSD)[43] outlines a detailed and differentiated global regions and countries that have adopted different types of end of life tyres (ELT) management systems that respond to the varied cultural and political needs, as well as to address the specific ELT situation facing the region.

WBCSD identified three different existing options

(i) The free market model
(ii) The tax-based model, and
(iii) The producer responsibility model.

WBCSD further establishes that many countries have adopted a hybrid of these approaches. **Table 32** below provides an overview of the models.

[43] *www.wbcsd.org/web/tyres*

Table 32: End of Life Tyre Management Models

	Existing ELT Management Models		
	Producer Responsibility Model	**Free Market Model**	**Tax Model**
Disposal fee and how the fee is collected (flow of the fee)	Consumer pays fee at tyre purchase: all fees transferred to join organization	Consumer pays fee at tyre purchase: fee is then transferred along management chain	Consumer pays fee at tyre purchase: fees transferred to government
Disposal route	Recycling/recovery. Some governments may require minimum material & of recycling or retreading	Recycling/recovery without targets	Recycling/recovery, eventually with targets managed by government
Tyre manufacturers' responsibility	…until final disposal documentation is received by appointed recycler	…in some cases must report ELT recovery trends to government	… to grant that the tax is transferred from consumer to government
Government enforcement	Legal framework around PR model, identifying relevant responsibilities	Same as for any nonhazardous waste	Governments' and producers/importers responsibilities established by law
Responsibility for illegal dumping	Person performing the illegal dumping	Person performing the illegal dumping	Person performing the illegal dumping
Responsibility for historical stockpiles	Tyre industry not responsible, but often voluntary oversees disposal to maintain good relationship and credibility with authorities	Government responsibility if the directly responsible person is not identified	Government responsibility

Case Studies from other countries in the world[44]

An international compilation of practices by different countries in the world in terms of economic instruments adopted by the respective countries spanning few decades of historical deliberations have been examined.

The examples of systems for the collection and treatment of used tyres show quite varied and different possibilities for the placement of responsibilities or obligations of the various stakeholders including how funds and fees are managed and disbursed.

[44] *www.wbcsd.org/.../Appendices-**Tyre**s-FrameworkForEffectiveELTManagementSystems-Final.pdf*

- **Chile; Development of a Producer Responsibility Model**

The Chilean government is promoting Producer Responsibility (PR) model (2010), in a joint effort with recently formed Chilean Tyre Chamber (CINC). It is hoped that this voluntary agreement can later be used as the basis for a law on ELT management. The voluntary program started by Goodyear Chile in 2004 is being shown by the authorities as a good example to follow. The government has asked Goodyear to perform an exhibition of their ELT work, and is preparing a law under the extended producer responsibility concept. It is also promoting a voluntary agreement like Goodyear's for other companies, to be used before the law is enforced. The government intention is that the costs and responsibility to dispose correctly the used tyres be aggregated on the value of the tyres.

- **Korea; Changing to an Extended Producer Responsibility Model**

In 1991, the Ministry of Environment in Korea started a deposit-refund scheme, run by KOTMA, the Korean Tyre Manufacturers' Association. In this scheme, producers or importers had to deposit some money with the government for tyre waste disposal (based on quantity of tyres), money which was refunded after the completion of the actual recycling of their products. This was because some producers / importers paid the deposit yet did not recycle the tyres – presumably because the deposit was not high enough. This was replaced by an Extended Producer Responsibility (EPR) model in January 2003.

Producers or importers now take full responsibility for recycling and disposal of their products, in a system based on individual tyre weight. The Ministry of Environment charges mandatory recycling amounts on producers and importers every year related to their ELT generation, business condition for recycling, etc. If their actual results for ELT recycling do not live up to the mandatory amount, additional cost of recycling is charged. There are 28 collection companies (designated by KOTMA) and 48 recycling companies.

- **The European Union; Promoting the Producer Responsibility Model**

In the European Union (EU), landfilling ELTs has been prohibited since 2006 following the European directive 1999/31/EC. By 2008, the European ELT recovery rate had reached an average of 95% across all 27 states. Today, 60% of the volume is managed under a Producer Responsibility system, promoted by the tyre industry, which endorses its benefits related to sustainability, efficiency and transparency for the consumers, the operators and the administration.

In 2010, 14 different ELT management companies were operating, set up by the tyre manufacturers, and mandated by the producers to collect and organize the treatment of 100% of the volumes of tyres sold collectively by these companies on the national market. An environmental fee is charged to the consumers, usually through a separate

line on the invoice and independently of the location of the collection point. It has been observed that this fee is decreasing overtime.

The chain is managed by the ELT company from collection to recovery or recycling, with the support of a reliable and transparent traceability or auditing system. Following the new waste framework directive (2008/98/EC), ELT-derived products will be studied according to certain criteria to potentially be recognized as a secondary raw material or an alternative energy source, and may no longer be considered as a waste in the future. (Source: European Tyre and Rubber Manufacturers' Association, ETRMA)

- **Hungary; Changing from Tax to Producer Responsibility Model[45]**

The Eco Tax System for several waste streams (e.g. tyres, oils, packaging, electrical equipment) was introduced in Hungary in 1995. In 2003, following much dissatisfaction, the government changed the law to replace this with a producer responsibility scheme. By the end of 2005, the Hungarian tyre industry had decided to establish its own ELT company to manage this. Established in 2006 , first by one manufacturer and rapidly joined by 4 others, the company, Hurec, is now fairly efficient in managing the stream of ELTs to the benefit of its clients (manufacturers, tyre importers, car dealers) and also actively provides support to the government on further legal improvements.

- **Spain; Rapid Progress within the Producer Responsibility Model**

In Spain, a producer responsibility scheme has been in place since 2006. Confronted with huge landfill rates throughout the country (in 2004 over 70% of ELTs were sent to landfill), the government introduced producer responsibility obligations by law. This was following the similar existing laws and practices in other European countries. The Signus ELT management company owned by the 5 largest tyre manufacturers was set up in May 2005, began operating in 2006 and reached its 100% collection and recovery target in 2008, a very short period of time. This rapid progress was made possible with strong cooperation between Signus and other European experienced ELT companies who shared learning and best practice with Signus[46].

- **France; Further Progress within the Producer Responsibility Model**

In France, the Aliapur ELT management company, owned by the 5 largest tyre manufacturers, has been in operation since 2004. Over its 6 years of experience, Aliapur has become a clear and credible reference case, with two recent progresses:

(i) Historic stockpiles: according to the French decree on used tyre disposal, tyre producers have been responsible for the treatment of annual ELT generation since 2004, with allocation of responsibility determined by volume of sales on the national

[45] *(Source: European Tyre and Rubber Manufacturers' Association, ETRMA)*

[46] *(Source: European Tyre and Rubber Manufacturers' Association, ETRMA)*

market. This decree does not include any reference to the treatment of abandoned ELT stockpiles (approximately 200,000 tonnes).In order to progress on the treatment of those stockpiles, in 2005 Aliapur financed an abatement program to deal with 30,000 tonnes.

An important agreement was signed in February 2008 between the manufacturers, the distributors and the government aiming to treat all remaining stockpiles over the next 10 years.

(ii) Aliapur supports different R&D projects for the promotion of new, sustainable, and valuable recycling and recovery routes. Such projects, generally lasting 2-3 years, are collaborative and involve different industries, the government, laboratories and Aliapur. One of the projects recently clarified the biomass fraction of ELTs used as an alternative energy (about 20%), and, as a consequence, this value related to the decrease of the CO_2 emissions is now officially recognized in France, with the support of the administration.(Source: European Tyre and Rubber Manufacturers' Association, ETRMA

- **Free Market System: United States of America**

The United States based tyre manufacturers started a "shared product responsibility" ELT management program in 1990: this is a free market system. This approach is based on the concept that all entities that have contact or control of or over the tyre are responsible for their portion of their management scheme. This includes the tyre manufacturer, the tyre retailer, the consumer, collectors/transporters, tyre processors, the company that uses tyre-derived material and the state regulatory agency. ELTs are not regulated by the federal government, but by individual US states. Most states have some type of regulatory system governing ELT management. Many conduct market development activities. States have played an integral role in providing funding and management to significantly reduce the number of tyres in stockpiles. In 1990, over 1 billion ELTs were stockpiled across the US. Now, fewer than 130 million ELTs remain stockpiled.

- **California[47] a Command and Control Approach[48]**

It is estimated that, for the time being 65% of California's used tyres are reused, recycled or incinerated, while 35% are legally or illegally stored at landfills or other sites. The recycling facilities of California are not able to consume all the used tyres generated. For this reason, the Californian system for collection and treatment of used tyres seems to focus very much on the storage of used tyres, using special Waste Tyre Facility Permits in order to prevent environmental, health or safety threats from tyre fires. The system includes a fee on the sale of new tyres. The collected revenue is deposited in a fund which allocates money for the changing tyre programme needs.

[47] *NREB/DANCED A study on used tyres in the area of Kuching, 2001*

[48] *www.ciwmb.ca.gov/Tyres*

A national organisation, the California Integrated Waste Management Board (CIWMB) is responsible for the regulation, development and funding of used tyre activities in California. It is expected that an increasing use of waste tyres as feedstock material in commercial applications will solve the problems from legal and illegal storage of used tyres.

A fee is collected from the retailers of new tyres. Otherwise focus is put upon the registration of waste tyre haulers that is any person or company who want to collect used tyres. Likewise, focus is put upon permits for waste tyre facilities, meaning locations for storage or stockpiling of used tyres.

- **An Evolving Free Market System: Japan**

In the 1960s, End-of-Life Tyres had a monetary value in Japan. This changed in the 1970s with soaring demand for tyres and therefore more ELTs being generated annually, and a major revision of the Waste Management Law in Japan for controlling waste treatment. Therefore in the mid-1970s, fees were levied on the collection of End-of-Life Tyres, and JATMA developed an End-of-Life Tyres Control Committee in 1971. In the 1980s, increased energy demands boosted ELT demand, used as effective alternative fuels because of their high heat potential.

From the 1990s to the year 2000, the demand of ELTs has been affected by the changing oil price. The tyre industry has begun strengthening tyre disposal measures and, from 2001, the tyre industry sought to cultivate large-scale and interregional users including paper mills, gasification furnaces and biomass power reactors. Even in a country where the free market system is used for ELTs, tyre associations and the tyre industry needs to cooperate closely to ensure high recovery rates required by governmental regulations. (Japan Automobile Tyre Manufacturers' Association, JATMA)

- **Denmark[49]**

In Denmark (1997), 93% of all small tyres were collected and recycled. The new objective concerning all types of used tyres is recycling or incineration of 80% of all discarded tyres before 2004. The existing recycling capacity is expected to be sufficient to achieve the objective for 2004. The Danish system is based on a take-back scheme made by an agreement between the Danish Minister for Environment and Energy, the Danish Motor Trade Association, the Association of Danish Recycling Industries and municipal associations. The agreement requests enterprises selling tyres to take back a corresponding number of discarded tyres without additional costs for the consumer. The system includes a fee which has to be paid by the producers, importers or dealers of tyres. The fee finances the collection and treatment, administration of the scheme and information campaigns. The fee system is administered by the taxation authorities, while the collection system is administered by a special national organisation: the Danish Tyre Trade Environmental Foundation. The municipalities are the authority responsible for

[49] *NREB/DANCED A study on used tyres in the area of Kuching, 2001*

waste collection and therefore for enforcing that all generators of used tyre use the collection and treatment system established.

The system includes the obligation for the generators of used tyres to segregate the tyres at the source. According to the special Danish take-back system, the producers (producers, importers, dealers) are obliged to pay a fee and to take back used tyres without additional costs for the consumer. Furthermore, the professional collectors of used tyres are requested to receive all tyres from enterprises collecting or receiving discarded tyres, and to deliver these for recycling or incineration. Collectors also have a general obligation to report the types and quantities of the transported waste. The collectors have to be registered by the Danish Environmental Protection Agency, and the treatment plants have to be approved by the authorities.

- **Sweden**[50]

In 1999, 92% of the Swedish used tyres were collected and handled according to the Swedish regulations for waste tyres, which means that only about 2% of the collected tyres were landfilled, about 40% were used for various types of energy recovery, about 30% were reused or recycled and about 18 % were exported. The recycling capacity in Sweden seems to be sufficient for the appropriate treatment of used tyres.

The Swedish system differs totally from the Californian and Danish fee-systems by placing the total responsibility for collection, information, removal and recycling on the producers, importers or dealers of tyres. Because of the producer responsibility, a fee-system is not necessary. The non-profit national organisation SDAB is responsible for the overall supervision of the Swedish collection system for used tyres. The principals of the organisation are the Swedish Association of Tyre Suppliers and the Swedish Federation of Tyre Specialists with its retreading division. The SDAB co-operates with the Swedish Environmental Protection Agency. A private company, Ragn-Sells AB, has been named general contractor for the collection and handling of tyres.

The total responsibility for the Swedish system is placed with the producers (producers, importers, dealers). Of course, there has to be co-operation with the local authorities and the consumers, but by national ordinance, the producers still maintain the responsibility for information, collection and treatment of used tyres in Sweden. The producers are requested to receive waste tyres and take care that they are handled in a way which is approved by the authorities. A producer also has to give information to the Swedish Environmental Protection Agency concerning amounts, reuse, recycling and recovery of the delivered waste tyres.

[50] *NREB/DANCED A study on used tyres in the area of Kuching, 2001*

- **Taiwan**[51, 52]

In Taiwan, a management system for used tyres has been established by the Environmental Protection Agency. The system is financed by the Resource Recovery Fund. The sources of the Resource Recovery Fund come from the fees paid by the tyre manufacturers. The fees cover the administrative cost of the system and the subsidies for the recycling firms in order to make the recycling profitable. The Resource Recovery Fund is set up based on the provisions provided under the Resource Recovery Act, stipulating that importers, manufacturers and traders have the responsibility to recover the resources of the items which are recyclable. There are about 10 appointed recyclers of used tyres in Taiwan, who process some 20 million used tyres per year.

The fee and subsidy system is administered by the Resource Recovery Fund. A rate committee fixes the fees to be paid. A Management Committee of the Resource Recovery Fund is responsible for the distribution of the subsidies for the recovery /recycling of the used tyres, while an Audit Committee carries out the auditing of the recycle factories.

- **Ontario, Canada; Shared Responsibility**

In 2009, Ontario changed its ELT management legislation, to shift the costs from the government and taxpayer to the industry and its consumers. This is different from much of the rest of Canada where fees are collected by the retailer. From 1 September 2009, the tyre industry had legal responsibility to pay fees based on what they sell in Ontario (but not on ELTs that leave Ontario).

Different stakeholder responsibilities are:

(i) Provincial Government/Ministry of the Environment
- – Establishes diversion policy & sets program requirements
- – Provides guidance during program development
- – Approves or rejects program

(ii) Waste Diversion Act Board
- – Establishes Industry Funding Organization (IFO) to co-ordinates industry initiatives monitors IFO performance

(iii) Industry Funding Organization (called Ontario Tyre Stewardship, OTS)
- – IFO manages program development & implementation
- – Stewards contribute to plan development through participation in consultation process
- – Stewards register, report & pay fees to OTS

[51] *NREB/DANCED A study on used tyres in the area of Kuching, 2001*

[52] *Chang, N. B. Economic and policy instrument analyses in support of the scrap tyre recycling program in Taiwan; available online http://www.aseanenvironment.info/Abstract/41016818.pdf*

– OTS uses fees to pay for "collecting, storing, transporting, processing, marketing" ELTs

♦ **New Zealand[53]**

In New Zealand, there are no central or local government regulations that relate specifically to the management of EOL tyres, instead relied on a number of broader controls that exist and are relevant in the management of EOL tyres.

The New Zealand's Litter Act[54] provide a general and broad regulatory instrument that prohibits illegal emplacement of EOL tyres on any property, whether publicly or privately owned, without the owner's permission

Further, under the New Zealand's Resource Management Act (RMA), it is stated that no person may use any land in a manner that contravenes a rule in a district plan or proposed district plan unless the activity is expressly allowed by a resource consent granted by the territorial authority responsible for the plan. As tyres storage is a form of land use and the act of storing the tyres on it onto any land render the land non-functional for any other use planned by the local authorities, therefore the act of storing or dumping tyres in any land is a prohibited act. Accordingly, local authorities have the clear ability to control or ban tyre piles through their district plans. The RMA can also be used to prohibit or control the establishment of tyre piles where another activity that requires consent - such as moving earth to create space for a pile - needs to be undertaken to create the pile

Similarly, the New Zealand's Local Government Act (Part 8) gives local authorities the right to make bylaws to protect the public from nuisance, and to maintain public health and safety. It explicitly states that this includes the right to pass bylaws on:

(i) Waste management
(ii) Trade wastes
(iii) Solid wastes

A report to the Ministry of Environment New Zealand[55], concluded in their study for the management and storage options available for EOL tyres that a nationally or regionally integrated system for the collection and transport of end-of-life tyres to specific storage facilities would provide the level of monitoring and control that, given the literature, appears to be required to manage end-of-life tyres.

The report further corroborated their findings to systems that are provided in the United Kingdom and the United States, in which there are specific companies that are

[53] *http://www.mfe.govt.nz/publications/waste/management-end-of-life-tyres-jan04/html/page1.html*

[54] *www.legislation.govt.nz/act/public/1979/0041/latest/DLM33082.html*

[55] *MWH New Zealand Ltd, End-of-Life Tyre Management: Storage Options Final Report for the Ministry for the Environment, July 2004*

authorised to collect end-of-life tyres and transport them to authorised tyre storage facilities. The report further emphasized that an integrated system would also maximise the amount of tyres that could be used in tyre reprocessing operations.

- **South Africa**

The minimum tread depth of a tyre in South Africa is legally fixed at 1.0 mm by the Council of the South African Bureau of Standard (CSABS, 2005) as opposed to that in the EU, Japan and the US which are currently at 1.6 mm (USDT, 2001). This creates seemingly ironic new markets for used tyres from these countries. Used tyres in these countries are therefore usable in South Africa and tyres imported from those countries for retreading in many case are directly sold into the market for a short life span of two to three months, thus further compounding the stockpile of waste tyres (SAMTC, 2005)

The Minister of Environmental Affairs and Tourism identify waste tyre as a special waste in terms of the Environment Conservation Act. Local governments however reuse to accept waste tyres at their disposal sites despite their responsibility to provide waste management services. The refusal stems from the disruption that the tyres caused to waste landfills. The lack of incentives, policy directives and enforceable legislation causes waste tyre illegally dumped in the open, as well as uncontrollably burnt to recover the steel strap.

- **Germany**[56]

The EU's most industrialized nation, probably has the best scrap tyre recycling record amongst its peers. While it generates more scrap tyres than any other nation, it recycles most of them (78% in 2003). Tyre-derived fuel (TDF) is the most important end-market in Germany. There is no specific regulation that applies to scrap tyres. There are also no specific organizations that co-ordinate or manage scrap tyre programs. While increased recycling rates are expected following EU regulations, high growth rates are unlikely as the industry is already well developed.
The industry structure is fairly similar to what exists across Europe. Tyre retailers and others collect scrap tyres from consumers. Collectors transport the tyres to processors who process them for end-markets.

Scrap tyre generation is likely to grow further as recycling rates improve but at a lesser pace than other European peers. Automotive demand in Germany has been stagnant for the past few years, which means that replacement demand is likely to be flat for the next few years.

The main industry driver is Germany is the demand from the end markets since there is no regulation that specifically deals with scrap tyres.

[56] *Tyre Recycling Industry; The Global Overview. www.irevna.com*

Tyre-derived fuel is the main end-market for scrap tyres in Germany. While tyre-derived fuel accounted for 68% of the recycling market in 2003, tyre-derived products accounted for 24%.

Demand for tyre-derived products is expected to outpace demand for tyre-derived fuel, since the tyre-derived products market is still in a nascent stage. While demand for tyre-derived fuel should benefit from higher energy prices, a still sluggish German economy and industrial production should partially offset it.

There is no specific legislation in Germany for scrap tyre recycling. The generally applicable law is the Act for promoting closed substance cycle waste management. A few waste categories are governed by ordinances while others are governed through voluntary organizations. Germany prefers a voluntary industry approach to scrap tyre recycling to a regulatory approach

♦ **Australia**

In Australia, the current system is based on the following[57]:

- Legislation that calls for retailer, transporter and recycler / land fill operator to take responsibility for safe waste tyre handling, storage, disposal and offers stiff penalties for illegal operations.
- Substantial private investment at all levels; retailer, transporter, recycler, waste management.
- A high degree of competition at all levels which delivers effective market mechanisms in many respects albeit there is room for improvement in recycling market development
- Market flexibility to create, react to and embrace new initiatives
- The requirement that EPA legislation be fully enforced

In a paper published by the association in response to the NSW EPA consultation paper, the Australian Tyre Recyclers Association summarized that the government should facilitate the introduction of a levy benefit scheme used to fund:

- A fully resourced, national audit and enforced waste tracking system, to be delivered by the State EPA Offices
- Rebates to recyclers on sales to encourage recycling and compete with cheaper imported crumb
- Rebates for end use manufactures to compete with virgin products
- Clean ups of tyres dumped from operators who have ceased trading, and
- A consumer/industry education campaign and
- Assist market development, especially through government buying strategies favouring recycled product

[57] *http://www.atra.or.au*

- **Singapore**

Scrap tyres management in Singapore is part of the integrated waste management system of Singapore. The waste management system is based on the combination of a regulatory set up, availability of incentives and funds for eligible waste minimisation and 3R programs and activities, including tax incentives

The public waste collection in Singapore is managed by four licensed Public Waste Collectors that are responsible for the collection of waste from residential and trade premises. They are also required to provide recycling services under the Singapore's National Recycling Program (NRP). Waste from commercial and industrial premises however are collected separately by licensed general waste collectors. Waste that are not disposed at Singapore's four municipal solid waste incinerators / waste to energy plants are sent for recycling.

Scrap tyres recycling in Singapore was at 88%[58] recycling rate while in 2010 at 83%[59]. There are nine scrap tyre recycling centres in Singapore that provide services for the collection, transportation, rethreading, reprocessing and trading[60].

- **Thailand**

There are established, complex regulatory frameworks in the management of solid waste in Thailand. There are however unclear demarcation among the responsible central agencies and complicated relationship between local municipalities and central agencies. These have resulted in the various inabilities of the local municipalities' project implementation capacity both technically and financially. There are designated funds and incentives introduced by the government in promoting recycling. Thailand's recycling rate is for municipal solid waste is about 22%.
There are three scrap tyre recovery facilities in Thailand[61] with total annual processing capacity of approximately 20,000 metric tonnes. Thailand's new tyre production capacity is at 60,000 metric tonnes per year.

Scrap tyre collection systems are largely based on informal sectors and recycling companies purchase scrap tyres at approximately 1.8 – 2.0 baht per kilogram. Scrap tyres recovery products are either exported or used in the local markets.

[58] *2008*

[59] *http://app2.nea.gov.sg/topics_wastestats.aspx*

[60] *http://www.nea.gov.sg; http://app2.nea.gov.sg/data/cmsresource/20101123253319936830.pdf*

[61] *http://enviroscope.iges.or.jp/contents/APEIS/RISPO/inventory/db/pdf/0089.pdf*

Table 33: Summary of Scrap Tyre Management in Different Countries of the World[62]

	Canada	Japan	France	Germany	United Kingdom	Italy	Spain
Scrap Tyre Generation[1]	4,139,100	317,520	1,004,000	372,330	600,000	450,000	388,389
Existing stockpiles[2]	271	34	Minimal	NA	NA	NA	NA
Recycling rates	80%	86%	52%	78%	59%	70%	
Main end-markets	Tyre-derived fuel, Civil engineering products	Vary across states, mostly molded products	Tyre-derived fuel	Tyre-derived products	Tyre-derived fuel	Tyre-derived products	Tyre-derived fuel
Regulation	At state level; almost all states have laws dealing with scrap tyre management	At state level; almost all states have laws dealing with scrap tyre management	Regulated as part of solid waste	Manufacturers and importers responsible for scrap tyre management	No specific regulation for scrap tyres	Whole and shredded tyres banned from landfills, voluntary approach by industry preferred	Regulatory framework still evolving
Stewardship programs	Yes; At state level	Yes; At state level	None	None, but Aliapur co-ordinates the scrap tyre management program	None	None, but Tyre Recovery Association co-ordinates the program	None
Competition	Intense	High	-	-	-	-	-
Other comments	Highly advanced market	-	Well established industry	-	-	-	-
1 In tonnes **2 In millions**							

- **Accountability and Traceability: Examples of Manifest Systems**[63]

A minimum four-part system is generally practiced in the free market system, in which there are four copies of the individual manifest:

- Copy 1 given to the UT owner on disposal
- Copy 2 given to the distributor / retailer
- Copy 3 sent to the state regulatory agency
- Copy 4 kept by the collector

A copy for the processor and / or recovery and recycling companies could also be required. However, in Korea a 3 part manifest system works effectively:

[62] *http://www.irevna.com*

[63] *End-of-Life Tyres (ELTs): a Framework for Effective Management Systems' (WBCSD, June 2010)*

1) The collectors/transporters issue 3 copies of the individual manifest when they collect ELTs from the UT owners or distributors/retailers:

- copy 1 given to the UT owner or the distributors/retailers
- copy 2 kept by the collectors/transporters
- copy 3 sent to KOTMA

2) The recovery or recycling companies issues 3 copies of the individual manifest when the collectors/transporters supply them with ELTs:

- copy 1 given to the collectors/transporters
- copy 2 kept by the recovery/recycling companies
- copy 3 sent to KOTMA

KOTMA manages the collection and provision of ELTs with the manifest copies given by the collectors/transporters and by the recovery/ recycling companies. This system is generally in place in countries operating a Producer Responsibility model.

In Japan, a 7 part manifest system works effectively:

1) The distributors/retailers issue 7 copies of the individual manifest when they discharge ELTs to the collectors/transporters:

- copy A kept by the distributors/retailers
- copy B1 kept by the collectors/transporters
- copy B2 signed by the collectors/transporters and sent to the distributors/retailers
- copy C1 kept by the tyre shredder
- copy C2 signed by the tyre shredder and sent to the collectors/transporters
- copy D signed by the tyre shredder and sent to the sent to distributors/retailers
- copy E signed by the tyre shredder after receiving second manifest copy D from the
- recovery/recycling companies and sent to the distributors/retailers

2) The tyre shredder issues 6 copies of the individual manifest when they discharge ELTs to the collectors/transporters:

- copy A kept the tyre shredder
- copy B1 kept by the collectors/transporters
- copy B2 signed by the collectors/transporters and sent to the tyre shredder
- copy C1 kept by the recovery/recycling companies
- copy C2 signed by the recovery/recycling companies and sent to the collectors/transporters
- copy D signed by the recovery/recycling companies and sent to the tyre shredder.

JATMA developed this manifest system in accordance with the Japanese Waste Management Law.

3.4.4 Incentive Model for Peninsula Malaysia

In the case of scrap tyres management in the Peninsula Malaysia, the Consulting team noted the following for the 'proposed incentive model for the Peninsular Malaysia.

The Handbook of Economic Instruments in Environmental Management of Malaysia highlights a number of economic instruments and measures that could be introduced. The handbook however excludes the concept of Extended Producer Responsibility (EPR), and provide a relatively wide emphasis on the product charge or taxation based system. This is slightly different from the management of scheduled wastes where such waste are subject to the various regulations that requires all waste generators to notify and generate tracking documents for all of their scheduled wastes. The various parties involved in the collection, transportation, storage, treatment and final disposal are registered and licensed.

The European Union in line with the Basel's Revised Guidelines on environmentally sound management of Used Waste tyre 2008[64], has identified three different systems for managing waste tyre. The three systems are:-

- **The producer responsibility based system.**
  Under this system the law will be used to define the legal framework and assigns the responsibility to the producers (tyre manufacturers and importers) to manage the processing of waste tyres. A national operating company or association, usually a non-profit organization, is created and funded by producers who will contribute to a common fund to covers the cost of collecting and disposing of tyres. This system placed more emphasis on the collection of waste tyre.

- **The tax based system.**
  This system the recovery and recycling of scrap tyres will be financed by a tax or fees levied on tyre production or importation. Such tax or fees will likely to be passed on to the consumer. The government, with the funds collected, in return will be responsible for implementation of the collection and disposal of scrap tyres.

- **The free market based system**
  In a free market based system, the laws will set the objectives to be met but does not define those who shall be responsible for the implementation. In this way, all those that are involved are free to operate under free market conditions but must act in compliance with legislation. This usually requires voluntary cooperation between companies to promote best practices.

[64] *www.basel.int/meetings/oewg/oewg7/docs/i09e.pdf*

Table 34 below summaries the type of systems adopted for managing scrap tyres in various countries.

Table 34: Type of systems adopted for managing scrap tyres in various countries[65]

Producer Responsibility	Tax-based System	Free Market System
Europe (Belgium, Finland, France, Greece, Hungary, Norway, the Netherlands, Poland, Portugal, Romania, Spain, Sweden, and the Czech Republic), Turkey Italy in 2011	Europe (Denmark , Latvia, Slovak Republic)	Europe (Austria, Germany, Ireland, Switzerland, United Kingdom)
Brazil Canada,	United States (most states)	United States (some states)
Canada (British Columbia)		Australia

While not all of the system elements appear in all states or adopted dedicatedly and decidedly by any states, the agreement that can be inferred in the above grouping is that any effective system of scrap tyres management / incentive program must include some or all of the following features:

- Registration or licensing of haulers and processors; use of manifests; financial assurance requirements.
- Ban on stockpiles; provision for remediation
- Limitations on landfilling of whole or processed tyres
- Establishment of dedicated taxes or similar instrument for scrap tyre related programs
- Assistance to create or expand scrap tyre markets
- Public –private partnerships that create scrap tyre markets

The aim of the economic instrument for scrap tyre management in the Peninsula Malaysia is conceivably to create a “market-pull” demand for scrap tyres thus making inappropriate disposal of used tyres financially unattractive. Legislative requirements that are already in existence across the waste definitions in the Solid Waste Management Act, The Environmental Quality Act could be adopted to provide the existing framework to create this market pull conditions. The scheme’s objective is to divert all used tyres away from landfill and into uses where the maximum resource value can be recovered.

Registration or licensing of haulers and processors; manifests; financial assurance requirements

The first of these common features is a provision for establishing regulatory control over the business entities that deal with scrap tyres. The mechanism used is a registration or licensing requirement. Businesses desiring to engage in scrap tyre logistics or processing

[65] *Source: BASEL Revised technical guidelines on environmentally sound management of used tyres – November 30, 2008*

are required to register with a dedicated government agency and provide such information as the agency requires. This requirement is in addition to any other more general business licenses and permits it may be required to secure.
Continuation of the scrap tyre registration or license is contingent on compliance with rules and regulations established for that type of operation. In addition, scrap tyre generators, such as tyre dealers or vehicle dismantling yards are also required to register, although such registration is usually intended only to assign them a generator number to be used to track scrap tyre transactions.

A concurrent requirement is that scrap tyre generators can only contract with licensed or permitted haulers to secure collection services. Licensed or permitted haulers, in turn, must only deliver tyres to a licensed processor, storage site or end user. A limited exception to the permitting requirement may be provided to anyone carrying a minimum number of tyres, typically 10 or fewer, or in a few instances for tyre dealers hauling their own tyres to processors or markets. Established manifesting requirements like scheduled management administered by the DOE, to provide a paper trail from generator to ultimate use or disposal is put into place. Manifests are initiated at the generator when scrap tyres are collected, travel with the scrap tyres to the processor or end user, and provide both an audit trail for enforcement activities and a sentinel effect for all the parties involved.

Another common requirement is that processors, and less frequently haulers, may be required to post a financial assurance instrument in favor of the regulatory authority concerned to insure adequate funds to remediate their sites in the event they fail to do so. These may be bonds, letters of credit, insurance policies, or other instruments as allowed by the relevant regulations. The amount of the financial assurance is normally calculated on the maximum number of whole or processed tyres permitted at the processor's site, or on the number of vehicles the hauler is operating.

Ban on stockpiles; provision for remediation

Taking cue from the management of scheduled wastes in the country, prohibition of any new scrap tyre stock piles from being created and requiring owners or operators of existing stock piles to cease receiving or storing any new scrap tyres and to develop a plan to eliminate the existing stock piles should be in place. Recognizing that scrap tyre processors may require some scrap tyre storage, the existing regulatory framework on controlled solid waste management may be applied to require that any such above ground storage be allowed only in accordance with the terms of a permit that will specify the maximum tyres allowed to be stored.

These processors would be required to post a financial assurance instrument as described above based on the prevalent market rate for such insurance coverage (primarily due to fire and general liability risks). Equivalent standards for the outdoor storage of scheduled waste or other scrap materials destined for recycling could possibly be applied to scrap tyres operators. These standards typically follow guidelines adopted by the National Fire and Rescue department (Bomba), or alternatively that of the principal fire safety standards

development organization in the United States, the National Fire Protection Agency (NFPA). These guidelines provide specific guidance on physical size limitations on stock piles, and on minimum management requirements for stock pile operations.

A related requirement is for treatment of the piles to reduce or eliminate disease vectors, such as mosquitoes and rodents. Eliminating existing stock piles is also a major legislative and regulatory concern. If a responsible party can be found, that party typically is required to comply with the storage regulations and to prepare and follow a plan to eliminate the stock pile.

Often, however, there is no financially capable party present in the proper management of scrap tyres except for the current industrial operators, or the stock pile is on public land. In these cases the public scrap tyre authority (local authorities or designated agencies) is responsible for the stock pile remediation effort. The specific mechanisms used to remediate stock piles have varied along the countries in the world. Some countries have provided funds to their local counties, districts or other local government units to manage site clean ups, while other countries have taken on the task directly through their respective federal or state agency. Other complications that may arise from the management of these stockpiles are access to the stock pile. In some countries, their authorized governmental agency (either federal or state authorities) is provided direct legal powers to enter property to clean up a tyre pile. In other countries, a more involved legal process must be observed, usually adding additional time to the process.

In the United States, state scrap tyre funds are the usual source of funding for publicly supported clean ups, even on private property (as with the state of Sarawak scrap tyre management funding mechanism. If the site is on private property, the state will normally seek a lien on the property to recover the funds expended. At least one state in the United States (Maine) has used part of the proceeds of a public bond issue for environmental projects to be dedicated for scrap tyre pile remediation. Based on the experience reported for the United States, that is when a state begins to undertake stock pile remediation efforts, it often results in substantial voluntary remediation efforts by private landowners at their own expense. While these tend to be smaller piles, usually under *50,000* tyres, they tend to be the largest number of piles and to contain, in the aggregate, a substantial number of tyres. The Sarawak mechanism approaches this situation, while differing the implementation part of the program, that is the final operators of the scrap tyre mechanism is determined by way of an open tender.

Limitations on landfilling of whole or processed tyres

While generally there were minimal amount of scrap tyres found disposed in most of Malaysian landfills and open dumpsites, the majority of modern sanitary landfill operators have banned whole scrap tyres from landfills. Removing whole scrap tyres from landfills eliminates several problems, including the high volume that whole tyres occupy, the fact they do not easily compact, and their tendency to move through the landfill and break the cap. Cut or shredded tyres remove all these problems (from landfilling of tyres).

As was noted above in the discussion of scrap tyre markets, shredded tyres are being used in several ways in some civil, road pavement and secondary fuel operation. Pressure to limit landfilling of shredded tyres often comes from people who are seeking to build higher value markets for tyres. Landfill or monofill disposal, even of shredded tyres, often is the lowest cost option for handling scrap tyres. Higher value markets typically require higher tipping fees or other financial support.

In order to help develop these higher use markets, the authorities should consider prohibiting landfilling of tyres in any form, either whole, shredded or by products of any tyre reprocessing facilities as well as facilitate the establishment of higher value processes. One caution is in order. If landfill is the current destination for most scrap tyres (as are with all the illegal dumpsites as well as private repositories), imposition of an immediate ban will normally result in an increase in illegal dumping. Any landfill ban should be phased in to allow alternate markets to be established.

Establishment of dedicated taxes for scrap tyre related programs

A common feature of US and Canadian scrap tyre programs is a dedicated fee or tax imposed by the government to support scrap tyre programs. This is one very pointed mechanism intended to internalize some of the direct costs associated with scrap tyre management. These fees vary in such basics as the point of imposition, the amount of fees, and the pattern of utilization.

The most common point of imposition is retail sales transactions involving tyre purchases. In the US, most states limit the taxes to replacement tyre sales. In a few states and in Canada, the taxes are also imposed on tyres mounted on new vehicles at the retail sale level. In two states, Ohio and Maryland, the tax is imposed at the wholesale level and collected and remitted by the wholesaler.

Retail or wholesale level taxes are usually a fixed amount per tyre (as was determined for Sarawak scrap tyre management system). In two states, the amount is calculated on a percentage basis, with a cap on the maximum amount that can be imposed. Several states avoid the tyre sales transaction entirely and increase other fees imposed on vehicle ownership. Four states impose additional fees on vehicle title transfers. One state imposes a separate environmental fee on new car sales, with a portion of this fee dedicated to scrap tyres.

The rationale for this approach is that it avoids the administrative burden of establishing a new tax. The existing collection system is in place, and it is a relatively simple matter to transfer funds to the appropriate state account. The amount of tax or fee varies substantially and reflects the different approaches to internalizing management costs. Tax amounts imposed on passenger tyres range from USD$0.25 (RM0.75) per tyre to USD$4.00 (RM12.00) per tyre. In the United States, the most common figure is USD$1 (RM 3.00) per tyre. States with tax levels at USD$1 (RM3.00) or below per unit do not intend that the money generated will cover the cost of initial collection from tyre generators. Jurisdictions in

both the US and Canada that impose higher taxes, ranging from USD$1.50 (RM4.50) per tyre to USD$4.00 (RM12.00) per tyre, have established programs where the taxes represent prefunded disposal or collection costs. Fund utilization will be discussed in greater detail in other portions of this paper, but in general funds are utilized to support the staffing necessary to administer the program, for cleanup of scrap tyre piles, to provide market development assistance designed to create self-sustaining end use markets, and to find the tyre collection system.

Assistance to create or expand scrap tyre markets

The key to success in any effort to divert recyclable and reusable materials from the solid waste stream is to develop end use markets. *Diversion of materials is not recycling*, although many people who participate in such programs believe it to be so. Only when materials have markets is recycling or reuse taking place.

When states and provinces enact comprehensive scrap tyre legislation, one of the most prominent features is assistance to create or expand scrap tyre markets. Assistance programs can take several forms and point to note here is that successful programs have strong market development features. From the tyre recycling industry's perspective, the most appropriate system of economic instrument for waste tyres would comprise the following:

1. Enforce existing waste tyre disposal laws and encourage / require full cost recovery for scrap tyre recycling and prohibit landfill disposal. It is critical that new recycling systems not have to compete with illegal disposal and below the cost for landfill disposal in a sanitary landfill.
2. Apply this legislation to all tyres in all locations, nationally.
3. Do not replace the existing used tyre collection, aggregation, storage, and disposal system without thorough evidence of a better system that supports the range of recycling solutions. The current system is working for the purpose of collection, transportation and delivery to the various small and medium industries that are working relatively successful and demonstrate a notable emphasis on their environmental performance. The key issue is the development of recycling systems that are sustainable, methods of resource recovery that will draw on this collection system to feed various alternative recycling systems and in a way that is market driven.
4. Support a national levy on new tyres:

    - Paid at source
    - Collected from manufacturers and importers
    - On an equivalent passenger unit (EPU)[66] / weight basis
    - On all tyres (i.e. car, truck, off road)
    - Controlled by an appropriate government agency to collect and disburse

[66] *An equivalent passenger unit is a unit of measurement based on the mass of a quantity of tyres, or parts of tyres. For a quantity of tyres, or parts of tyres, each 9.5kg of the tyres or parts is equivalent to 1 equivalent passenger unit*

- Protected from general revenue by legislation requiring return to the industry
- Used to promote and enforce disposal legislation, development and commercialization of alternative and environmental friendly technology in recycling systems and markets.

5. Use government purchasing as a way to validate recycling technologies and stimulate threshold business development of accredited recycled waste tyre products.
6. Ensure that government buyers and suppliers use recycled products that have been shown to be cost effective and technically competitive. Provide government buyers with both commercial incentives and recognition incentives for using recycled products and establish systems to remove the impediments to use of recycled products by government entities. It is important to recognize that there are many impediments to the use of recycled products by governments and that the nature of these impediments is that some will require substantial programs to cause change. As a result, strategies for impediment removal should be both short term and long term and directed towards immediately accessible solutions and solutions that involve structural change.
7. Initiate and support a Malaysian based certification scheme for the purpose of validating the environmental credentials of alternative recycling systems, possibly for the purpose of assessing the relative environmental merit of alternative recycling systems.
8. Ensure the regulatory agencies like the NSWMD, DOE, Customs, DOT and SWPCMC that influence both government and private industry purchasing policies, are forthright and transparent in their assessment of recycled products.
9. Accelerating certification of recycled tyre products as being fit for purpose. This can be accomplished by funding the research required to gain certification.
10. Support removal of illegal stockpiles of waste tyres by subsidizing the recycling systems used to accomplish this task.
11. Recognise that the various recycling systems deliver varying degrees of resource recovery and support recycling initiatives proportionately to their relative resource recovery value.
12. Only support “energy from waste tyres” as an interim platform for volume disposal needs, until higher value recovery options are further developed. Any support must be carefully framed to ensure higher value options are not impeded.
13. Do not support producer organizations unless these organizations make a direct contribution to recycling that is not available from other sources.
14. Consider ways of promoting recycling systems that are shown to be effective, in resource recovery, to their appropriate markets. Use levy funds to subsidise waste tyre recycling systems for a period sufficient to determine the commercial feasibility of the alternative recycling systems.

The function of a levy should be a stimulus by manufacturers / importers of new and used tyres to the accelerated growth of recycling to address the end of life responsibilities of their

products. The purpose of the funds generated through the levy would be to accelerate the development of environmentally safe and beneficial waste tyre resource recovery systems.

Thus, the uses of levy funds should include a range of programs directed to achieving the objectives of the national waste tyre disposal policy. This should allow for:

- Education and promotion of the policy to local government and the tyre industry at large.
- Education of all levels of government in the value of recycled tyre derived products and actions they should take to use these products.
- Facilitation of activities to validate (or disprove) the claims of various waste tyre-recycling systems including use by government buyers and suppliers to government.
- Funding of research to prove the fitness for purpose of recycled products.
- Temporary subsidies for use of recycled products that reflect the environmental values of the alternative recycling systems. For instance energy recovery should attract a lower level of subsidy and crumbing / civil engineering applications should realise a high level of subsidy.
- Periodic measures of policy performance.

3.4.4.1 Operators for Scrap Tyres Collection and Treatment

In line with the above recommendations, the existing operators for the scrap tyres collection and treatment should be allowed to continue operating. They however should be registered much like the system adopted for the management of scheduled wastes. Replacing the existing operators and logistics systems with a single concessionaires or operators may not augur well with the economic potentials of the scrap tyre generations. Currently most of the scrap tyre collectors are in essence affiliated collectors and logistics providers that subscribe to particular scrap tyres buyers that require supply of scrap tyres to support their business models. Putting in place a system where these logistics providers as well as their primary buyers can have access to the funds (scrap tyre tax system) could eventually allow them to improve their access to the scrap tyres producers and generators, discouraging illegal dumping and unwanted deposition of the scrap tyres.

The appointment of a single operator via concessionaire model or contract will necessitate the outlay of an overall and all-encompassing logistical system that will add on to the cost for the implementation of the system. Large volume of scrap tyres are transient in nature and over time will not be able to support the sustaining costs to ensure complete logistical solutions for the whole of Peninsular Malaysia. This is in stark contrast to the generation of municipal solid wastes which are continuous in nature, thus necessitating differences in the manner at which the appointment of an operator or operators are made.

In comparison, the award of the scrap tyre management in Sarawak via an open tender, that include collection, transportation, treatment and disposal is due to the smaller market volume of scrap tyres, the existence of a pioneer operator in scrap tyre management and already

existing infrastructure facilities that could be immediately assumed and integrated with the government proposed system.

3.4.4.2 Size of Levy on Scrap Tyres

Based on the field survey, there are about 700 metric tonnes of scrap tyres generated daily in the whole of Peninsula Malaysia. Tabulating the results of economic evaluation of scrap tyre treatment or reprocessing technologies, the following transpires;

Table 35 : Economic evaluations of various technology options in tyre recycling, reprocessing

	F	R	C	T	D	P, per tyre	T, tyres (tonnes)	T, tyres (x106 pcs)	P, Total (mil/yr)	Payback (yrs)	Capital (mil)
TDF											
Coal Fired Power plant	0.00	5.93	2.00	2.00	0.30	1.63	30,000	6.25	10.20	9.80	100.00
Cement Kiln	0.00	4.30	0.50	2.00	0.00	1.80	30,000	3.50	15.08	3.33	5.00
Pyrolysis	0.50	9.60	5.00	2.00	0.00	3.10	30,000	3.75	3.88	5.18	20.10
TDP											
Shredding, Granulation	0.50	6.40	1.80	2.00	0.40	2.70	15,000	1.80	4.90	3.06	15.00

The economic evaluation in **Table 35** above is derived from the following relationship and has been discussed in detail in Section 4.3 of this report.

P = F + R – C –T- D

Where;

P	= profit per tyre
F	= tipping fee collected per tyre by the recycling facility
R	= revenue received per processed tyre
C	= processing cost per tyre for operating the facility
T	= transportation cost to bring in the tyre
D	= disposal cost for waste products
T, tyres (tonnes)	= Total tyres used or processed in tonnes in a year
T, tyres ($x10^6$ pcs)	= Total tyres used or processed in pcs in a year
P, Total (mil/yr)	= Total Profit per year in million RM
Payback period (yrs)	= Estimated payback time of capital investment calculated using ***Payback Period = Capital Invested / Annual Profit***
Capital (mil)	= Capital Investment necessitated for reuse of tyres in the different technology options.

TDF = Tyre Derived Fuel
TDP = Tyre Derived Products

The handbook of Economic Instrument in Environmental Management of Malaysia quoted the study by the project team of the Sarawak's scrap tyre management in terms of the proposed size of the levy.

The Sarawak's study team concluded that a product charge was the most feasible option if the polluter-pays-principle and sustainability were to be applied for the proposed state system. A sales tax was proposed as the instrument of collection. The processing method adopted during the study was based on tyre derived product (TDP), with particular emphasis on tyre shredding and granulation, and subsequent commercial trading of the resultant products like tyre crumbs, steel and nylons.

The Sarawak study estimated that RM2.9 million a year could potentially be raised if unit charges of RM3 a tyre for passenger cars and RM18 a tyre for trucks were imposed. An additional revenue of RM1.5 million could be obtained by selling recycled items from the tyres such as crumb rubber (RM1.1 million), steel (RM0.3 million), and canvas/textile (RM0.09 million). The estimated revenue, from the tax and other revenues, was about RM4.4 million.

The final recommendation of the Sarawak study was for the product charge to be pegged at RM450 a tonne. **Table 36** below shows the results of the financial assessment based on net present value (NPV) and internal rate of return (IRR).

Table 36 : Evaluation of scrap tyre tax levels in Sarawak: NPV & IRR[67]

Tax Level (RM/tonne)	Net Present Value (RM, million)	Internal Rate of Return (%)
300	0.30	1.4
400	0.96	18.7
450	1.17	31.0
500	137	44.5
600	1.79	73.8

Considering the estimation by the project team in section 4.3 above, taking into account of the corresponding TDP plants surveyed by the consulting team, it is highly probable that the proposed levy size for scrap tyres in the Peninsular Malaysia be considered at RM 450 per tonne of scrap tyre, giving rise to a taxation fees per tyre at RM 3.00.

The parallel consideration of the Sarawak economic model (levy, charge per tonne of scrap tyre) as well as the suggestion to adopt the fees and charges level for the proposed levy for scrap tyres in the Peninsular Malaysia will at the same time allow the standardization of policies between the two territories. There are no new tyre manufacturers in Sarawak that all new tyres are shipped from the Peninsula-based manufacturing facilities. In the Sarawak

[67] *NREB/DANCED, 2001*

model, the state government through the Sarawak Scrap Tyre Fund collects the levy at the point of new tyre sales which in the first place is paid by the new tyre manufacturer. For the purpose of conceptualization, the corresponding Solid Waste and Public Cleansing Management Corporation could be the agency that manages the similar fund created for the same purpose in the Peninsula Malaysia.

This is further supported by the fact that by comparing the Sarawak Study with that of the estimation made in Section 4.3 of this report, there is a very strong correlation between the impacts of the proposed levy as shown in **Table 37** below.

Table 37: Correlation between Sarawak scrap tyre management study and estimation made for the Peninsular Malaysia

	F	R	C	T	D	P, per tyre	T, tyres (tonnes)	T, tyres (x106 pcs)	P, Total (mil/yr)	Payback (yrs)	Capital (mil)
TDP											
Shredding, Granulation	0.50	6.40	1.80	2.00	0.40	2.70	15,000	1.80	4.90	3.06	15.00
Sarawak Study	N/A	N/A	3.15	1.10	N/A	9.16	5,410	0.48	4.4	N/A	8.89

The Sarawak model was based on a smaller annual tonnage of scrap tyres potentially available to support the capital requirements to set up the required scrap tyres reprocessing facilities. The profit per tyre is relatively high in comparison to the estimation made in this study, this could be attributed to the various underlying economic values and assumptions assigned to the Sarawak model.

3.4.4.3 Regulating the proposed levy

Regulating the proposed levy intended to be imposed in facilitating scrap tyre management shall require effective scrap tyre management programs that include several distinct elements, including establishing sound collection practices, developing end use markets or disposal alternatives, providing effective enforcement, and remediating the negative impacts of earlier practices. The issue of cost internalization is fundamentally one of determining factors, who should pay any costs associated with this scrap tyres management program and how should the necessary funds be collected and disbursed. In general, a world consensus seems to be growing with respect to tyres that costs associated with this end of life management should be reflected in the product itself, and methods should be developed to include these costs in the cost of its ownership.

The introduction of levy on tyres in the Peninsular Malaysia will necessitate the introduction or streamlining of relevant agency or agencies in the management of the levy monies. Currently there is no product charge being levied onto the use of new tyres in Malaysia.

Direct vs. Indirect Costs and Benefits

Earlier it was mentioned that there are two sets of costs associated with scrap tyre management and utilization or disposal.

- The first set are the immediate and direct costs of collection, processing, reuse and disposal, and can be extended to include the cost of governmental oversight and management of a scrap tyre industry and the cost of remediating the failures of past scrap tyre management techniques, especially stock piling.
- The second set of costs is higher order costs that can be a consequence of scrap tyre use or reuse. These are more diffused social and environmental burdens and benefits that result from various scrap tyre management options

Internalization of direct costs

In the United States and Canada, various approaches to this cost internalization for direct scrap tyre management costs have been developed. These include:

Free market activity; Taxes or fees imposed by governmental jurisdictions on new tyre sales to form some or all of these end of life activities; and Increases in other vehicle related levies dedicated to scrap tyre programs. Some jurisdictions utilize more than one approach depending on the different parts of the program.

For example, initial collection cost may be set by free market forces, while a tyre tax system supports enforcement and market development. In addition to different cost internalization methods, the North American jurisdictions have developed different regulatory structures for scrap tyre management.

Based on the proposed model of creating a market pull demand system, it is envisaged that the management of sales tax onto new tyre products in Malaysia (as well as the use of the levy monies to support the proposed scrap tyre management system in the country) may be adopted and implemented as follows;

- Phase 1 for the implementation of sales tax onto new tyre products either manufacturer locally within the country of imported. A tiered tax system may be considered by the Customs Department in order to determine the appropriate tax regime for the different new tyres origin.
- The Customs Department collects this tax on behalf of the National Solid Waste Management Department. Similarly the funds went to the Treasury.
- The collected fund therefore is managed by the Solid Waste Management and Public Cleansing Corporation in the implementation of the subsidy system for the proposed distributed collection and transportation system for scrap tyres. Since the requirement is that all collectors and transporters of scarp tyres be registered and recorded, the subsidy could be based on the commercial tariff that can be developed by the Corporation for returning part of the collected tax directly to the registered collector and transporters.

- Phase 2 is where the tax is extended to the retail level, which would cascade the tax directly to the consumers. At this time, the core collection and transportation systems would have been implemented and able to support the operatives under Phase 2.

This study has determined that despite paying the collectors for the scrap tyres, these scrap tyres recycling companies still consider such business viable and sustainable. It shows that without government intervention, scrap tyres will make its way to recycling companies as long as the collector makes its share of profit. Some of their concerns will be when the collectors decided to increase the price for the scrap tyres or the oil prices go below US$70 per barrel. Refer to **Section (4.4.4)** above of this report for the various recommendations that could follow the above proposed initialization of the proposed system.

We further noted in our preliminary findings that such environment only exist along the west coast of Peninsular Malaysia, namely in Penang, Perak, Selangor, Federal Territory and Johor, where the business conditions favour the recycling companies. In the east coast, we did not come across any scrap tyres companies and hence the issue of indiscriminate and improper disposal of scraps tyres may be more prevalent in those states concern. As such by returning part of the collected tax directly to the consumers, areas where the business conditions do not favour recycling companies can be pulled into the market demand too.

It is recommended that a steering committee is to be set up and chaired by NSWMD. The members shall comprise of representative from LGM, MITI, Custom, MATRDS, Malaysian Cement Manufacturers Association, DOE and JPSN.

The steering committee shall look into the following aspect to ensure the sustainability of scrap tyres management in all states.

a) To determine and appoint designated collectors based on geographical settings; or whether to enable current players to continue operating under the market conditions.
b) To decide on the levy or charges to be imposed on manufacturer of tyres and importers of tyres and used tyres as part of their contribution towards the management of scrap tyres, based on the outcome of the economic model for the incentives of the proposed system.
c) To fix a ceiling price for scrap tyres as a means to maintain the economic viability of both the designated collectors and recycling companies;
d) To provide a storage yard at least one yard for each state for collection of scrap tyres. This will also function as a transfer station pending bulk delivery to the scrap tyres recycling companies.
e) To set up a special fund derive from the collection of levy charges and to use the funds towards the management of scrap tyres only.
f) To jointly enforce the proper management and disposal of scrap tyres by retailers to ensure proper inventory of scrap tyres.

3.5 Brief Description of Legislation Requirement

Environmental regulatory programs in Malaysia are established and mature while business responses toward environmental responsibility have largely matured as well. There are large numbers of Malaysian companies now embracing environmental responsibility and while most insist on compliance, there are significant numbers that go beyond and institute credible practices that contribute to environmental stewardships.

3.5.1 Administrative and Organization Structure

The management of scrap tyres necessitate the involvement of the various governmental agencies as well as the stewardships of the various players – the scrap tyre manufacturers, distributors, users and generators, collectors, transporters as well as the end processors. These are shown in the following charts.

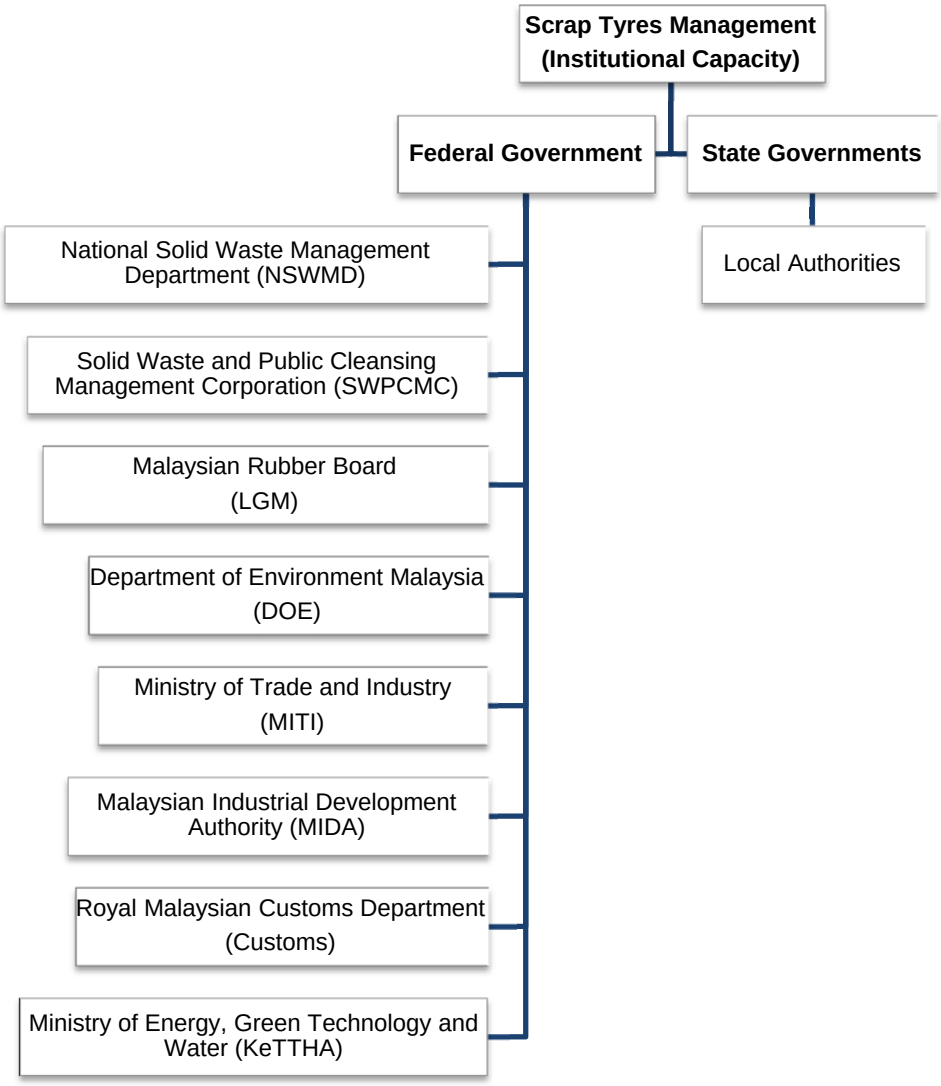


Figure 45 : The administrative and organizational structure of scrap tyre management in Malaysia

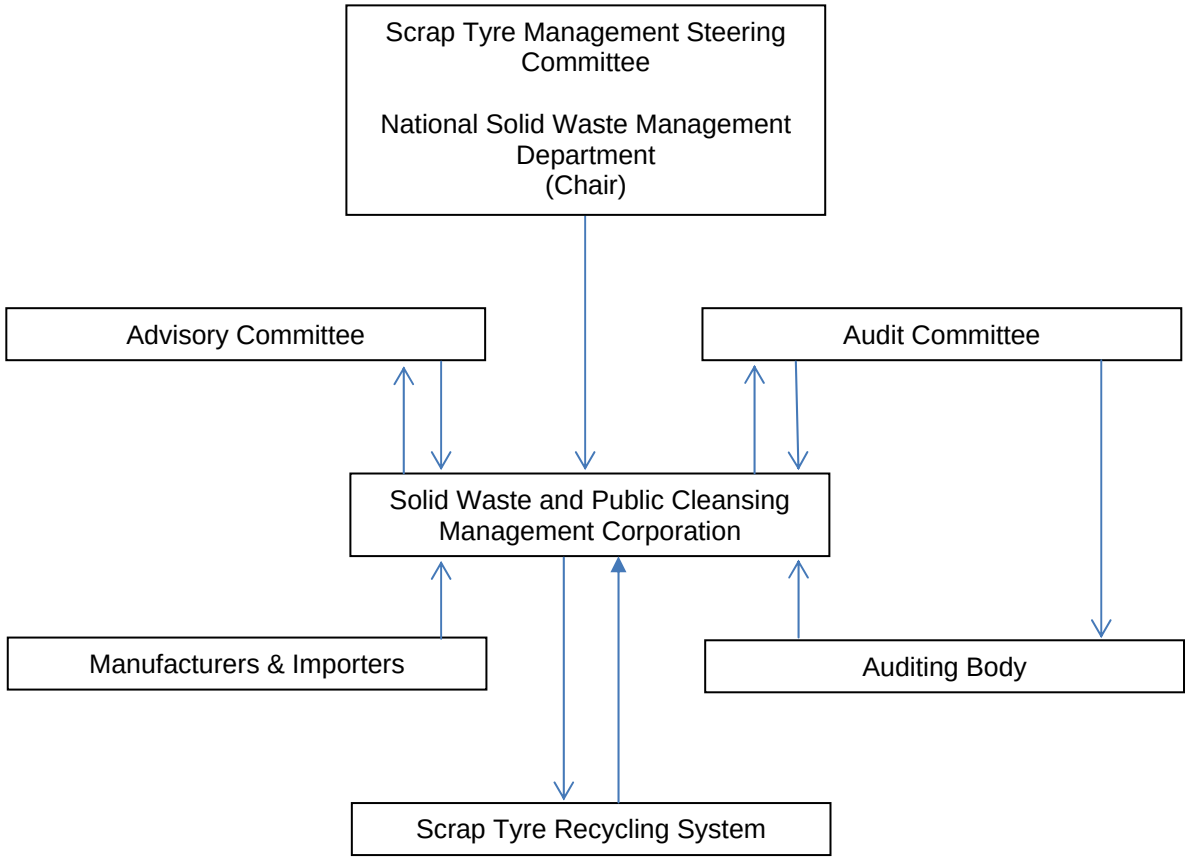


Figure 46: Proposed Scrap Tyre Management System in Malaysia: <u>Management Authority</u>

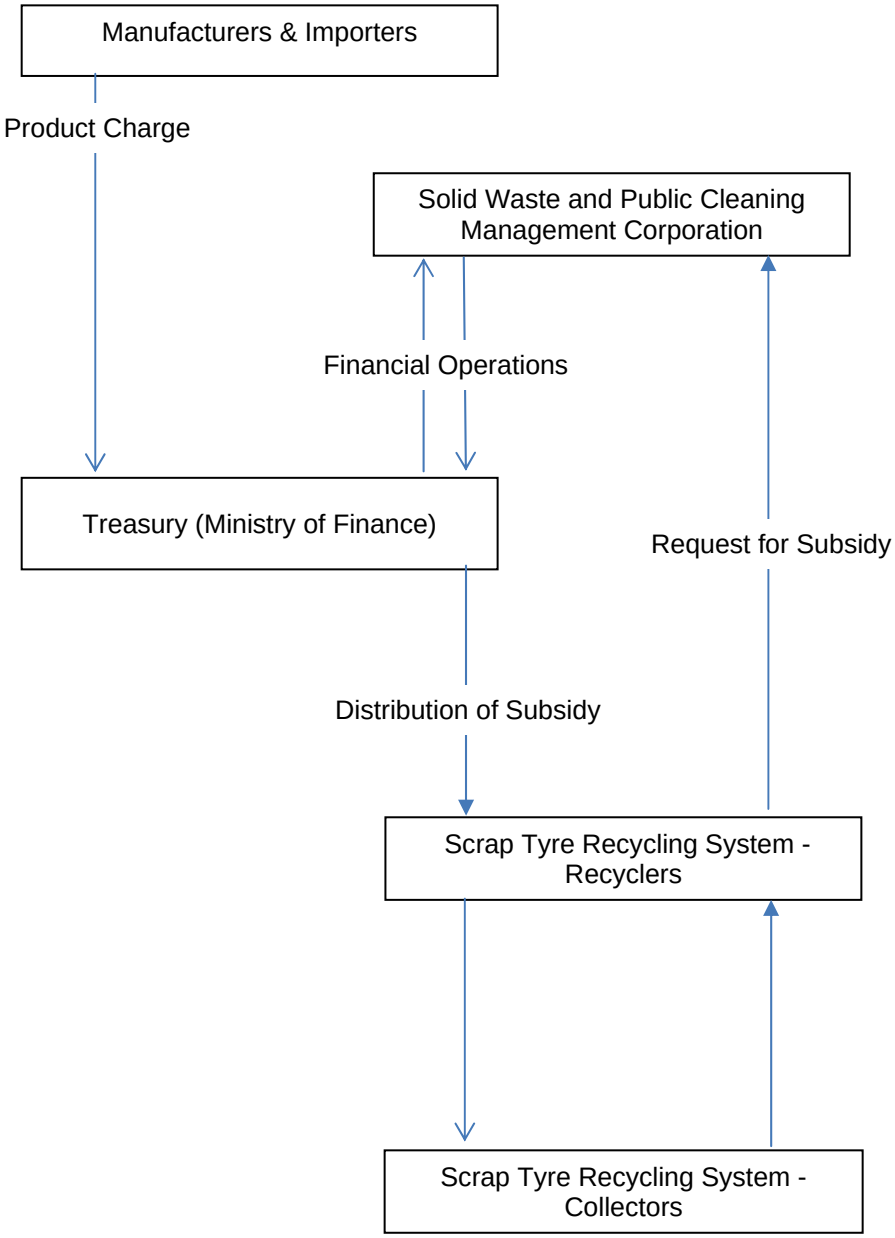


Figure 47: Proposed Scrap Tyre Management System in Malaysia: Cash Flow Pattern

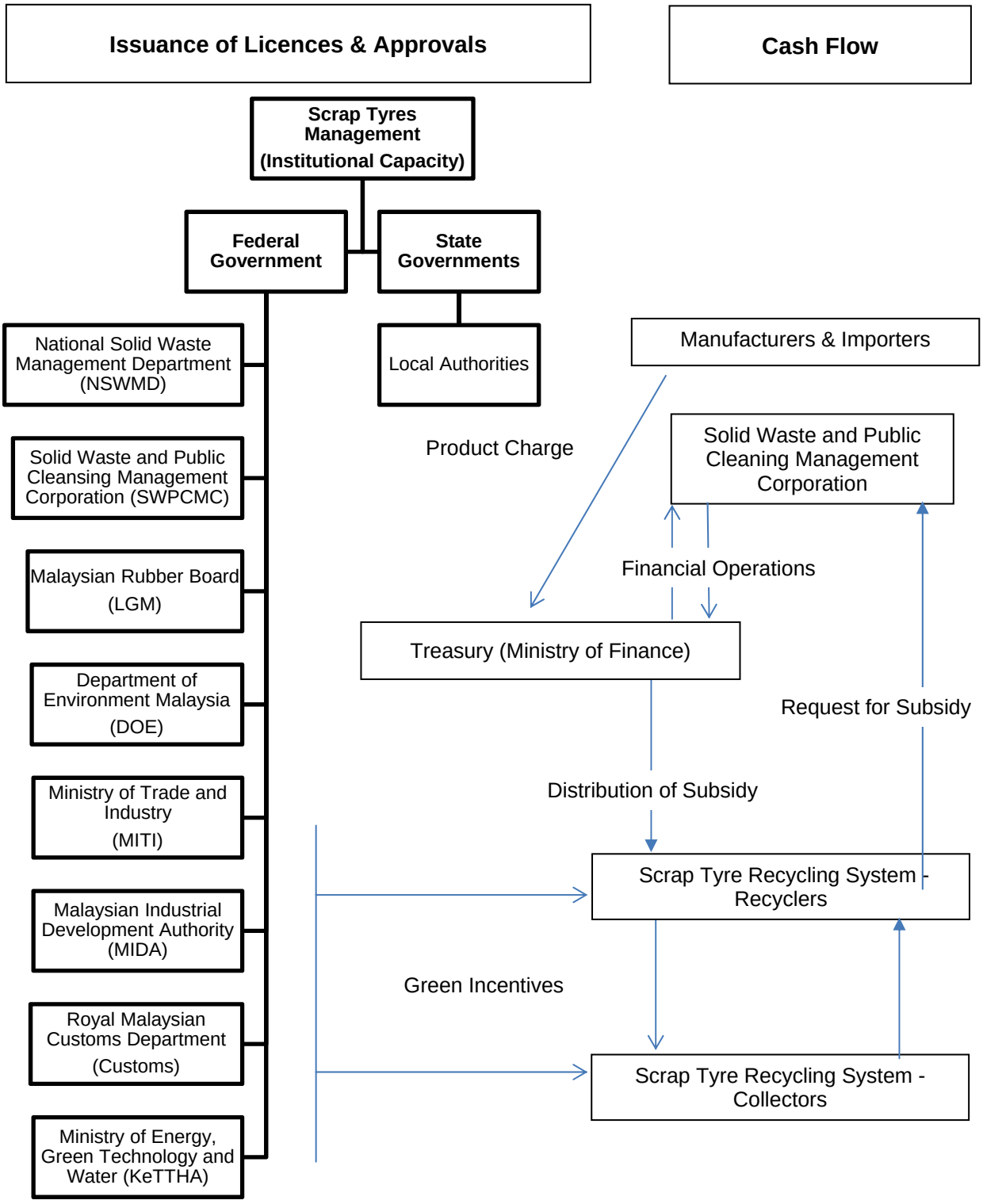


Figure 48: Proposed Scrap Tyre Management System in Malaysia: <u>Overall</u>

3.5.2 Laws and Regulations

The main legal frameworks in which municipality services in the Peninsula Malaysia are governed are outlined below.

Unlike the state of Sarawak and Sabah, there are no other state governments in the Peninsula Malaysia that have established their own state environmental agencies, and hence the states in the Peninsular Malaysia rely on the jurisdictions of the each of the state's Department of Environment office. As such, in that manner, applicable laws and regulations that may be relevant to the management of scrap tyres shall be that of the federal agencies currently overseeing each and every parts of scrap tyres management.

The primary regulatory provisions are as follows,

(i) The Solid Waste and Public Cleansing Management Act 2007 (Act 672)
(ii) The Solid Waste and Public Cleansing Management Corporation Act 2007 (Act 673)
(iii) The Environmental Quality Act 1974 and the applicable regulations under the Act.
(iv) The Local Authorities local by-laws in the respective states (where they are applicable)

Act 672 in particular already provides and all-encompassing regulatory provisions in the management of scrap tyres which can be classified as one of the controlled solid wastes.

Taking cue and adapting the approaches adopted in the (development of) scrap tyre framework and the development of legal provisions for scrap tyre management in the State of Sarawak, the important elements in the management of scrap tyre and the prescribing of the legislative requirements are outlined as follows.

(i) Amendments of Existing Regulations

- To establish in the existing legal framework the legal basis for the new collection and treatment system for used tyres
- Assignment of the respective authority/agency that is going to be responsible for the new collection and treatment system
- Streamlining and integrating the authorities / agencies and their respective existing regulations in order to deliver the required coverage of the regulatory controls without causing any overlap in their respective jurisdiction
- Integrating the current implementation of the solid waste management system in the Peninsula Malaysia with scrap tyres management
- Description on the new system for the collection and treatment of scrap tyres;
- Description on collection of fees (for both the collection of tax, if the tax system is a set goal);
- Description on public financing (if public financing is a set goal);
- Description on the enforcement of the new system.

(ii) Incentives

- Description on how the system can be profitable for the citizens to support the new system for used tyres
- Description on how the system can create a market pull demand for scrap tyres generated at multiple source of generations
- Description on how the system can ensure that the incentives are returned to the target group of scrap tyres stakeholder in order to create the market pull demand
- Description on how the system can determine that the source financing model for the incentives can sustain the market pull model

(iii) Awareness

- Description on how the various regulatory authorities make the new system understandable and acceptable to the citizens, to the existing operators and collectors, transporters.

(iv) Operation

- Description on how the authorities going to manage the collection system
- Description on how the system proposed create beneficial incentives to the current and existing players of the scrap tyres industries

(v) Implementing Measures

- Description of the measures, tools and time schedule for the implementation of the system.

(vi) Regulatory Measures

- Approval of all provisions concerning the new system;
- Approval of the deletion of possible existing provisions which might overlap the new provisions;
- Negotiation of necessary amendments to the existing contractual provisions concerning used tyres; and
- Enforcement of the regulatory measures.

(v) Incentives

- Implementation of possible economic incentives concerning the collection and treatment of used tyres.

(vi) Operational jurisdiction

- The responsible authority's establishment of own management of the activities **or**
- In case of delegation of the activities, tendering and contracting of the activities

(vii) Monitoring

When the measures have been implemented and the new system for the collection and treatment of used tyres is working, the responsible authority should currently collect data about the system by monitoring:

- If the activities are carried out according to instructions or contractual agreements;
- If the citizens comply with the new provisions in an acceptable manner; and
- If the set goals can be reached during the planned time span.

3.6 Action Plan and Implementation Schedule

A possible action plan in the implementation of the proposed scrap tyre management system for Peninsular Malaysia is tabulated below in **Table 38** while the implementation schedule is shown in **Table 39.**

Table 38 : Action plan for the implementation of the proposed scrap tyre management system

Agencies	Actions	Target Needs	Considerations	Output
NSWMD	Records and Registration	Scrap tyre as Controlled Solid Waste	Scrap tyre generators, collectors, transporters, storage owners, processors	Licensed scrap tyre generators, collectors, transporters, storage owners, processors
MITI, Customs, DOE	Records and Registration	Scrap tyre subjected to a "chain-of-custody" procedure	Inventorization, Documented flow of scrap tyres	Accurate inventory of scrap tyre
NSWMD	Legal & Regulatory Frameworks	Scrap tyre as Controlled Solid Waste	Existing legal framework (Act 672)	Specific regulations and orders where appropriate
DOE, SWPCMC, MIDA, MITI	Technology	Options for Recycling Concept, Technology & locations of facilities	Environmental regulations and compliances	EIA procedures over scrap tyre reprocessing facilities
SWPCMC, Treasury, Customs	Incentives & Penalties	Scrap tyre as commodity	Product Charge or Tax, Subsidy	Creation of scrap tyres market pull and demand
SWPCMC, Treasury, Customs	Subsidies, Economics Incentive	Scrap tyre reprocessing facilities, operators	Environmental regulations and compliances	Environmentally compliant scrap tyre facilities, viable business models
NSWMD, LGM,	Licensing Terms & Conditions	Scrap tyre generators, collectors, transporters, storage owners, processors	Compliant to terms and conditions of licensing	Environmentally compliant scrap tyre facilities, viable business models
NSWMD	Legal & Regulatory Requirement	Specific regulatory provisions for scrap tyre management	Existing regulations	Specific laws and regulations on scrap tyre

Table 39 : Proposed Time Schedule for the implementation of the proposed scrap tyre management system

Agencies	Actions	Output	Implementation Plan (Quarterly)									
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
NSWMD	Records and Registration	Licensed scrap tyre generators, collectors, transporters, storage owners, processors										
MITI, Customs, DOE	Reporting	Accurate inventory of scrap tyre										
DOE, SWPCMC, MIDA, MITI	Technology	EIA procedures over scrap tyre reprocessing facilities										
SWPCMC, Treasury, Customs	Incentive Models	Creation of scrap tyres market pull and demand										
SWPCMC, Treasury, Customs	Subsidies, Economics Incentive	Environmentally compliant scrap tyre facilities, viable business models										
NSWMD, LGM,	Licensing Terms & Conditions	Environmentally compliant scrap tyre facilities, viable business models										
NSWMD	Legal & Regulatory Requirement	Specific laws and regulations on scrap tyre										
All Agencies	Full Implementation	Public adoption										

APPENDICES

APPENDIX A
Approval Letter for the Study by DNSWM

JABATAN PENGURUSAN SISA PEPEJAL NEGARA
KEMENTERIAN PERUMAHAN DAN KERAJAAN TEMPATAN
ARAS 2 & 4, BLOK B UTARA
PUSAT BANDAR DAMANSARA
PETI SURAT 12579
50644 KUALA LUMPUR

Telefon : 03-2092 4488
Faks (Pentadbiran) : 03-2093 5982
Kawat : "MINRUMAH"
http://www.kpkt.gov.my

Ruj. Kami : KPKT/JPSPN/(S)800/2/2/1(59)
Tarikh : 4 Januari 2011

SURAT SETUJU TERIMA

CHEMSAIN KONSULTANT SDN BHD
No. 47, Wisma KO-Perkasa,
Jalan Simpang 3,
93550 Kuching,
SARAWAK

Tel : 082-422 736
Faks : 082-415 506

Tuan,

SURAT PELANTIKAN PERUNDING BAGI PROJEK KERAJAAN

Dengan hormatnya saya merujuk kepada perkara di atas dan memaklumkan bahawa Jabatan Pengurusan Sisa Pepejal Negara, Kementerian Perumahan dan Kerajaan Tempatan telah bersetuju untuk melantik firma tuan sebagai perunding dengan kaedah bayaran secara Input Masa (*Man-Months*) bagi kajian seperti berikut:

Nama Kajian	:	**Kajian Pengurusan Sisa Tayar Terpakai Di Semenanjung Malaysia**
Skop Perkhidmatan	:	**Kajian Bukan Fizikal**
Tempoh Kajian	:	**4 Bulan**
Bidang Perunding	:	**Alam Sekitar**

2. Selain yuran perunding, pihak tuan juga boleh membuat tuntutan kos imbuhan balik yang diluluskan oleh Kerajaan. Perbelanjaan imbuhan balik ini hendaklah mengikut kadar sebenar berdasarkan **prinsip yang mana lebih rendah.**

3. Kerajaan akan menyediakan peruntukan sejumlah 5% daripada yuran perunding dan elaun tapak (jika berkenaan) untuk bayaran cukai perkhidmatan yang akan dibayar oleh perunding kepada Kastam DiRaja Malaysia tertakluk kepada syarat-syarat yang ditetapkan.

4. Dengan penerimaan tawaran pelantikan ini, tuan adalah dinasihatkan bahawa suatu ikatan Kontrak terwujud di antara Kerajaan dengan tuan. Suatu Kontrak rasmi akan disempurnakan kemudiannya dengan memasukkan semua terma perjanjian sebagaimana yang dipersetujui.

5. Surat ini dihantar kepada tuan dalam tiga (3) salinan. Sila kembalikan salinan asal dan kedua setelah ditandatangani dan disaksikan dengan sempurna di ruang yang berkenaan dalam masa **14** hari daripada tarikh surat ini kepada pejabat ini untuk simpanan.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

"1MALAYSIA: RAKYAT DIDAHULUKAN, PENCAPAIAN DIUTAMAKAN"

(DATO' NADZRI BIN YAHAYA, Ph.D)
Ketua Pengarah
Jabatan Pengurusan Sisa Pepejal Negara
Kementerian Perumahan dan Kerajaan Tempatan

s.k

Ketua Pegawai Eksekutif
Lembaga Hasil Dalam Negeri
(Cawangan Syarikat)
Aras 3 – 10, Blok 11
Jalan Duta
50596 KUALA LUMPUR

Ketua Pengarah Kastam Malaysia
Ibu Pejabat Kastam DiRaja Malaysia
(Cawangan Cukai Perkhidmatan)
Aras 6 Selatan, Blok 2G 1B
Kompleks Kementerian Kewangan, Presint 2
Pusat Pentadbiran Kerajaan Persekutuan
62592 PUTRAJAYA

Ketua Setiausaha Perbendaharaan
Kementerian Kewangan
Kompleks Kementerian Kewangan
Bahagian Pengurusan Perolehan Kerajaan Presint 2,
Pusat Pentadbiran Kerajaan Persekutuan
62502 PUTRAJAYA
(u.p.: Y. Bhg. Dato' Fauziah binti Yaacob)

Ketua Pengarah
Unit Perancang Ekonomi
Seksyen Perkhidmatan Sosial
Jabatan Perdana Menteri
Blok B5 & B6, Kompleks Jabatan Perdana Menteri
Pusat Pentadbiran Kerajaan Persekutuan
62502 PUTRAJAYA

Edaran Dalaman:

SUB (Kew)

SUB (Pemb)

Dengan ini yang bertandatangan di bawah ini mengakui penerimaan surat tersebut di atas, salinannya yang mana telahpun disimpan dan mengesahkan bahawa tiada apa-apa terma, syarat atau stipulasi tambahan kepada yang terkandung dalam surat tersebut.

.....
Tandatangan Perunding

Nama Penuh : Chong Sin Hian
No. Kad Pengenalan : 660709-13-5337
Alamat : c/o No. 47, 1st Floor
Wisma Ko-Perkasa
Jalan Simpang Tiga
93350 Kuching, Sarawak

Meteri atau Cop Perunding

Tarikh : 10 January 2011

.....
Tandatangan Saksi

Nama Penuh : Anthony Rentap Enchana
No. Kad Pengenalan : 690811-13-5955
Alamat : c/o No. 51, 1st Floor
Wisma Ko-Perkasa
Jalan Simpang Tiga
93350 Kuching, Sarawak

Tarikh : 10 January 2011

JABATAN PENGURUSAN SISA PEPEJAL NEGARA
KEMENTERIAN PERUMAHAN DAN KERAJAAN TEMPATAN
ARAS 2 & 4, BLOK B UTARA
PUSAT BANDAR DAMANSARA
PETI SURAT 12579
50644 KUALA LUMPUR

Telefon : 03-2092 4488
Faks (Pentadbiran) : 03-2093 5982
Kawat : "MINRUMAH"
http://www.kpkt.gov.my

Ruj. Kami : KPKT/JPSPN (S)800/2/2/1 (30)
Tarikh : 14 Oktober 2009

Chemsain Konsultant Sdn. Bhd.
No. 47, Wisma KO-Perkasa
Jalan Simpang Tiga
93350 Kuching
Sarawak

Tel : 082-422 736
Faks : 082-415 506

Tuan,

SURAT PELAWAAN CADANGAN TEKNIKAL DAN KEWANGAN (CTK) BAGI PERKHIDMATAN PERUNDING UNTUK PROJEK KERAJAAN

Saya dengan hormatnya merujuk kepada surat Jabatan ini bertarikh 16 September 2009 dalam siri yang sama mengenai perkara tersebut di atas.

2. Sukacita dimaklumkan, memandangkan terdapat banyak perunding berpotensi yang lewat menerima surat pelawaan tersebut, maka Jabatan telah bersetuju untuk melanjutkan tarikh penghantaran Cadangan Teknikal dan Kewangan (CTK) bagi kedua-dua kajian tersebut **kepada 20 Oktober 2009 sebelum 4.00 petang. Dokumen CTK yang lewat diterima tidak akan dipertimbangkan.**

3. Kerjasama dan perhatian pihak tuan amatlah dihargai dan didahului dengan ucapan ribuan terima kasih.

Sekian.

"BERKHIDMAT UNTUK NEGARA"
"1MALAYSIA : RAKYAT DIDAHULUKAN, PENCAPAIAN DIUTAMAKAN"

Saya yang menurut perintah,

(DATO' NADZRI BIN YAHAYA, Ph.D)
Ketua Pengarah
Jabatan Pengurusan Sisa Pepejal Negara
Kementerian Perumahan dan Kerajaan Tempatan

nurul/okt.09/ctk

JABATAN PENGURUSAN SISA PEPEJAL NEGARA
KEMENTERIAN PERUMAHAN DAN KERAJAAN TEMPATAN
ARAS 2 & 4, BLOK B UTARA
PUSAT BANDAR DAMANSARA
PETI SURAT 12579
50644 KUALA LUMPUR

Telefon : 03-2092 4488
Faks (Pentadbiran) : 03-2093 5982
Kawat : "MINRUMAH"
http://www.kpkt.gov.my

"KITAR SEMULA - FIKIR DULU SEBELUM BUANG"

Ruj. Kami : KPKT/JPSPN(S)800/2/2/1(12)
Tarikh : 16 September 2009

Chemsain Konsultant Sdn. Bhd.
No.47, Wisma KO-Perkasa
Jalan Simpang Tiga
93350 Kuching
SARAWAK.

Tel : 082-422 736
Faks : 082-415 506

Tuan,

SURAT PELAWAAN CADANGAN TEKNIKAL DAN KEWANGAN (CTK) BAGI PERKHIDMATAN PERUNDING UNTUK PROJEK KERAJAAN

Dengan hormatnya saya merujuk kepada perkara tersebut diatas dan memaklumkan bahawa Jabatan bercadang untuk memperolehi perkhidmatan perunding dengan kaedah bayaran secara Input Masa (*Man-Months*) bagi kajian seperti berikut:

Nama Kajian	:	Kajian Mengenai Pengurusan Sisa Tayar Terpakai di Semenanjung Malaysia
Terma Rujukan	:	Seperti di Lampiran A
Tempoh Kajian	:	4 Bulan
Bidang Perunding	:	Kajian Alam Sekitar

2. Tuan adalah dipelawa mengemukakan Cadangan Teknikal dan Kewangan (CTK) dalam tiga (3) salinan bagi perkhidmatan perunding untuk projek tersebut ke Jabatan di alamat seperti di bawah selewat-lewatnya pada **12 Oktober 2009. Dokumen CTK yang lewat diterima tidak akan dipertimbangkan.** 20.10.2009

Alamat : Jabatan Pengurusan Sisa Pepejal Negara
Kementerian Perumahan dan Kerajaan Tempatan
Bahagian Dasar dan Perancangan
Aras 2, Blok B Utara
Pusat Bandar Damansara
Peti Surat 12579
50782 KUALA LUMPUR.

3. Cadangan Teknikal dan Kewangan tersebut hendaklah dikemukakan dalam 2 sampul surat yang berasingan yang berlakri dan ditandakan "Cadangan Teknikal" dan

Cadangan Teknikal

"Cadangan Kewangan" di atas sebelah kiri setiap sampul surat berkenaan. Cadangan Teknikal dan Cadangan Kewangan yang dikemukakan hendaklah berpandukan kepada Terma Rujukan seperti di Lampiran A dan Garis Panduan CTK seperti di Lampiran B dengan tempoh sah laku tawaran sekurang-kurangnya 90 hari daripada tarikh tutup pelawaan.

4. Bagi perunding tempatan yang menggunakan perkhidmatan perunding asing, markah akan dipotong sebanyak 30% daripada jumlah input (*man-month*) perkhidmatan setiap perunding asing. Sistem potongan markah terhadap input pakar atau perunding asing dikecualikan bagi kajian yang dibiayai daripada sumber kewangan luar negara (seperti pinjaman Bank Dunia, Bank Pembangunan Asia dan sebagainya) dan pihak pembiaya dan Kerajaan Malaysia telah bersetuju mengenai penggunaan pakar asing dalam bidang tertentu.

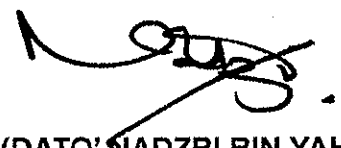
5. Jabatan tidak terikat untuk menerima tawaran yang termurah atau mana-mana tawaran.

6. Sila akui penerimaan surat pelawaan ini dan mengesahkan penyertaan tuan dalam urusan pemilihan ini seperti di Lampiran C.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
"1MALAYSIA : RAKYAT DIDAHULUKAN, PENCAPAIAN DIUTAMAKAN"

Saya yang menurut perintah,



(DATO' NADZRI BIN YAHAYA, Ph. D)
Ketua Pengarah
Jabatan Pengurusan Sisa Pepejal Negara
Kementerian Perumahan dan Kerajaan Tempatan

s.k.

Ketua Setiausaha
Kementerian Perumahan dan Kerajaan Tempatan
Bahagian Kewangan Dan Perolehan
Aras 3, Blok K, Pusat Bandar Damansara
50782 Kuala Lumpur
(u.p : Pn. Nor Inchun Bt. Hj Mohd Salleh)

LAMPIRAN A

TERMS OF REFERENCE

A STUDY ON SCRAP TYRES MANAGEMENT FOR PENINSULAR MALAYSIA

BACKGROUND

1. INTRODUCTION

The Parliament has passed the Solid Waste Management and Public Cleansing Act 2007. The Act provides the legal framework towards comprehensive management of all solid waste streams in Malaysia. Under the Act, scrap tyres are classified as "special solid waste"[1] which will require a dedicated collection and treatment system (see section 2 for more details). Previously, the management of scrap tyres is not being regulated under any existing regulations in Malaysia.

Prior to the passing of the Act, the Government of Malaysia in August 2005, adopted "The National Strategic Plan for Solid Waste Management in Malaysia" as one of the steps to improve solid waste management in Malaysia, taking due consideration of economic development and the needs and responsibilities of the various stakeholders within the society.

Under the National Strategic Plan (NSP), the principle of waste minimisation and waste recycling is given high priority. Furthermore, the NSP concludes that "there must be a gradual and sustainable increase in recycling, but only for materials that are marketable" and "reduce reliance on landfill".

This Terms of References (TOR) aims to ensure that the management of scrap tyres are managed systematically according to the principles stipulated under the NSP and to establish a system which will complement the Act.

1.1 Scrap Tyres in Malaysia – The Background

In May 2003, the Department of Road Transport in Peninsular Malaysia registered 11.2 million vehicles. Based on this number, it is estimated that 150,000- 180,000 tonnes of scrap tyres are generated annually in Malaysia. In Malaysia, it is normal for vehicle owners to leave their scrap tyres at the tyre

---

[1] "Special solid waste" means any kind of controlled solid waste which

(a) is or may be dangerous to public health

(b) is so difficult to treat, keep or dispose of that special provisions are required for dealing with it

(c) due to the amount, dimensions or other properties is unwanted in the general collection and disposal systems for controlled solid waste

are no longer retreaded in Malaysia as the prices for newly manufactured tyres are comparable to retreaded tyres.

Scrap tyres are kept at the workshops or service centres until they are collected. Tyre shops currently do not have any legal obligations to report where their scrap tyres end up and thus do not request where the collectors deliver the scrap tyres to. They are more keen to get rid of their tyres,

In general, more than 50% of the tyre dealers do not know where the scrap tyres collected are delivered to. Most of the tyres end up in landfills or at illegal dumping grounds, despite that scrap tyres are prohibited at many landfills. A tipping fee between RM10-33/tonne of tyres is charged for disposal at landfills depending on the landfill.

1.2 Missing scrap tyres

According to a study carried out by DANIDA/Economic Planning Unit of Malaysia, about 25-35 % of the used tyres can be accounted for disposal.

Based on stakeholders response, the following possible means of disposal were identified:

- Many scrap tyres (estimated around 30-40% of the passenger tyres) are possibly exported for "regrooving" or sold as second hand tyres. Scrap tyres for regrooving or second hand tyres are currently purchased at an average price of RM5/piece.
- Some scrap tyres are burned for the recovery of steel at a number of sites, especially in the sub-urban or rural area. The number of such sites or activities is not officially recorded and known.

However, a number of recycling facilities[2] have appeared recently. This includes a number of rubber granulation companies and a pyrolysis facility. This development may among others be caused by increasing rubber prices. The facilities currently hire transporters to supply used tyres. Other companies have expressed that they are prepared to invest in large scale granulation pending on the establishment of a collection system, which can ensure the supply. In addition, the cement industries have expressed interest in acquiring granulated tyres as fuel.

[2] Recycling facilities in this context includes all facilities accepting and processing scrap tyres to secondary products. These includes physical recovery of rubber crumb, pyrolysis to recover fuel gas and carbon black, use of scrap tyres as a fuel in industries e.g. cement kilns and so forth.

2. EXISTING LEGISLATION

Generally scrap tyres are considered business or domestic waste, depending on origin and hence captured by the Local Government Act 1976.

The Local Government Act 1976 (act 171) generally specifies that local authorities have the powers, among others, to carry out sanitary systems for the removal, and destruction of, or otherwise dealing with rubbish, litter, dead animals and all kinds of refuse and effluent.

Local Government Act 1976 Section 81 (c) states that *"any accumulation or deposit which is a nuisance or is or likely to become a breeding ground for mosquitoes, flies or any vermin"* shall be dealt with similarly under the Act. This means that the local authority shall serve the guilty party an enforcement notice under Section 82. The provision provides for cost recovery and closing down of activity in case of non-compliance. The provision creates a requirement to discard objects which is then considered as waste. This provision is used to regulate the storage of used tyres at individual businesses and premises.

3. STUDY JUSTIFICATION

The dynamic growth in the number of cars and motorcycles in Malaysia results in a continuous accumulation of scrap tyres. "The scrap tyre problem" has been discussed much in recent years internationally. In Europe where the issue has been put high on the agenda after the EU landfill directive from 1999 banned landfilling of whole scrap tyres from 2003 and banned shredded scrap tyres in landfills from 2006.

According to the "Technical Guidelines" of the Basel Convention [1], leachate from scrap tyres shows no evidence of increase level of toxic substances based drinking water standards. However other survey document found that disposed tyre releases of potentially harmful compounds into the environment, e.g. polyaromatic hydrocarbons (PAHs), benzene and phenol which have carcinogenic properties. [2]

3.1 Issues related to disposal of used tyres

According to the Malaysian and the EU legislation, scrap tyres are not categorised as scheduled (hazardous) waste. Scrap tyres disposed at landfills do not give rise to major leachate problems. However, a number of issues have to be taken into consideration regarding disposal of used tyres:

- The rubber decompose very slowly;
- Scrap tyres is very difficult to compact at landfills;
- Scrap tyres have a tendency over time to float to the top of landfills and thereby risking breaking the top membrane. There is a rather high fire risk (self ignition) for used tyres accumulated at landfills, and in

case of fire hazardous levels of especially PAH's can be found in the pume;

- Scrap tyres disposed at landfills may trap methane causing explosions when ignited;
- Scrap tyres are very voluminous and require 3-4 times the landfill space compared to general solid waste for disposal (1 t require 4 m3);
- Open burning of used tyres resulted in hazardous compounds like pyrolytic oils and other residues will remain on the soil causing environmental damage to the flora and fauna;
- Scrap tyres may trap clean stagnant rain water and becomes mosquito breeding ground; and
- The amount of scrap tyres is huge, and scrap tyres are very visible in the environment (aesthetic issue).

Therefore, proper special management of scrap tyre is crucial to avoid environmental problems.

3.2 Advantages of a Proper Scrap Tyres Management System

The benefits from introducing a proper collection and recycling/disposal system for used tyres include:

- *The public* will get the advantage of an environment without scrap tyres lying around, without air and soil pollution from burned scrap tyres and with less danger of mosquito transferred diseases deriving from mosquito breeding in water trapped in old scrap tyres;
- *The tyre shops* will have the advantage of a system for easy removal of their scrap tyres;
- *The collectors and transporters* will have the advantage, to get a stable business transporting the scrap tyres to the treatment facilities. They do not need to find alternative or illegal ways to get rid of them anymore;
- *The recycling facilities* will have the advantage to get scrap tyres delivered in a steady flow allowing the facilities to optimize the processes;
- *The Local Government and the Ministry of Housing and Local Government* (MHLG) will have the advantage to have solved a major nuisance and environmental issue. Furthermore the scrap tyres will no longer arrive at landfills, facilitating the operation of the landfills and considerably extending their lifespan;

- *The Ministry of Natural Resources and Environment (NRE) and the Department of Environment (DOE)* will have the advantage of not having to deal with the hazard remaining after open burning of scrap tyres;

- *The Ministry of Health* (MOH) will have solved the problem with scrap tyres being the host of vector born diseases like malaria and dengue fever etc.; and

- *The Ministry of International Trade and Industry (MITI)* will have the advantage that a national industry for recycling of scrap tyres is developed (Waste to wealth (W2W)).

3.3 Scrap Tyres Management System

Scrap tyres management system shall:

- keep scrap tyres from landfills;
- avoid scrap tyres from being illegal dumped; and
- collect scrap tyres for the purpose of proper recycling and disposal.

Such a system will demand:

- Systematic collection of used tyres from tyre workshops to recyclers;
- Facilities to recycle the collected used tyres;
- Systematic administration including licensing of contractors and recyclers;
- Establishing of realistic recycling targets;
- Reporting obligations for the tyre manufacturers, importers, dealers, workshops, retreaders and recyclers;
- Information campaign, targeted at the consumers, to be carried out on a continuous basis;
- Establishing of the necessary incentive structures; and
- Financing of the system including the administration and the collection and recycling, involving fees and user charges depending on the prices for recycled products and the costs for managing and operating the systems.

In Malaysia, despite the lack of a dedicated policy and legislation on scrap tyres, a number of small scale scrap tyre recycling facilities have been established.

This development may facilitate the establishing of a coherent collection and recovery system, requiring only minor or no charges/fees on tyres to finance the system. The established system must, however, be able to sustain, even if natural rubber prices decline in the future.

The above facilities are facing the following barriers in sustaining and expanding their business:

- Guarantee of scrap tyre supplies: The facilities currently pay transporters to supply used tyres. The high transportation cost of the scrap tyre limits the collection within approximately 30 km radius from the facilities; and
- The fluctuating market price of the recovered products affects the overall viability of the facilities;

A used tyre recycling system for Sarawak has been prepared by the Sarawak Government. The system involves imposing a sales tax on new tyres to finance the collection and recycling of the used tyres. The proposed system will be implemented upon approval by the Sarawak Government. The Government of Malaysia is aware of the need to intervene but requires more comprehensive information to determine the necessary steps and extent of assistances for setting up a scrap tyre management system.

4. OBJECTIVES OF THE STUDY

Main objective

The main overall objective of this study is to provide the Malaysian Government with sufficient background information and recommendations for a decision to establish a collection and treatment system for scrap tyres for Peninsular Malaysia.

Specific objectives

Within this overall objective, the more specific objectives are:

1. To update the existing inventory of scrap tyre generation in Peninsula Malaysia
2. To determine the legal and administrative system required to direct the flow of scrap tyres towards approved recycling facilities and to identify and propose such systems for directing the flow.

3. To explore the options for scrap tyres recycling in Peninsular Malaysia, to specify the advantages and disadvantages of the different recycling systems and to propose future recycling option(s).

4. To analyse the market for products from recycled scrap tyres from different recycling systems.

5. To analyse the need for adding an economic incentive system to the legal and administrative systems to direct the flow of scrap tyres towards the approved recycling and propose such system as required.

6. To evaluate the impacts of issuing exclusive license for collection of scrap tyres on the market and proposed system

7. To propose the legal framework for the implementation of the system.

8. To propose action plans to be carried out by all related organizations.

5. COVERAGE AND SCOPE OF WORK

The work boundary shall be geographically limited to Peninsula Malaysia.

The detail scope of work is described below:

Activity 1: Inception Phase

The inception phase shall be used by the Consultant to mobilise a project team, gather information, conduct preliminary analyses, evaluate the suitability and practicability of the proposed tasks for the subsequent phases of the project, detail a strategy and methodology for completion of the project, present preliminary findings and proposals to a wider audience of administrators, experts and other persons involved, and to obtain feedback from them.

Activity 1.1: Identifying relevant stakeholder organisations and institutions to take part in the inventory activities

Activity 1.2: Identify existing scrap tyre treatment plants and other parties currently prepared to establish new recycling plants for scrap tyres.

Activity 1.3: Identify existing reports and inventories on scrap tyres in Peninsular Malaysia

Activity 1.4: Propose adjustments to the TOR and prepare detailed project implementation plan.

Activity 2: Institutional analysis

Activity 2.1: The Consultant shall undertake a detailed review of the responsibilities, capabilities, facilities, strengths and weaknesses, funding and present level of co-operation and information exchange between the principal organisations (federal and state) currently involved in scrap tyres management in Malaysia.

This detailed institutional analysis should concentrate on those key organisations that have a direct role in the scrap tyres management and generally in waste management systems..

Activity 3: Inventory Phase

Activity 3.1: Verify and update the inventory of scrap tyres in West Malaysia

The output from this activity will be a report updating the figures in the reports (e.g. amount in numbers and tonnes of scrap tyres generated in various categories (motorcycles, cars, trucks etc.) and geographical distribution (e.g. in each State)

Activity 3.2: Make a mass flow model for existing scrap tyres movement today, from the tyre shops till the final disposal or end users. Identify the quantity of scrap tyres, who is transporting them and where they go for the final disposal.

Activity 4: Treatment and recycling options

Activity 4.1: Assess the recommended options for scrap tyres recycling in further details.

- Describe the technical and economic feasibility of the technologies.
- The technologies include but are not limited to:

  a. Cement kilns

  b. Pyrolysis

  c. Shredding and Granulation

  Due to encountered problems with the use of scrap tyres as artificial reefs it is not considered expedient to include artificial reefs in the study.

- Make a comparison of the different methods and discuss the advantages and disadvantages of each method with respect to economic, environmentally and social aspects.

Activity 4.2: Perform a planning analyses of recycling plants

- Describe the minimum size for the different types of recycling technologies (tons/year treated) to be technical and economical viable.

- Describe the optimal geographical allocation of facilities and scale of operation of the facilities for a future scrap tyre recycling system, taking into consideration the existing facilities for recycling of used tyres.

Activity 5: Incentive system

Identify the need for establishing an incentive system to ensure sustainability of the system for tyres recycling. Determine possible incentive systems to meet any identified need. The information and experiences from the system implemented in Sarawak should be taken into account

The description shall among others propose on the following issues:

- 1 concession or more operators for collection and treatment respectively
- size of levy on scrap tyres, if required
- description of how to regulate the possible levy in the future
- How to collect and redistribute the levy

Activity 6: Brief Description of Legislation Requirement

Based on the findings and recommendations from the study, the consultant shall elaborate the important elements to be included in the required legislations on scrap tyres. These elements could include for example the obligations of scrap tyres generators, transporters and treatment facility operators, empowerment of the government on enforcement and so forth.

Activity 7: Action Plan

Prepare possible action plans for various stakeholders. Such action plan shall delineate the roles and actions required of each stakeholders, a time schedule of implementations and so forth.

6. OUTPUTS

The study will be carried out under supervision of a Steering Committee set at the Department of National Solid Waste Management, Ministry of Housing and Local Government as the focal point.

The assignment is anticipated to be completed within 4 months. The reporting requirements for the consultant and assignment schedule will be established in the contract.

A suggested reporting schedule is as follows:

- Inception Report (after 1 month). The expected outputs of the inception phase are:
  - Project organization is established with steering committee, inventory teams and possible other working groups;
  - Project staff and consultants are identified;
  - Experts from ministries and institutions are identified;
  - Pre-feasibility studies on existing treatment facilities are prepared;
  - Overall methodology for inventory activities is outlined
  - Updated project implementation plan;
  - Steering group meeting held at which the Inception Report is approved;

- Interim report (after 2 month)

  - Updated inventory
  - Report on treatment and recycling options
  - Draft proposal for incentive system

- Final report (after 4 month)

20 copies in English language of all reports shall be prepared and reports shall include translated version in Bahasa Malaysia. Soft copy of the report shall be submitted to the Department.

7. CONSULTANT'S QUALIFICATION

The consultant shall be registered with the Ministry of Finance and shall provide a concise detail of the company's qualifications, experiences and resources. This shall include detailed list of personnel to be involved in the study with their curriculum vitae attached.

8. NEED FOR SPECIALIST

The Consultant shall suggest to the department and assign several well qualified and specialized officers to conduct this study and to provide consulting services to the Government of Malaysia.

The consultant shall appoint at least thirty percent (30%) *bumiputera* employees who are professionals.

9. RESPONSIBILITY OF THE GORVENMENT OF MALAYSIA

9.1 Steering and Technical Committee

The government of Malaysia may establish a steering committee to revise and approve any matters related to study. All matters pertaining to the study shall be brought before the committee for approval.

10. ASSISTANCE FROM THE GOVERNMENT AGENCIES AND EXCEPTION

The government may assist the consultant if need arises for :

i. To obtain approval for the purpose of conducting this study and other documents needed by the consultant; and

ii. To obtain cooperation from other relevant government agencies.

11. REPORT AND DOCUMENT

Document obtained by the consultant shall and must abide the Malaysian Code Of Practice and shall be financed by the consultant and shall not be reimbursed except where the original document are returned back to the Government of Malaysia.

12. PROTECTION TO THE GOVERNMENT OF MALAYSIA

The consultant shall be held fully responsible on any damages or lost of lives or property should there be any eventualities during the conduct of the study which includes the need for an insurance to protect the government from financing any claims which may occur due to the negligence of the consultant.

13. PAYMENT PROCEDURES

Consultant fees shall be paid to the consultant on man-month basis which will be stipulated in the Memorandum Of Agreement (MOA) between the consultant and the Government of Malaysia.

All reimbursable expenditure particularly for out of pocket expenditure shall be claimed together with the monthly expenditure, with the condition that the amount claimed should not exceed the amount reimbursable in the Financial Proposal submitted by the consultant. Any claim for reimbursable after the period of three (3) months shall not be approve, except where approval has been obtained by the agency. All claims shall be submitted together with the original receipt.

Five percent (5%) of the service charge payable to the consultant shall be held by the Government of Malaysia until the final report is submitted by the consultant together with all the original documents. All documents submitted shall be approved and verified in writing by the Government of Malaysia.

14. AGREEMENT

The consultant appointed shall prepare ten (10) copies of the Consultant Services Agreement or Memorandum of Agreement (MOA) in format approved by the government and shall be signed within a time not exceeding one (1) month after receiving the Letter of Appointment (LOA).

Prepared By :

Department Of National Solid Waste Management
Ministry Of Housing And Local Government

LAMPIRAN B

GARIS PANDUAN CADANGAN TEKNIKAL DAN KEWANGAN

1. Cadangan Teknikal hendaklah mengandungi maklumat berikut :

    a) Latar belakang firma dan pengalaman dalam bidang dan /atau projek berkaitan

    b) carta organisasi dan kakitangan yang dicadangkan termasuk biodata setiap kakitangan (nama, umur, latar belakang pendidikan, pengalaman kerja dan lain-lain jika ada);

    c) metodologi

    d) jadual kerja keseluruhan aktiviti dan cadangan input masa bagi setiap aktiviti dan kakitangan ; dan

    e) maklumat-maklumat lain yang berkaitan.

2. Cadangan Kewangan hendaklah mengandungi maklumat berikut:

    a) Nama, jawatan dan gaji pokok kakitangan yang dicadangkan;

    b) jumlah yuran setiap kakitangan dan keseluruhan perkhidmatan yang ditawarkan;

    c) input masa yang diperlukan bagi setiap kakitangan; dan

    d) kos imbuhan balik termasuk butiran kos terperinci.

LAMPIRAN C

BORANG PENGESAHAN PENERIMAAN

Ketua Pengarah
Jabatan Pengurusan Sisa Pepejal Negara
Kementerian Perumahan Dan Kerajaan Tempatan
Aras 2 & 4, Blok B (Utara)
Pusat Bandar Damansara
50644 Kuala Lumpur — Tel : 03-2094 5454
(u.p. : Puan Ellyza Mastura Bt. Ahmad Hanipiah) — Faks : 03-2093 5982

Puan,

PENGESAHAN PENERIMAAN PELAWAAN CADANGAN TEKNIKAL DAN KEWANGAN (CTK) BAGI PERKHIDMATAN PERUNDING UNTUK PROJEK KERAJAAN

Dengan segala hormatnya saya merujuk kepada perkara di atas.

2. Sukacita dimaklumkan saya mengesahkan * Penerimaan Pelawaan Cadangan Teknikal dan Kewangan (CTK), Lampiran A – Terma Rujukan dan Lampiran B – Garis Panduan Cadangan Teknikal dan Kewangan.

Nama :.....

Jawatan :.....

Agensi :.....

Sekian dimaklumkan. Terima kasih.

Tandatangan :
Nama :
Jawatan :
No. Tel :

Sila kembalikan borang ini sebelum atau pada **28 September 2009**
Tel : 03-2099 8491 (Puan Ellyza Mastura) /
03-2099 8203 (Cik Juliana Mustaffa)
Faks : 03-2093 5982
Email : ellyza@kpkt.gov.my

*** Potong mana yang tidak berkenaan**

APPENDIX B
Authorization Letter for the Study by DNSWM

JABATAN PENGURUSAN SISA PEPEJAL NEGARA
KEMENTERIAN PERUMAHAN DAN KERAJAAN TEMPATAN
ARAS 2 & 4, BLOK B UTARA
PUSAT BANDAR DAMANSARA
PETI SURAT 12579
50644 KUALA LUMPUR

Telefon : 03-2092 4488
Faks (Pentadbiran) : 03-2093 5982
Kawat : "MINRUMAH"
http://www.kpkt.gov.my

"KITAR SEMULA - FIKIR DULU SEBELUM BUANG"

Ruj. Kami : KPKT/JPSPN/(S)800/2/2/1(65)
Tarikh : 4 Mac 2011

SEPERTI SENARAI EDARAN

Tuan,

SURAT SOKONGAN JABATAN BAGI PROJEK KERAJAAN - KAJIAN PENGURUSAN SISA TAYAR TERPAKAI DI SEMENANJUNG MALAYSIA

Dengan hormatnya saya merujuk kepada perkara tersebut di atas.

2. Sukacita dimaklumkan bahawa Kerajaan akan melaksanakan penguatkuasaan Akta Pengurusan Sisa Pepejal dan Pembersihan Awam 2007 (Akta 672) yang bertujuan untuk mewujudkan sistem pengurusan sisa pepejal yang menyeluruh dan diterima oleh masyarakat yang mementingkan alam sekitar dan menjamin kesihatan awam.

3. Oleh yang demikian, pihak Kementerian Perumahan dan Kerajaan Tempatan melalui Jabatan Pengurusan Sisa Pepejal Negara telah melantik perunding iaitu Chemsain Konsultant Sdn Bhd bagi melaksanakan Kajian Pengurusan Sisa Tayar Terpakai Di Semenanjung Malaysia.

4. Sehubungan dengan itu, Jabatan memohon kerjasama pihak tuan bagi mengemukakan maklumat berkaitan yang diperlukan oleh perunding tersebut sepanjang tempoh kajian selama empat (4) bulan dari tarikh ini. Kerjasama pihak tuan adalah amat penting kerana hasil kajian tersebut akan digunakan oleh pihak Kerajaan dalam membuat keputusan dasar khususnya mengenai pengurusan sisa tayar. Oleh yang demikian, maklumat-maklumat yang tepat daripada pihak tuan diperlukan supaya keputusan dasar yang dibuat kelak adalah tepat dan tidak menjejaskan industri-industri berkaitan termasuk pihak tuan.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

"1MALAYSIA: RAKYAT DIDAHULUKAN, PENCAPAIAN DIUTAMAKAN"

(DATO' NADZRI BIN YAHAYA, Ph.D)
Ketua Pengarah
Jabatan Pengurusan Sisa Pepejal Negara
Kementerian Perumahan dan Kerajaan Tempatan

JABATAN PENGURUSAN SISA PEPEJAL NEGARA
KEMENTERIAN PERUMAHAN DAN KERAJAAN TEMPATAN
ARAS 2 & 4, BLOK B UTARA
PUSAT BANDAR DAMANSARA
PETI SURAT 12579
50644 KUALA LUMPUR

Telefon : 03-2092 4488
Faks (Pentadbiran) : 03-2093 5982
Kawat : "MINRUMAH"
http://www.kpkt.gov.my

"KITAR SEMULA - FIKIR DULU SEBELUM BUANG"

Ruj. Kami : KPKT/JPSPN/(S)800/2/2/1(64)
Tarikh : 4 Mac 2011

KEPADA YANG BERKENAAN

Tuan,

SURAT SOKONGAN JABATAN BAGI PROJEK KERAJAAN - KAJIAN PENGURUSAN SISA TAYAR TERPAKAI DI SEMENANJUNG MALAYSIA

Dengan hormatnya saya merujuk kepada perkara tersebut di atas.

2. Sukacita dimaklumkan bahawa Kerajaan akan melaksanakan penguatkuasaan Akta Pengurusan Sisa Pepejal dan Pembersihan Awam 2007 (Akta 672) yang bertujuan untuk mewujudkan sistem pengurusan sisa pepejal yang menyeluruh dan diterima oleh masyarakat yang mementingkan alam sekitar dan menjamin kesihatan awam.

3. Oleh yang demikian, pihak Kementerian Perumahan dan Kerajaan Tempatan melalui Jabatan Pengurusan Sisa Pepejal Negara telah melantik perunding iaitu Chemsain Konsultant Sdn Bhd bagi melaksanakan Kajian Pengurusan Sisa Tayar Terpakai Di Semenanjung Malaysia.

4. Sehubungan dengan itu, Jabatan memohon kerjasama pihak tuan bagi mengemukakan maklumat berkaitan yang diperlukan oleh perunding tersebut sepanjang tempoh kajian selama empat (4) bulan dari tarikh ini. Kerjasama pihak tuan adalah amat penting kerana hasil kajian tersebut akan digunakan oleh pihak Kerajaan dalam membuat keputusan dasar khususnya mengenai pengurusan sisa tayar. Oleh yang demikian, maklumat-maklumat yang tepat daripada pihak tuan diperlukan supaya keputusan dasar yang dibuat kelak adalah tepat dan tidak menjejaskan industri-industri berkaitan termasuk pihak tuan.

Sekian, terima kasih.

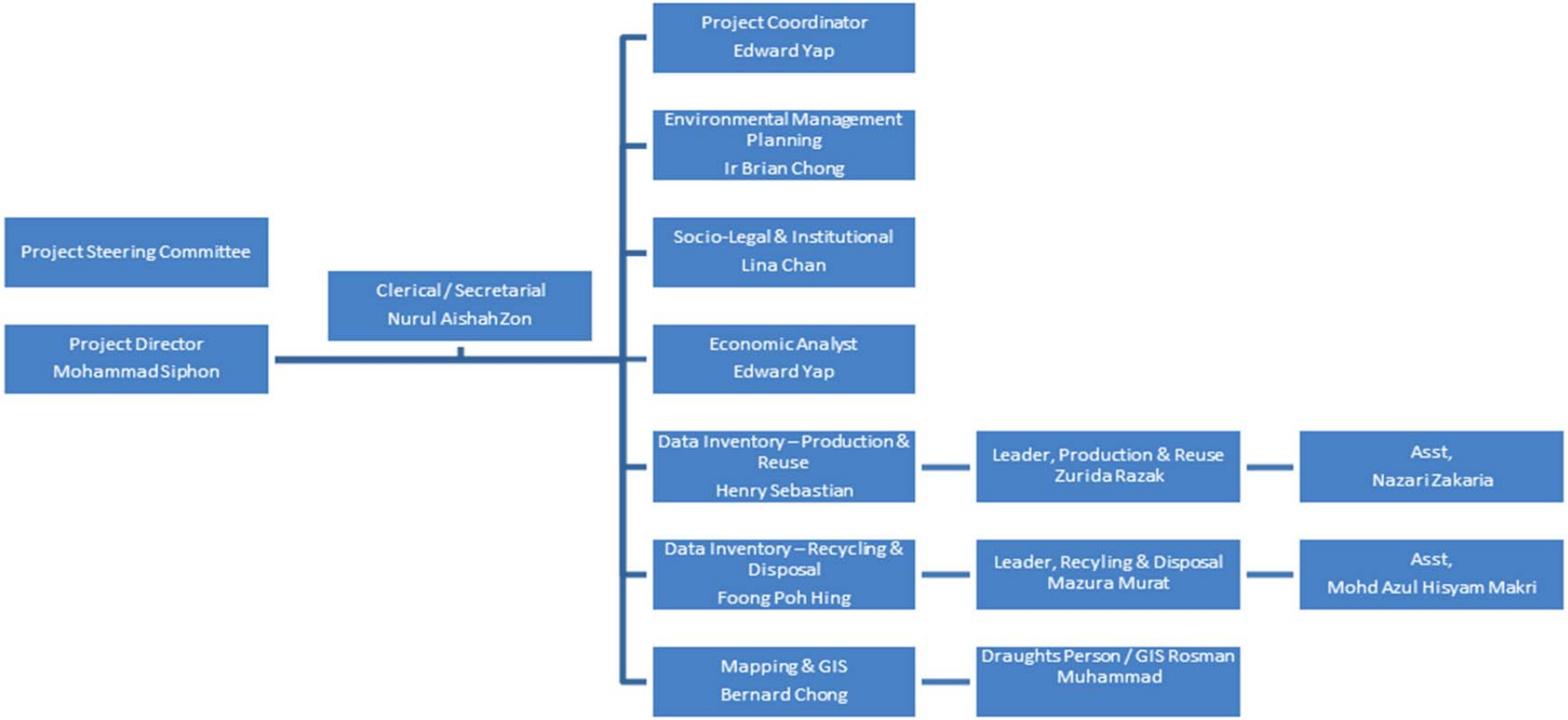
"BERKHIDMAT UNTUK NEGARA"

"1MALAYSIA: RAKYAT DIDAHULUKAN, PENCAPAIAN DIUTAMAKAN"

(DATO' NADZRI BIN YAHAYA, Ph.D)
Ketua Pengarah
Jabatan Pengurusan Sisa Pepejal Negara
Kementerian Perumahan dan Kerajaan Tempatan

APPENDIX C
Organization Chart of the Consultant Team

APPENDIX C: ORGANIZATION CHART OF THE CONSULTANT TEAM



APPENDIX D
Detailed Study Implementation Plan for the Study

APPENDIX D: DETAILED STUDY IMPLEMENTATION PLAN FOR THE STUDY

	Activity & Work Descriptions	Month 1				Month 2				Month 3				Month 4			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**Stage 1 - Inception Phase**																
1.1	Review of Existing Studies, Gathering of Information																
1.2	Data Gathering																
1.3	Review data and methodology																
1.4	Inception report submission																
2	**Stage 2 – Interim Report Phase**																
2.1	Compilation and analysis of data																
2.2	Field Survey and Update Inventory																
2.3	Assess & Evaluate treatment technologies																
2.4	Review Options																
2.5	Review Environmental Legislation & Incentive																
2.6	Interim Report Submission																
3	**Stage 3 : Final Report Phase**																
3.1	Finalize report for submission																
3.2	Review study output with Project Steering Committee																
3.3	Submit Final Report																

			Week Starting																		
			March				April				May					June					July
		Date	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4
	Project Kick-Off	7/3/2011	▲																	
Activity 1:	**Inception Phase**																			
1.1	Indentify relevant stakeholder organisations and institutions to take part in the inventory activities		■	■	■	■														
1.2	Identify existing scrap tyre treatment plants and other parties currently prepared to establish new recycling plants for scrap tyres		■	■	■	■														
1.3	Identify existing reports and inventories on scrap tyres in Peninsular Malaysia		■	■	■	■														
1.4	Propose adjustments to the TOR and prepare detailed implementation plan		■	■																
	Preparation of Inception Report				■	■														
	Submission of Inception Report	4/4/2011				▲														
Activity 2:	**Institutional Analysis**																			
2.1	Detailed review of the responsibilities, capabilities, facilities, strength and weaknesses, funding and present level of cooperation and information exchange between organisations (federal & state) currently involved in scrap tyres management						■	■	■	■										

			Week Starting																	
			March				April				May					June				July
		Date	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4
Activity 3:	**Inventory Phase**																			
3.1	Verify and update the inventory of scrap tyres in Peninsular Malaysia (including ground surveys)																			
3.2	Make a mass flow model of existing scrap tyres movement (from tyre shops to final disposal or end users)																			
3.3	Identify quantity of scrap tyres, transporters of scrap tyres and location of treatment/disposal sites for scrap																			
Activity 4:	**Treatment and Recycling Options**																			
4.1	Assess recommended options for scrap tyres recycling in detail																			
4.2	Perform a planning analyses of recycling plants																			
Activity 5:	**Incentive System**																			
5.1	Identify need of establishing incentive system to ensure sustainability of the system																			
5.2	Determine possible incentive systems to meet the need																			
5.3	Recommend how to implement the incentive system (regulation and distribution of incentives)																			

			Week Starting																	
			March				April				May					June				July
		Date	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4
Activity 6:	**Brief Description of Legislation Requirement**																			
6.1	Elaborate important elements to be included in the required legislations of scrap tyres (e.g. obligations of generators, transporters, treatment and disposal facilites operators, empowerment of the government on																			
Activity 7:	**Action Plan**																			
7.1	Prepare possible action plans for stakeholders, to include their roles and actions, and a timeline for implementation																			
	Preparation of Interim Report																			
	Submission of Interim Report (after 2 months)	23-May																		
	Preparation of Final Report																			
	Submission of Final Report (after 4 months)	4-Jul																		

APPENDIX E
List of Existing Reports and Inventories on Scrap Tyres Currently Available in Peninsular Malaysia

APPENDIX E: LIST OF EXISTING REPORTS AND INVENTORIES ON SCRAP TYRES CURRENTLY AVAILABLE IN PENINSULAR MALAYSIA

List of Existing Reports on Scrap Tyres in Peninsular Malaysia

No.	Title	Author	Type of Report & Year Published	Summary of the Content	Source
GENERAL REPORT					
1.	A Concept Paper for Waste Tyre Disposal through Cement Kiln for Department of Environment, Ministry of Environment, Science & Technology – Putrajaya	Mohammad Dit	Concept Paper & 29th November 2002	• A concept paper to provide as an alternative solution to waste tyres disposal (Lafarge Group has vast experiences & has established facilities at its cement plants in United Kingdom (UK), France, European Union (EU), United States of America (USA), Canada & Morocco)	Lafarge
2.	Malaysia Developing a Solid Waste Management Model for Penang	United Nations Development Programme (UNDP), Malaysia	Book & 2008	• Developing a solid waste management (SWM) model for Malaysia (National & global issues of SWM, institutional framework, stakeholder consultation, incentives, pilot project, lessons learnt, etc.) • Table 4, page 19 – Estimates of other waste fractions in Penang, 2005-2020 for scrap tyres	http://www.undp.org.my/uploads/SWM-2008_final.pdf (accessed on 15th March 2011)

No.	Title	Author	Type of Report & Year Published	Summary of the Content	Source
TECHNICAL REPORT					
3.	Economic Approaches to Sustainable Development Completion Report	EPU & DANIDA	Completion Report & November 2003	• Document the status of the project at the time of completion • Provide an overall assessment of the degree to which the immediate objectives have been or are expected to be achieved • Content – project context, achievement of project outputs, project inputs, financial statement, impact & sustainability assessment, lessons learnt, etc. • Page 34 – Collection & treatment of scrap tyres in the state of Sarawak • Page 36 – Disposal of scrap tyres in Peninsular Malaysia • Annex G – Working papers for scrap tyres – international experience, EPU-DANIDA background paper: Scrap Tyres in Peninsular Malaysia, October 2003, options paper, Rapid Assessment Survey findings	EPU

No.	Title	Author	Type of Report & Year Published	Summary of the Content	Source
4.	Handbook: Economic Instruments for Environmental Management of Malaysia	Economic Planning Unit (EPU) & Danish International Development Assistance (DANIDA)	Handbook & 2004	• Economic instruments (framework for developing & designing, demonstration projects, toolkit, etc.) • Section 3.5 – Initiating a scrap tyre management system (Kuching)	http://www.epu.gov.my/html/themes/epu/images/common/pdf/publication/handbook.pdf (accessed on 15th March 2011)
ARTICLE					
5.	Waste to Wealth: How it Works in Malaysia	Dr. Theng Lee Chong	Newsletter & 2006	• Recycling of waste in Malaysia (waste-to-energy technology & composting) • Recycling of scrap tyres & e-waste	IMPAK Issue 2, 2006 (http://www.confucianalumni.com/pdf/Impak%20%28Issue%202-2006%29%20-%20TLC.pdf, accessed on 15th March 2011)
6.	Overview of Recycling and Reuse of Used Tires	Anas Ibrahim, Abdul Rahman Ayub & Mohd Suffian Yusoff	Article & N/A	• Problems associated with discarded scrap tyres • Recycling practices in Taiwan, EU, United States (US) & Malaysia	http://www.oocities.org/icolg2006/Overview_of_Recycling.htm (accessed on 15th March 2011, Tuesday)

No.	Title	Author	Type of Report & Year Published	Summary of the Content	Source
UNIVERSITY THESIS / RESEARCH					
7.	Waste Tyre Management in Malaysia	Sandra Kumar a/l Thiruvangodan	PhD Thesis & March 2006	• Literature reviews on waste tyres – amount generated, current disposal options & its limitations, management, collection & disposal, Government's role, regulations on disposal, etc. • Conducted field surveys • Researched on disposal options, issues faced by tyre dealers in waste tyre disposal, current regulations & policies on waste tyre management, impact of waste tyres on environment, etc.	*psasir.upm.edu.my/145/* (accessed on 14th March 2011)
8.	Shredded Scrap Tire Based Lightweight Geomaterial for Civil Engineering Works	A. Naser Ghani	Thesis & N/A	• Discussed the practical applicability of shredded tyres as lightweight geomaterial in civil engineering construction & their key properties	http://www.bvsde.paho.org/bvsacd/cd24/ghani.pdf (accessed on 15th March 2011, Tuesday)
9.	Preparation of Activated Carbons from Waste Tyres Char Impregnated with Potassium Hydroxide and Carbon Dioxide Gasification	Nurulhuda binti Amri	Master Thesis & 2008	• Researched on how to prepare activated carbons from waste tyres using two-step physiochemical activation method • Presented on waste tyre and problem disposal & utilization of waste tyre using pyrolisis process (Chapters 1.1 & 1.2)	http://eprints.usm.my/10265/1/PREPARATION_OF_ACTIVATED_CARBONS_FROM_WASTE_TYRES_CHAR_IMPREGNATED_WITH_POTASSIUM_HYDROXIDE_AND_CARBON_DIOXIDE_GASIFICATION.pdf (accessed on 15th March 2011, Tuesday)

No.	Title	Author	Type of Report & Year Published	Summary of the Content	Source
10.	Use of Scrap Tyres in Earth Retaining Structures	Loh Wooi Chuan	Master Thesis & April 2008	• Assessed the technical feasibility of using whole scrap tyres as one of the elements of retaining structures • Literature reviews – overview of tyre, worldwide scrap tyre problems, current management option, etc.	http://psasir.upm.edu.my/5387/1/FK_2008_30.pdf (accessed on 15th March 2011, Tuesday)
11.	Teknik Baru untuk Pengitaran Semula Pelbagai Sisa Getah or New Technique to Recycle Various Rubber Waste	Prof. Hanafi Ismail	Laporan Akhir Projek Penyelidikan USM Jangka Pendek or USM Short-Term Research Project Final Report & N/A	• Presented 10 working papers* which were written by the author on the 2 methods used for recycling rubber waste • Methods: Using a new chemical called 'DeCrossCHEM' & blending with virgin rubber and thermoplastic	http://eprints.usm.my/10656/1/Teknik_Baru_Untuk_Pengktaran_Semula_Pelbagai_Sisa_Getah_%28PPKSumber_Mineral%29.pdf (accessed on 15th March 2011, Tuesday)
12.	Establishing Industrial Standard for Recycled Waste: The Case of Malaysia	Ahmad Fariz Mohamed	PhD Research Paper & N/A	• Country experience in establishing & implementing standards for waste recycling (EU, Federal Republic of Germany & US) • Initiative towards development of standards for sustainable industrial waste recycling industry in Malaysia • Establishing standards for waste recycling in Malaysia (Table 3, page 210 – Malaysian Standards (MS) for recycling industry)	http://www.eria.org/pdf/research/y2009/no10/Ch07_3R.pdf (accessed on 16th March 2011, Wednesday)

No.	Title	Author	Type of Report & Year Published	Summary of the Content	Source
13.	Study on Scrap tyres in Peninsular Malaysia	Mohd Nasir Hassan	Study Final Report & 2003	• Presented comprehensive data on the scrap tyres in Peninsular Malaysia • Particular emphasis on the quality & volume of scrap tyres generated • Flow of scrap tyres • Existing practices of scrap tyre disposal • Tyre recycling & reuse • Impacts of existing scrap tyres management & practices	University of Putra Malaysia

*** Note:**

The 10 working papers of Prof. Hanafi Ismail are as listed below:

1. Effect of Palm Oil Fatty Acid Additive (POFA) on Curing Characteristics, Mechanical and Morphological Properties of Silica Filled Natural Rubber/Recycle Rubber Powder Blends, Hanafi Ismail & R. Nordin, 28th July 2003
2. Thermoplastic Elastomers based on Polypropylene/Natural Rubber and Polypropylene/Recycle Rubber Blends, H. Ismail & Suryadiansyah, 3rd September 2001
3. Cure Characteristics, Tensile Properties and Swelling Behaviour of Recycled Rubber Powder-Filled Natural Rubber Compounds, H. Ismail, R. Nordin & A.M. Noor, 16th October 2001

4. The Effect of Filler Loading on Curing and Mechanical Properties of Natural Rubber/Recycled Rubber Powder Blends, H. Ismail, R. Nordin & A.M. Noor, 16th April 2003

5. Properties of Polypropylene/Natural Rubber/Recycle Rubber Powder Blends, Hanafi Ismail & Suryadiansyah, 2002

6. The Effects of Recycle Rubber Powder (RRP) Content and Various Vulcanization Systems on Curing Characteristics and Mechanical Properties of Natural Rubber/RRP Blends, Hanafi Ismail, Razif Nordin & Ahmad Mohd Noor, 21st June 2003

7. The Comparison Properties of Recycle Rubber Powder, Carbon Black and Calcium Carbonate Filled Natural Rubber Compounds, Hanafi Ismail, R. Nordin & Ahmad Md. Noor, 2002

8. Effect of Epoxidized Natural Rubber (ENR) and Ethylene-co-acrylic Acid Copolymer on Properties of Silica-Filled Natural Rubber/Recycle Rubber Powder Blends, Hanafi Ismail & R. Nordin, 2004

9. A Comparative Study of the Effect of Degradation on the Properties of PP/NR and PP/RR Blends, H. Ismail & Suryadiansyah, 2004

10. Tensile Properties and Swelling Behaviour of Polypropylene/Natural Rubber and Polypropylene/Recycled Rubber Blends, Suryadiansyah & H. Ismail, January 2002

List of Existing Inventories on Scrap Tyres in Peninsular Malaysia

No.	Inventory	Author	Details of Inventory	Source
1.	Data used for the estimation of annual tonnage for scrap tyres generations (until 2003)	EPU & DANIDA	• Annex G – EPU-DANIDA background paper: Scrap Tyres in Peninsular Malaysia, October 2003 & Rapid Assessment Survey findings	EPU-DANIDA background paper: Scrap Tyres in Peninsular Malaysia, October 2003 from the Economic Approaches to Sustainable Development Completion Report, November 2003
2.	Data used for the estimation of annual tonnage for scrap tyres generations (until March 2004)	Mohd Nasir Hassan	Study on Scrap tyres in Peninsular Malaysia, Final Report, 2003	University of Putra Malaysia

APPENDIX F
List of Relevant Stakeholders (Organisations and Institutions) to be Involved in the Scrap Tyre Inventory Activities

APPENDIX F: LIST OF RELEVANT STAKEHOLDERS (ORGANISATIONS AND INSTITUTIONS) TO BE INVOLVED IN THE SCRAP TYRE INVENTORY ACTIVITIES

Government Agencies	
No.	**Stakeholders**
1	Public Cleansing Management Corporation (SWPCMC)
2	Ministry of International Trade and Industry (MITI)
3	Royal Malaysia Customs Department
4	Road Transport Department (DOT)
Tyre Associations	
No.	**Stakeholders**
1	Malaysian Association Of Tyre Retreaders & Dealers Societies (MATRDS)
2	Malaysia Tyre Manufacturers and Retreaders' Association
3	Selangor & Federal Territory Tyre Dealers & Retreaders' Association
4	Perak Tyre Dealers Retreaders Association
5	Johor Tyre Dealers Association
6	Negeri Sembilan Tyre Dealers Association
7	Pahang Darul Makmur Tyre Dealers Association
8	Melaka Motor Trade Association
9	North Malaysia Tyre Association
10	Kelantan Motor Trade Association
11	Terengganu Darul Iman Tyre Dealers & Retreaders' Association
Main Players in Tyre Businesses	
No.	**Stakeholders**
Manufacturers, Distributers and Importers	
1	Continental Sime Tyre PJ Sdn. Bhd.
2	Goodyear Malaysia Berhad
3	Silverstone Berhad
4	Dunlop Malaysia Industries Berhad
5	Bridgestone Tyre Sales (MALAYSIA) Sdn. Bhd.

No.	Stakeholders
Retreaders	
1	Sun Tyre Industries Sdn. Bhd.
2	Olympic Retreads (M) Sdn. Bhd.
3	Tai Hin & Son (Pg) Sdn. Bhd.
4	eTYRES
5	Asta Sales & services Sdn. Bhd.
6	Autoli Tyre Retreading Sdn. Bhd.
7	Yoong Sing Tyre Retreaders Sdn. Bhd.
8	Autoways (Malaysia) Sdn. Bhd.
9	First Unitex Tyre Retreading Sdn. Bhd.
10	Joba Tyre Retreading Sdn. Bhd.
11	Kayel Retreads Sdn. Bhd.
12	Syarikat Nam Meow Sdn. Bhd.
13	Pine Castle Sdn. Bhd.
14	Sime Tyres International (M) Sdn. Bhd.
15	Sin Hua Tyre Retreading Sdn. Bhd.
16	Sing Tong Lee Full Circle Tyre Retreading Sdn. Bhd.
17	Usmeta Manufacturing Sdn. Bhd.
Workshops / Tyre Retailers – to be identified	

APPENDIX G
List of Existing Scrap Tyre Treatment Plants and Other Parties Prepared to Establish New Recycling Plants for Scrap Tyres

APPENDIX G: LIST OF EXISTING SCRAP TYRE TREATMENT PLANTS AND OTHER PARTIES PREPARED TO ESTABLISH NEW RECYCLING PLANTS FOR SCRAP TYRES

No.	Scrap Tyre Treatment Plant	Type of Business
1	**Gcycle** 30&31, Jalan Industri 1/4, Kaw. Perusahaan Ringan Desa Aman, Sungai Lalang, Kedah Malaysia 08100 Tel: +6012-4388258 (Ms. Jill Lim) Email: admin@gcycle.com.my	Produce reclaimed rubber. e.g. tyre granules (Gread 1/2), tyre beads, shredded tyre pieces, steel free tyre granules.
2	**RUBPLAST Sdn. Bhd** Lot 1922, Jalan Kampung Dew, Simpang Halt, Taiping Perak. Tel: 603-2694 1028 / 2694 6217 Fax: 603 - 2694 0028 Email: info@rubplastmalaysia.net	Reclaimed rubber is produced from selected discarded or worn rubber products, mainly tyres and tubes.
3	**Yong Fong Rubber Industries Sdn. Bhd.** Lot 9078 Jalan Udang Galah, Telok Gong, 42000 Port Klang, Selangor D E, Malaysia Telephone : + (603) 3134 3135 Fax : + (603) 3134 3136 Email : inquiry@yongfong.com.my	Quality reclaimed rubber manufacturer in Malaysia with ISO9001 certified.
4	**Jeng Yuan Reclaimed Rubber Sdn. Bhd.** Lot 3, Lingkaran Sultan Hishamuddin, Kaw.20, PKNS Industrial Estate, Selat Klang Utara, 42000 Port Klang, Selangor Darul Ehsan, Malaysia. Tel:603 - 3176 2602 (5 lines) Fax:603 - 3176 1045 E-mail:enquiry@jeng-yuan.com	Principal activity in manufacturing of premium quality reclaimed rubber.

No.	Scrap Tyre Treatment Plant	Type of Business
5	**E-Waste Management (M) Sdn. Bhd.** No 29, Jalan TTC2, Taman Teknology Cheng, Melaka 75250, Malaysia. Tel: +606 3352670 Fax: +606 3372675 E-mail: info@e-waste.com.my	Produce Special Process Recycle Rubber.
6	**Green World Recycling Sdn. Bhd.** Plot 168, Jalan Perindustrian Bukit Minyak, Kawasan Perindustrian Bukit Minyak, 14100 Simpang Empat, S.P.T. Pulau Pinang, Malaysia. Tel: +604 552 1188 Fax: +604 552 1182 Email: sales@greenworld.net.my Contact Person:Mr. Brandon (+6017 582 5788)	Produce reclaimed rubber.
7	**Octagon Consolidated Berhad** 24th Floor, UBN Tower, 10 Jalan P.Ramlee, 50250 Kuala Lumpur Malaysia Tel : +60 3 2070 2133 Fax : +60 3 2070 3133 Email : octagon@octagon-consolidated.com Pyrolysis plant : Westport, Taman Indah, Taman Perindustrian Fasa 2.	Continuous process pyrolysis technology.
8	**Green Pluslink Sdn. Bhd.** Lot 1641, Jln Leboh Raja Lumu, Kawasan Perindustrian PKNS, Selangor, Malaysia. Tel:603-31679388 Fax:603-31679839 Mobile Phone:012-2008320	Manufacturing of carbon black.

No.	Cement Industry	Type of Business
1	**La Farge Cement Berhad** Level 12, Bangunan TH Uptown 3 3, Jalan SS21/39 47400 Petaling Jaya Selangor Darul Ehsan Malaysia Tel: +603-7723 8200 Fax: +603-7722 4100 Email : info@my.lafarge.com Cement plant: Teluk Ewa, Mukim Air Hangat, Pulau Langkawi	Uses scrap tyre as supplementary fuel.

APPENDIX H
Tyre Retreaders in Peninsular Malaysia

APPENDIX H: TYRE RETREADERS IN PENINSULAR MALAYSIA

State	No.	Company Name
Pulau Pinang	1	**Tai Hin & Son (Pg) Sdn. Bhd.** 2410, Jalan Perusahaan Kawasan Perusahaan Prai 13600 Perai Pulau Pinang Tel: 04-3990108/0109 Fax: 04-3991117
	2	**OLYMPIC RETREADS (M) Sdn. Bhd.** 6424, Jalan Permatang Pauh, Mak Mandin Industrial Estate, 13400 Butterworth, Penang, Malaysa. Tel: (60 4) 332 9206, 333 2706 Fax: (60 4) 332 9219
	3	**KAYEL RETREADS SDN BHD** Lot 395, lorong Perusahaan 8, Kawasan Perusahaan Prai, 13600 Prai, Penang Tel: 604 390 8753 / 7568 / 2886 Fax: 604 390 2881
Perak	4	**PINE CASTLE SDN BHD** Kawasan Perusahaan Kamunting Raya, P.O.Box No. 1, 34600 Kamunting Taiping, Perak Tel: 605 891 9119 Fax: 605 891 7025
Kelantan	5	**SIN HUA TYRES RETREADING SDN BHD** Lot 2458 Kws. Perindustrian Pengkalan Chepa 2, Mukim Panchor, Kemuning, 16100 Kota Bahru, Kelantan Darul Naim Tel: 609 774 5555 / 5666 Fax: 6079 774 5999

State	No.	Company Name
Selangor	6	**AUTOLI TYRE RETREADING SDN BHD** No. 4A, Lorong Kilang, Jalan 206, 46050 Petaling Jaya, Selangor Darul Ehsan Tel: 603 7781 0031 / 7782 8299 Fax: 603 7781 0490
	7	**AUTOWAYS (MALAYSIA) SDN BHD** Jalan Ribet 15/15, 40702 Shah Alam , Selangor Darul Ehsan Tel: 603 5519 2300 Fax: 603 5519 2508
	8	**FIRST UNITEX TYRE RETREADING S/BHD** Lot 1316, Jalan Padu 25/127, Seksyen 25, Batu 8, Off Jalan Kemuning, 40400, Shah Alam, Selangor Darul Ehsan Tel: 603 5122 1168 Fax: 603 5122 8168
	9	**SIME TYRES INTERNATIONAL (M) S/BHD** No. 2, (3rd floor) Sime Darby Technology Centre, Jalan Tandang 46050, Petaling Jaya, Selangor Darul Ehsan Tel: 603 7783 0905 Fax: 603 7783 3627
	10	**YOONG SING TYRE RETREADERS S/BHD** Lot 1029, Kampung Baru Balakong, Jalan Balakong, Batu 13, 43300 Seri Kembangan Selangor Darul Ehsan Tel: 603 8961 4180 / 4187 / 7881 Fax: 603 8960 4189

State	No.	Company Name
	11	**eTyres** No. 20, Jalan Utama 2 / 12, Puchong, Selangor. Taman Perindustrian Puchong Utama, Puchong, Selangor. Website: http://www.etyres.com.my/ Tel: +6016-3420888
Kuala Lumpur	12	**ASTA SALES & SERVICES Sdn. Bhd.** lot 3, Lorong Enggang 31, Kawasan Perindustrian Ulu Klang, 54200 Kuala Lumpur Tel: 603 4257 8955 Fax: 603 4251 8697
	13	**SYARIKAT NAM MEOW SDN BHD** 58-59 Jalan Loke Yew, 55200 Kuala Lumpur Tel: 603 9074 7542 / 7543 Fax: 603 9074 7551
	14	**SING TONG LEE FILL CIRCLE TYRE RETREADING SDN BHD** Lot No 284, Jalan Tiga, Off Jalan Chan Saw Lin, 55200 Kuala Lumpur Tel: 603 9221 5094 / 1046 / 1092 Fax: 603 9221 9499
	15	**USMETA MANUFACTURING SDN BHD** No. 2, Lorong Enggang 4 Taman Keramat, 54200 Kuala Lumpur Tel: 603 4256 6198 Fax:603 4257 6332

State	No.	Company Name
Negeri Sembilan	16	**Sun Tyre Industries Sdn. Bhd.** 53, Senawang Industrial Estate 70450 Seremban Negri Sembilan Darul Khusus Website :www.suntex.com.my Telephone: 06-6771711 Fax: 06-6777872
	17	**SUN ORGANISATION SDN BHD** 53, Senawang Industrial Estate, 70450 Seremban Negeri Sembilan Darul Khusus Tel: 606 677 1711 / 2993 Fax: 606 677 7872
Johor	18	**JOBA TYRE RETREADING SDN BHD** No 5, Jalan Taruka, Kawasan Perindustrian Tampoi, 80350, Johor Bahru, Johor Darul Takzim Tel: 607 335 6700 Fax: 607 335 6703

APPENDIX I
Data from Department of Road and Transport (DOT)

APPENDIX I: DATA FROM DEPARTMENT OF ROAD AND TRANSPORT (DOT)

JADUAL 1.2 : JUMLAH TERKUMPUL KENDERAAN BERMOTOR MENGIKUT JENIS DAN NEGERI, MALAYSIA, 2007
Table 1.2 : Total Registered Motor Vehicles By Type And State, Malaysia, 2007

NEGERI State	MOTOSIKAL Motorcycle	MOTOKAR Motorcar	BAS Bus	TEKSI Taxi	KERETA SEWA PANDU SENDIRI Hire & Drive Car	KENDERAAN BARANG - BARANG Goods Vehicle	LAIN - LAIN Others	JUMLAH Total
PERLIS	49,225	13,502	188	185	2	1,737	1,298	66,137
KEDAH	572,614	212,866	3,105	3,270	202	32,616	17,881	842,554
PULAU PINANG	979,853	728,493	5,133	3,354	440	54,552	16,866	1,788,691
PERAK	948,255	510,013	4,377	4,199	46	57,873	33,014	1,557,777
SELANGOR	886,970	869,169	6,076	6,355	242	130,805	55,461	1,955,078
WILAH PERSEKUTUAN	1,108,324	2,271,722	15,389	27,162	9,176	183,067	133,586	3,748,426
NEGERI SEMBILAN	389,453	236,300	2,635	1,867	25	36,953	7,398	674,631
MELAKA	320,657	218,568	1,942	1,664	41	22,129	5,150	570,151
JOHOR	1,205,058	953,439	9,036	11,308	94	108,546	42,859	2,330,340
PAHANG	368,294	247,491	1,924	2,630	12	35,606	12,242	668,199
TERENGGANU	220,222	123,193	1,032	1,075	15	18,360	6,522	370,419
KELANTAN	312,293	182,768	1,866	2,090	7	23,891	7,326	530,241
SABAH	134,129	379,878	6,669	5,004	1,610	99,627	45,582	672,499
SARAWAK	448,017	472,241	2,936	2,211	456	65,472	47,467	1,038,800
JUMLAH	7,943,364	7,419,643	62,308	72,374	12,368	871,234	432,652	16,813,943

SUMBER : JABATAN PENGANGKUTAN JALAN
Source : Road Transport Department

JADUAL 1.2 : JUMLAH TERKUMPUL KENDERAAN BERMOTOR MENGIKUT JENIS DAN NEGERI, MALAYSIA, 2008
Table 1.2 : Total Motor Vehicles by Type and State, Malaysia, 2008

NEGERI State	MOTOSIKAL Motorcycle	MOTOKAR Motorcar	BAS Bus	TEKSI Taxi	KERETA SEWA PANDU SENDIRI Hire & Drive Car	KENDERAAN BARANG - BARANG Goods Vehicle	LAIN - LAIN Others	JUMLAH Total
PERLIS	53,310	14,944	194	194	3	1,773	1,330	71,748
KEDAH	610,804	227,201	3,153	3,295	215	33,424	18,226	896,318
PULAU PINANG	1,033,025	780,519	5,232	3,387	479	57,462	17,648	1,897,752
PERAK	999,884	543,920	4,469	4,219	60	60,031	34,238	1,646,821
SELANGOR	939,211	912,178	6,338	7,120	275	138,673	61,190	2,064,985
WILAH PERSEKUTUAN	1,196,780	2,459,939	16,065	28,733	12,404	190,276	137,300	4,041,497
NEGERI SEMBILAN	409,981	250,924	2,705	1,897	26	37,952	7,531	711,016
MELAKA	338,701	235,964	1,964	1,695	42	23,060	5,341	606,767
JOHOR	1,286,032	1,020,978	9,348	11,461	103	113,589	45,351	2,486,862
PAHANG	399,312	266,911	1,957	2,613	11	37,039	12,788	720,631
TERENGGANU	240,964	134,434	1,061	1,099	15	18,957	6,722	403,252
KELANTAN	341,450	198,726	1,895	2,080	8	24,632	7,474	576,265
SABAH	156,554	412,374	6,692	5,050	1,338	103,334	48,587	733,929
SARAWAK	481,443	507,513	2,977	2,185	467	69,041	50,432	1,114,058
JUMLAH Total	8,487,451	7,966,525	64,050	75,028	15,446	909,243	454,158	17,971,901

SUMBER : JABATAN PENGANGKUTAN JALAN
Source : Road Transport Department

JADUAL 1.2 : JUMLAH TERKUMPUL KENDERAAN BERMOTOR MENGIKUT JENIS DAN NEGERI, MALAYSIA, 2009
Table 1.2 : Total Motor Vehicles by Type and State, Malaysia, 2009

NEGERI State	MOTOSIKAL	MOTOKAR	BAS	TEKSI	KERETA SEWA	KENDERAAN BARANG	LAIN - LAIN	JUMLAH Total
PERLIS	56,676	16,137	205	197	3	1,789	1,348	76,355
KEDAH	644,334	241,360	3,204	3,491	302	34,215	18,720	945,626
PULAU PINANG	1,076,409	830,678	5,511	3,545	500	59,744	18,271	1,994,658
PERAK	1,042,839	577,160	4,580	4,232	62	61,821	35,361	1,726,055
SELANGOR	984,115	947,802	6,857	8,193	315	143,469	65,030	2,155,781
W. PERSEKUTUAN	1,271,768	2,650,317	17,070	30,785	13,491	196,593	141,580	4,321,604
NEGERI SEMBILAN	425,676	265,636	2,738	2,001	17	38,830	7,639	742,537
MELAKA	352,923	252,606	1,983	1,747	41	23,648	5,547	638,495
JOHOR	1,348,349	1,086,147	9,638	11,808	103	117,338	47,237	2,620,620
PAHANG	422,183	285,061	1,987	2,660	12	37,812	13,136	762,851
TERENGGANU	259,232	146,091	1,078	1,123	18	19,338	6,908	433,788
KELANTAN	365,810	215,020	1,935	2,067	9	25,329	7,651	617,821
SABAH	177,779	447,378	6,732	5,108	1,220	104,650	50,905	793,772
SARAWAK	512,137	544,687	3,063	2,192	486	71,646	52,608	1,186,819
JUMLAH	8,940,230	8,506,080	66,581	79,149	16,579	936,222	471,941	19,016,782

SUMBER : JABATAN PENGANGKUTAN JALAN
Source : Road Transport Department

JADUAL 1.2 : JUMLAH TERKUMPUL KENDERAAN BERMOTOR MENGIKUT JENIS DAN NEGERI, MALAYSIA, SUKU PERTAMA, 2010
Table 1.2 : Total Registered Motor Vehicles By Type And State, Malaysia, First Quarter, 2010

NEGERI State	MOTOSIKAL Motorcycle	MOTOKAR Motorcar	BAS Bus	TEKSI Taxi	KERETA SEWA PANDU SENDIRI Hire & Drive Car	KENDERAAN BARANG - BARANG Goods Vehicle	LAIN - LAIN Others	JUMLAH Total
PERLIS	57,979	16,722	206	196	3	1,800	1,354	78,260
KEDAH	656,316	245,045	3,212	3,529	420	34,449	18,798	961,769
PULAU PINANG	1,090,593	845,255	5,605	3,586	498	60,473	18,405	2,024,415
PERAK	1,056,023	586,605	4,605	4,256	67	62,214	35,596	1,749,366
SELANGOR	998,886	957,345	6,933	8,532	322	144,768	66,028	2,182,814
WILAYAH PERSEKUTUAN	1,293,206	2,702,872	17,348	31,358	13,791	198,473	142,132	4,399,180
NEGERI SEMBILAN	430,782	269,753	2,747	2,010	16	39,033	7,657	751,998
MELAKA	357,362	257,377	1,983	1,759	44	23,797	5,589	647,911
JOHOR	1,366,661	1,104,477	9,731	11,855	103	118,382	47,744	2,658,953
PAHANG	428,487	290,020	1,994	2,670	12	38,061	13,196	774,440
TERENGGANU	265,118	149,567	1,084	1,130	18	19,490	6,943	443,350
KELANTAN	373,979	219,516	1,970	2,043	9	25,548	7,676	630,741
SABAH	184,370	457,988	6,761	5,101	1,228	104,294	51,392	811,134
SARAWAK	521,402	555,587	3,090	2,197	488	72,092	53,080	1,207,936
JUMLAH	9,081,164	8,658,129	67,269	80,222	17,019	942,874	475,590	19,322,267

SUMBER : JABATAN PENGANGKUTAN JALAN
Source : Road Transport Department

JADUAL 1.2 : JUMLAH TERKUMPUL KENDERAAN BERMOTOR MENGIKUT JENIS DAN NEGERI, MALAYSIA, SUKU KEDUA, 2010
Table 1.2 : Total Registered Motor Vehicles By Type And State, Malaysia, Second Quarter, 2010

NEGERI State	MOTOSIKAL Motorcycle	MOTOKAR Motorcar	BAS Bus	TEKSI Taxi	KERETA SEWA PANDU SENDIRI Hire & Drive Car	KENDERAAN BARANG - BARANG Goods Vehicle	LAIN - LAIN Others	JUMLAH Total
PERLIS	58,822	17,233	205	194	2	1,811	1,357	79,624
KEDAH	665,749	249,186	3,220	3,540	516	34,662	18,984	975,857
PULAU PINANG	1,102,967	860,356	5,643	3,635	511	61,579	18,622	2,053,313
PERAK	1,067,126	595,716	4,646	4,289	68	62,638	35,927	1,770,410
SELANGOR	1,011,784	967,224	6,999	8,896	333	146,535	67,533	2,209,304
WILAYAH PERSEKUTUAN	1,313,347	2,760,129	17,582	32,204	14,056	200,543	142,762	4,480,623
NEGERI SEMBILAN	434,871	273,314	2,758	2,038	16	39,411	7,691	760,099
MELAKA	361,255	261,951	2,000	1,777	44	23,950	5,674	656,651
JOHOR	1,383,063	1,123,042	9,828	11,915	102	119,649	48,455	2,696,054
PAHANG	434,035	294,941	2,014	2,666	16	38,279	13,355	785,306
TERENGGANU	270,300	152,956	1,099	1,127	16	19,614	6,997	452,109
KELANTAN	381,438	224,127	1,976	2,038	9	25,747	7,763	643,098
SABAH	190,926	467,901	6,764	5,082	1,233	104,334	52,004	828,244
SARAWAK	529,906	565,471	3,114	2,216	504	72,772	53,747	1,227,730
JUMLAH	9,205,589	8,813,547	67,848	81,617	17,426	951,524	480,871	19,618,422

SUMBER : JABATAN PENGANGKUTAN JALAN
Source : Road Transport Department

JADUAL 1.2 : JUMLAH TERKUMPUL KENDERAAN BERMOTOR MENGIKUT JENIS DAN NEGERI, MALAYSIA, SUKU KETIGA, 2010
Table 1.2 : Total Registered Motor Vehicles By Type And State, Malaysia, Third Quarter, 2010

NEGERI State	MOTOSIKAL Motorcycle	MOTOKAR Motorcar	BAS Bus	TEKSI Taxi	KERETA SEWA PANDU SENDIRI Hire & Drive Car	KENDERAAN BARANG - BARANG Goods Vehicle	LAIN - LAIN Others	JUMLAH Total
PERLIS	59,579	17,630	206	197	2	1,819	1,367	80,800
KEDAH	675,009	253,232	3,242	3,563	641	34,887	19,088	989,662
PULAU PINANG	1,114,269	875,420	5,721	3,668	522	62,281	18,864	2,080,745
PERAK	1,078,756	604,343	4,682	4,334	67	62,993	36,218	1,791,393
SELANGOR	1,025,629	977,816	7,134	9,265	327	148,060	68,989	2,237,220
WILAYAH PERSEKUTUAN	1,331,867	2,814,705	17,787	33,174	14,530	203,202	144,029	4,559,294
NEGERI SEMBILAN	439,202	277,248	2,770	2,064	17	39,703	7,730	768,734
MELAKA	364,959	266,171	2,009	1,782	46	24,077	5,778	664,822
JOHOR	1,399,385	1,141,349	9,907	11,973	113	120,754	49,059	2,732,540
PAHANG	439,978	300,033	2,028	2,675	16	38,319	13,491	796,540
TERENGGANU	274,888	155,837	1,110	1,129	17	19,692	7,047	459,720
KELANTAN	388,015	228,325	1,990	2,045	10	25,837	7,819	654,041
SABAH	197,935	477,634	6,768	5,088	1,219	104,393	52,618	845,655
SARAWAK	539,422	575,554	3,126	2,226	522	73,399	54,535	1,248,784
JUMLAH	9,328,893	8,965,297	68,480	83,183	18,049	959,416	486,632	19,909,950

SUMBER : JABATAN PENGANGKUTAN JALAN
Source : Road Transport Department

JADUAL 1.2 : JUMLAH TERKUMPUL KENDERAAN BERMOTOR MENGIKUT JENIS DAN NEGERI, MALAYSIA, SUKU KEEMPAT, 2010
Table 1.2 : Total Registered Motor Vehicles By Type And State, Malaysia, Fourth Quarter, 2010

NEGERI State	MOTOSIKAL Motorcycle	MOTOKAR Motorcar	BAS Bus	TEKSI Taxi	KERETA SEWA PANDU SENDIRI Hire & Drive Car	KENDERAAN BARANG - BARANG Goods Vehicle	LAIN - LAIN Others	JUMLAH Total
PERLIS	60,200	17,979	206	196	2	1,826	1,379	**81,788**
KEDAH	683,134	257,193	3,254	3,591	755	35,008	19,209	**1,002,144**
PULAU PINANG	1,124,476	890,652	5,781	3,701	529	62,952	19,140	**2,107,231**
PERAK	1,089,128	613,094	4,729	4,355	73	63,303	36,487	**1,811,169**
SELANGOR	1,037,498	987,024	7,232	9,593	325	149,805	70,406	**2,261,883**
WILAYAH PERSEKUTUAN	1,349,885	2,867,830	18,050	34,142	14,632	204,886	145,787	**4,635,212**
NEGERI SEMBILAN	443,358	280,914	2,785	2,080	16	39,923	7,778	**776,854**
MELAKA	368,365	270,143	2,019	1,797	46	24,193	5,865	**672,428**
JOHOR	1,414,665	1,160,041	9,982	12,022	114	121,729	49,713	**2,768,266**
PAHANG	445,922	305,042	2,050	2,666	16	38,435	13,677	**807,808**
TERENGGANU	278,927	158,860	1,131	1,127	17	19,731	7,288	**467,081**
KELANTAN	393,690	232,322	2,002	2,044	10	25,889	7,895	**663,852**
SABAH	204,662	487,510	6,783	5,096	1,233	104,495	53,402	**863,181**
SARAWAK	547,997	586,316	3,145	2,251	532	74,002	55,425	**1,269,668**
JUMLAH	**9,441,907**	**9,114,920**	**69,149**	**84,661**	**18,300**	**966,177**	**493,451**	**20,188,565**

SUMBER : JABATAN PENGANGKUTAN JALAN
Source : Road Transport Department

APPENDIX J
Example of Survey Form

APPENDIX J: EXAMPLE OF SURVEY FORM

Date: _____

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (B)

For Tyres Shops, Workshops and Depots

GENERAL INFORMATION

Name of company: _____

Contact address: _____

_____

_____

Type of shop surveyed: Tyre shop / Workshop / Depot

Contact person / Respondent: _____

Position: _____ Contact number: _____

GPS Reading: _____

GENERATION, STORAGE & COLLECTION

i) What type of vehicles is serviced in the tyre shop / workshop / depot? *(Can tick more than one.)*

- ☐ Motorcycle
- ☐ Motorcar
- ☐ Commercial vehicle
- ☐ Others (please specify: _____)

ii) How many workers in the tyre shop / workshop / depot?

_____

iii) What are the types and estimated amounts of tyres changed **per week**?

Tyre Size	Examples	Estimated amount (No. of tyres)
Small	Motorcycle, bicycle	
Medium	Motorcar, taxi, MPV, van	
Large	Bus, truck, lorry, trailer	
Others (if any)		

iv) How many (in amount or %) of the customers requested to bring back their used tyres?

_____

Date: _____

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (B)

For Tyres Shops, Workshops and Depots

GENERAL INFORMATION

Name of company: _____

Contact address: _____

_____

_____

Type of shop surveyed: Tyre shop / Workshop / Depot

Contact person / Respondent: _____

Position: _____ Contact number: _____

GPS Reading: _____

GENERATION, STORAGE & COLLECTION

i) What type of vehicles is serviced in the tyre shop / workshop / depot? *(Can tick more than one.)*

- ☐ Motorcycle
- ☐ Motorcar
- ☐ Commercial vehicle
- ☐ Others (please specify: _____)

ii) How many workers in the tyre shop / workshop / depot?

_____

iii) What are the types and estimated amounts of tyres changed **per week**?

Tyre Size	Examples	Estimated amount (No. of tyres)
Small	Motorcycle, bicycle	
Medium	Motorcar, taxi, MPV, van	
Large	Bus, truck, lorry, trailer	
Others (if any)		

iv) How many (in amount or %) of the customers requested to bring back their used tyres?

_____

Storage	Collection	Type of collection	Contact details and information of the collectors / buyers	Charge for collection	Management after collection
❑ Open area, under control (fenced, gated, etc.) ❑ Open area, uncontrolled (not fenced, not gated, etc.) ❑ Stored in an area inside the building ❑ Others, please specify: _____ _____	(Can tick more than one.) ❑ By collector ❑ By trader ❑ By exporter ❑ Others, please specify: _____ _____ ❑ Discarded on your own, location of frequency of disposal*: _____ _____ _____	❑ Collect without notice ❑ Collect upon request ❑ Collect on agreed schedule ❑ Unknown Others, please specify: _____ _____ Collection Frequency :- ❑ Daily ❑ 3 times per week ❑ Weekly ❑ Once per 2 weeks ❑ Monthly ❑ Depended on storage capacity	❑ Name: _____ _____ ❑ Contact No.: ❑ Address: _____ _____ _____	❑ Amount in RM: _____ _____ per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres ❑ Others, please specify: _____	❑ Sent to the transfer station ❑ Sent to the disposal site ❑ Sent to recycler ❑ Sent to retreader ❑ Sent to trader ❑ Sent to importer ❑ Sent to exporter ❑ Burnt ❑ Unknown ❑ Others, please specify: _____ Name and location: _____

Date: _____

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (C)

For Tyres Collectors, Traders, Importers and Exporters

Name of company: _____

Contact address: _____

_____

_____

Type of collector / buyer surveyed: Collector / Trader / Importer / Exporter

Contact person / Respondent: _____

Position: _____ Contact number: _____

GPS Reading: _____

COLLECTION & TRANSPORTATION

Please fill in the table below on used tyres collection and transportation practices carried out by the collector / trader / importer / exporter surveyed.

Location of collection	Type & quantity of tyre collected	Type of collection vehicle used	Distance / area of collection (coverage)	Charge for collection	Management after collection
❑ Tyre shop ❑ Workshop ❑ Depot ❑ Service centre ❑ Petrol station ❑ Others, please specify: _____ _____ _____	❑ Small (motorcycle, bicycle) _____ ❑ Medium (motorcar , taxi) _____ ❑ Large (mini bus, bus, goods vehicle) _____ ❑ Others (light truck, lorry, trailer) _____	❑ Open lorry ❑ Covered lorry ❑ Others, please specify: _____ _____ _____ No. of lorries in the company: _____ _____ _____	_____ _____ _____	Amount in RM: _____ _____ per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: _____ _____ _____	❑ Stored ❑ Sent to the transfer station ❑ Sent to the disposal site ❑ Sent to recycler ❑ Sent to retreader ❑ Sent to trader ❑ Sent to importer ❑ Sent to exporter ❑ Burnt ❑ Others, please specify: _____ _____ _____ Name and location: _____ _____ _____ Location ended up most: _____ _____

Date: _____

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (D)

For Tyres Recyclers and Treatment Facilities

Name of company: _____

Contact address: _____

_____

_____

Contact person / Respondent: _____

Position: _____ Contact number: _____

GPS Reading: _____

i) What are the types and estimated amounts of tyres received **per day / week / month**?

Tyre Size	Examples	Estimated amount (No. of tyres)
Small	Motorcycle, bicycle	
Medium	Motorcar, taxi, MPV, van	
Large	Bus, truck, lorry, trailer	
Others (if any)		

SOURCES AND END PRODUCTS

Please fill in the table below on the sources of used tyres and the end products produced by the facility surveyed.

Type of facility	Source of used / scrap tyre	Collectors' information	Other waste collected	Gate fee	End products
❑ Retreading ❑ Recycling ❑ Treatment ❑ Others, please specify: _____ _____ _____ Please elaborate on the activities carried out at the facility. _____ _____ _____ _____ _____	❑ Own collection ○ Tyre shop ○ Workshop ○ Depot ○ Service centre ○ Petrol station ❑ From collector ❑ From trader ❑ From importer ❑ Others, please specify: _____ _____ _____ If own collection, please indicate the coverage area of collection _____ _____ _____ _____	❑ No. of collector: _____ _____ _____ ❑ Name: _____ _____ _____ ❑ Contact No.: _____ _____ ❑ Address: _____ _____ _____ _____	_____ _____ _____ Segregation of other waste from the used / scrap tyre? Yes / No	Amount in RM: _____ _____ per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: _____ _____ _____ **Capacity of facility** Amount of tyres treated per day / week / month: _____ _____ _____ _____	_____ (%) _____ (%) _____ (%) _____ (%) _____ (%) Are the end products for export? Yes / No

APPENDIX K
Summary from the Survey Conducted for Treatment Facilities

APPENDIX K: SUMMARY FROM THE SURVEY CONDUCTED FOR TREATMENT FACILITIES

TR 1 Date: 14/4/2011

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (D)

For Tyres Recyclers and Treatment Facilities

Name of company: G-Cycle / Heap Hoe Tyres Sdn. Bhd.

Contact address: 30 & 31, Jalan Industri ¼, Kawasan Perusahaan Ringan Desa Aman, 08100 Sungai Lalang, Kedah

Contact person / Respondent: Mr. Teoh Beng Keat

Position: Boss Contact number: 04-976 2188

GPS Reading: N° 5.7053, E° 100.5194

i) What are the types and estimated amounts of tyres received **per day / week / month**?

Tyre Size	Examples	Estimated amount (No. of tyres)
Small	Motorcycle, bicycle	
Medium	Motorcar, taxi, MPV, van	
Large	Bus, truck, lorry, trailer	200/day
Others (if any)		

Note:

- G-Cycle has been in business for 5-6 years
- The plant has an area about 25,000 ft^2
- They collected the scrap tyres in both small and big lorries (60-70 tyres per trip)
- The tyres collected which came with the sport rims will be sold to other people
- The recycling / processing of scrap tyres will take about 1-2 days before being transported to Klang
- The end products (rubber granules) were normally sent to KL / Klang which will then be manufactured / processed into rubber tiles
- Once in a while, the end products will also be exported to other countries
- They have a few transporters / collectors
- 2 contact details of transporters:
    1. FTH Biogreen Enterprise, 14, Kampung Alor Prun, Mukim Sidam Kiri, 09400 Padang Serai, Kedah (019-450 0619 / 04-431 1752 / 04-478 5717)
    2. See Beng (012-478 0098)

TR 1 Date: 14/4/2011

SOURCES AND END PRODUCTS

Please fill in the table below on the sources of used tyres and the end products produced by the facility surveyed.

Type of facility	Source of used / scrap tyre	Collectors' information	Other waste collected	Gate fee	End products
❑ Retreading ❑ Recycling ❑ Treatment ❑ Others, please specify: Please elaborate on the activities carried out at the facility. To produce rubber powder which will be made into pieces of rubber tiles by a factory in Klang & steel recovery	❑ Own collection ○ Tyre shop ○ Workshop ○ Depot ○ Service centre ○ Petrol station ❑ From collector ❑ From trader ❑ From importer ❑ Others, please specify: From commercial vehicle transporters If own collection, please indicate the coverage area of collection. Kedah, Seberang Perai & northern area within 100km radius	❑ No. of collector: ❑ Name: ❑ Contact No.: ❑ Address:	Nil Segregation of other waste from the used / scrap tyre? Yes / No	Amount in RM: 7.00-8.00 per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: **Capacity of facility** Amount of tyres treated per day / week / month: 300/day	Rubber granules (80 %) Steel (20 %) Are the end products for export? Yes / No

TR 2 Date: 11/4/2011

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (D)

For Tyres Recyclers and Treatment Facilities

Name of company: Rubplast Sdn. Bhd.

Contact address: Lot 1922, Jalan Kampung Dew, Simpang Halt, 34700 Taiping, Perak

Contact person / Respondent: Mr. Muniandy Chellamuthu (Andy)

Position: Boss Contact number: 03-2694 1028 / 2694 6217

GPS Reading: N° 4.8449, E° 100.6956

i) What are the types and estimated amounts of tyres received **per day / week / month**?

Tyre Size	Examples	Estimated amount (No. of tyres)
Small	Motorcycle, bicycle	
Medium	Motorcar, taxi, MPV, van	
Large	Bus, truck, lorry, trailer	
Others (if any)		200t of tyres in the factory

Note:

- Rubplast has been bought over by Mr. Muniandy for RM 3.6 million he has been in the business for over 45 years
- It has a land area of 10 acres which was fenced from the public
- He has claimed his plant to be the largest in Malaysia
- Previously, he was a lecturer in Rubber Research Institute (RRI) and has lectured on recycling and reclaiming of rubber
- He was also an ex-MARDEC staff and informed that he has experienced and completed the whole rubber business cycle from planting, processing in the factory, tapping to recycling
- Since the last 2 years, he has stopped buying scrap tyres as he still has a lot of stock in his plant. He has bought the scrap tyres when the prices were low and once enough, he will stop buying them. When the prices were high, the scrap tyres will not be bought and at last, maybe the tyres will end up illegally dumped
- Generally, he buys any raw material embedded with rubber and metal
- He informed that the Lembaga Getah Malaysia (LGM) has a full list of licensed rubber product collectors with their contact details
- The processes in the factory included recovery of steel to be sold, exporting of carbon & oil extraction from the waste product received to run the plant

TR 2 Date: 11/4/2011

- The recycled water from the plant operation was reused for the plant operation. In addition, rain water will be collected in the well and used for the plant operation
- He informed that there were only 2 reclaim factories / plants in Peninsular – Rubplast and Jeng Yuan which was owned by Taiwan and produced rubber powder which can be sold up to US$ 300/t

TR 2 Date: 11/4/2011

SOURCES AND END PRODUCTS

Please fill in the table below on the sources of used tyres and the end products produced by the facility surveyed.

Type of facility	Source of used / scrap tyre	Collectors' information	Other waste collected	Gate fee	End products
❑ Retreading ❑ Recycling ❑ Treatment ❑ Others, please specify: Recycling to produce powder and reclaiming of vulcanise rubber to produce devulcanise rubber Please elaborate on the activities carried out at the facility.	❑ Own collection ○ Tyre shop ○ Workshop ○ Depot ○ Service centre ○ Petrol station ❑ From collector ❑ From trader ❑ From importer ❑ Others, please specify: Bought from the collectors who were either approved by LGM or not, foam factory, any natural or synthetic rubber, tubes, tyres, gloves, any polymer etc.	❑ No. of collector: 15 suppliers from Alor Setar to Johor Bahru ❑ Name: ❑ Contact No.: ❑ Address:	Wood (RM 30/t), willing to accept other waste Segregation of other waste from the used / scrap tyre? Yes / No	Amount in RM: During good time, RM 150/t (tyre) & RM 5.00/t (glove) per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: **Capacity of facility** Amount of tyres treated per day / week / month:	Glove reclaim (10 %) Rubplas GRV (30 %) Tube reclaim (10 %) Tyre reclaim (30 %) Tyre dust (20 %) Are the end products for export? Yes / No The reclaim products were sold to Australia, Japan, Sri Lanka, India, Russia, China, Europe as raw materials

TR 3 Date: 21/4/2011

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (D)

For Tyres Recyclers and Treatment Facilities

Name of company: Advanced Pyrotech Sdn. Bhd. (Octagon Consolidated Berhad)

Contact address: 55, Jalan Sungai Pinang 5/7, Taman Perindustrian Pulau Indah (Fasa 2A), 42920 Klang, Selangor

Contact person / Respondent: Mr. Ramzi Ali & Mr. Ong

Position: Project Manager & Managing Director Contact number: 012-327 2798

GPS Reading: N 2.9575°, E 101.3286°

Note:

- The plant imports about 40t/day of scrap tyres from Europe daily
- Previously, the local (private) logistics will charge RM 85/t for the transportation of scrap tyres
- Currently, if the collectors wanted to charge for the transportation of scrap tyres, the plant will not receive the tyres
- Pyrolysis process:
    1. Extraction of steel wires from the whole tyres
    2. Shredding process
    3. Feeding and Pyrolysis process at control temperature
    4. Carbon Discharge and Packing process
    5. Oil storage
    6. Monitoring system
- According to the MD, the machine for shredding of tyres is very costly (2-3 million).
- He informed that shredding of tyres is the highest in energy consumption in the process.
- The plant operates 24 hour (1engineer & 3 technician/ shift) in 2 shifts.
- The end product (oil) will be sold to oil traders which will then be exported
- Carbon black as a raw material will then be sent to local factories to be processed into fuel / activated carbon before being sold
- The steel recovered will then be sold to steel mills

TR 3 Date: 21/4/2011

SOURCES AND END PRODUCTS

Please fill in the table below on the sources of used tyres and the end products produced by the facility surveyed.

Type of facility	Source of used / scrap tyre	Collectors' information	Other waste collected	Gate fee	End products
❑ Retreading ❑ Recycling ❑ Treatment ❑ Others, please specify: Pyrolysis plant Please elaborate on the activities carried out at the facility. Pyrolysis	❑ Own collection ○ Tyre shop ○ Workshop ○ Depot ○ Service centre ○ Petrol station ❑ From collector ❑ From trader ❑ From importer ❑ Others, please specify: Imported from Europe in shredded form, received scrap tyres from Michelin Malaysia & some other local collectors (daily)	❑ No. of collector: _____ ❑ Name: Michelin Malaysia and some other local collectors ❑ Contact No.: _____ _____ ❑ Address: _____ _____ _____ _____	Accept either whole or shredded tyres Segregation of other waste from the used / scrap tyre? Yes / No	Amount in RM: Free of charge per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: Previously paid RM 85/t **Capacity of facility** Amount of tyres treated per day / week / month: 120/day	Recovered oil (40 %) Carbon black (40 %) Syn gas (10 %) Steel (10 %) Are the end products for export? Yes / No

TR 4 Date: 21/4/2011

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (D)

For Tyres Recyclers and Treatment Facilities

Name of company: Green Pluslink Sdn. Bhd.

Contact address: Lot 1641, Jalan Leboh Raja Lumu, Kawasan Perindustrian PKNS, Selangor

Contact person / Respondent: Mr. Leong

Position: _____ Contact number: 03-3167 9388

GPS Reading: _____

Note:

- The area of the plant is 100ft x 80ft
- The plant has been in operation since year 2004 but recently, it was not in operation for almost a year due to upgrading
- Altogether, they have 15 staff who were working in 2 shifts
- The plant has stored / stockpiled scrap tyres constantly even though the plant was not yet in operation
- 1 tonne of scrap tyres collected can be about the weight of tyres for 143 pieces of passenger car tyres and 23 pieces of commercial vehicle tyres
- The management has planned to build another plant in Melaka
- The plant was licensed by both the Department of Environment (DOE) and Department of Occupational Safety and Health (DOSH)
- The main source of business at the moment was selling of carbon black produced. The carbon black was packed into bags of 2kg each which can be used as ink and for printing purposes. Previously, the carbon black was exported to Korea, China, Indonesia and Vietnam. The selling price of carbon black is RM 1.30/kg
- Carbon black was initially in low demand and must be mixed with other materials. As for the fuel oil, the plant used the fuel for the operation of their boiler as heavy fuel which can be sold for RM 1.10/litre

TR 4 Date: 21/4/2011

SOURCES AND END PRODUCTS

Please fill in the table below on the sources of used tyres and the end products produced by the facility surveyed.

Type of facility	Source of used / scrap tyre	Collectors' information	Other waste collected	Gate fee	End products
❑ Retreading ❑ Recycling ❑ Treatment ❑ Others, please specify: Pyrolysis plant Please elaborate on the activities carried out at the facility. Pyrolysis	❑ Own collection ○ Tyre shop ○ Workshop ○ Depot ○ Service centre ○ Petrol station ❑ From collector ❑ From trader ❑ From importer ❑ Others, please specify: If own collection, please indicate the coverage area of collection.	❑ No. of collector: ❑ Name: ❑ Contact No.: ❑ Address:	Segregation of other waste from the used / scrap tyre? Yes / No	Amount in RM: 303 per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: **Capacity of facility** Amount of tyres treated per day / week / month: 7303 tyre/month	Carbon black (50 %) Fuel oil (35 %) Steel (15 %) Are the end products for export? Yes / No

TR 5 Date: 22/4/2011

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (D)

For Tyres Recyclers and Treatment Facilities

Name of company: Environmental Protection Technology Sdn. Bhd.

Contact address: Lot PT 33638, Plot 7, Jalan Bukit Kemuning, Section 32, 40460 Shah Alam, Selangor

Contact person / Respondent: Mr. Zhuo Shou Yong / Mr. Ho

Position: Executive Director, President, CEO (Mr. Zhuo)

Contact number: 03-5121 1160 GPS Reading: _____

Note:

- A demo plant that can process 20ton/day (non-continuous; each full chamber processes approximately 4 hours)
- Paying RM 50/ton for rejected scrap tyre (truck) from tyre retreading company (maximum RM 80/ton for scrap tyre in better condition) in order to keep up the supply
- The plant will take shredded tyres, waste rubber/plastic which will be used as supplement to pyrolysis process
- The end product consists of metal wire, carbon black, oil, and carbon ball (waste gas is produced slightly and recycled in the system for combustion).

TR 5 Date: 22/4/2011

SOURCES AND END PRODUCTS

Please fill in the table below on the sources of used tyres and the end products produced by the facility surveyed.

Type of facility	Source of used / scrap tyre	Collectors' information	Other waste collected	Gate fee	End products
❑ Retreading ❑ Recycling ❑ Treatment ❑ Others, please specify: _____ _____ _____ Please elaborate on the activities carried out at the facility. Scrap tyres were manually placed on the conveyor belt. The belts lifted the tyres up and dropped them into the furnace (3 units) where heated air (300°C) was used to heat up the furnace (without catalyst & plastic / rubber shreds)	❑ Own collection ○ Tyre shop ○ Workshop ○ Depot ○ Service centre ○ Petrol station ❑ From collector ❑ From trader ❑ From importer ❑ Others, please specify: If own collection, please indicate the coverage area of collection. _____ _____ _____ _____	❑ No. of collector: _____ _____ _____ ❑ Name: _____ _____ _____ ❑ Contact No.: _____ _____ ❑ Address: _____ _____ _____ _____	Rubber, plastic, litters Segregation of other waste from the used / scrap tyre? Yes / No	Amount in RM: 501 – 801 per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: _____ _____ _____ **Capacity of facility** Amount of tyres treated per day / week / month: 200/day	Metal stray (12 %) Oil (40 %) Waste gas (4 %) Carbon ball (9 %) Black carbon (35 %) Are the end products for export? Yes / No

TR 6 Date: 25/4/2011

Ministry of Housing and Local Government
Department of National Solid Waste Management

A Study on Scrap Tyres Management for Peninsular Malaysia

Questionnaire Form (D)

For Tyres Recyclers and Treatment Facilities

Name of company: Jeng Yuan Reclaimed Rubber Sdn. Bhd.

Contact address: Lot 3, Lingkaran Sultan Hishamuddin, Kawasan 20, PKNS Industrial Estate, Selat Klang Utara, 42000 Port Klang, Selangor

Contact person / Respondent: Mr. Lee Yin Sun & Pn. Rasimah Aziz

Position: General Manager & Assistant Manager Contact number: 03-3176 2602

GPS Reading: _____

- What are the types and estimated amounts of tyres received **per day / week / month**?

Tyre Size	Examples	Estimated amount (No. of tyres)
Small	Motorcycle, bicycle	
Medium	Motorcar, taxi, MPV, van	
Large	Bus, truck, lorry, trailer	
Others (if any)		

Note:

- JYRR does not collect scrap tyres. They receive the raw materials as shredded tyres, rubber crumb and powder usually as byproducts or unwanted materials from tyre retreading company.
- In addition, JYRR does not possess infrastructure with the capabilities to treat, e.g. shredding in their facility and rely on the raw materials which are wastes from the retreading company or directly from tyre recyclers who can provide the raw materials in shredded form or powder form.
- According to General Manager, the raw materials however must come specifically from the truck tyres. The tyre of passenger car and other smaller types of tyres are not favorable as their production raw materials.
- The capacity of facility is 10,000 tons/year. The product is usually sold to mainly Southeast Asian countries for use as raw materials in manufacturing tyres, rubber sole, automotive rubber products, inner tube, rubber sheeting and conveyor belt.
- The facility has a wastewater treatment plant.

SOURCES AND END PRODUCTS

Please fill in the table below on the sources of used tyres and the end products produced by the facility surveyed.

Type of facility	Source of used / scrap tyre	Collectors' information	Other waste collected	Gate fee	End products
❑ Retreading ❑ Recycling ❑ Treatment ❑ Others, please specify: _____ _____ _____ Please elaborate on the activities carried out at the facility. _____ _____ _____ _____ _____	❑ Own collection ○ Tyre shop ○ Workshop ○ Depot ○ Service centre ○ Petrol station ❑ From collector ❑ From trader ❑ From importer ❑ Others, please specify: _____ _____ _____ If own collection, please indicate the coverage area of collection. _____ _____ _____ _____	❑ No. of collector: Not Disclosed _____ ❑ Name: _____ _____ _____ ❑ Contact No.: _____ _____ ❑ Address: _____ _____ _____ _____ _____	_____ _____ _____ Segregation of other waste from the used / scrap tyre? Yes / No	Amount in RM: _____ _____ _____ per: ❑ Trip ❑ Size of tyres ❑ Number of tyres ❑ Weight of tyres Others, please specify: _____ _____ _____ **Capacity of facility** Amount of tyres treated per day / week / month: _____ _____ _____	_____ (%) _____ (%) _____ (%) _____ (%) _____ (%) Are the end products for export? Yes / No

Date: 15/4/2011

List of scrap tyre treatment facilities in Peninsular Malaysia

No.	Name	Remarks
TR 1	G-Cycle	Interviewed
TR 2	Rubplast Sdn. Bhd.	Interviewed
TR 3	Advanced Pyrotech Sdn. Bhd.	Interviewed
TR 4	Green Pluslink Sdn. Bhd.	Interviewed
TR 5	Environmental Protection Technology Sdn. Bhd.	Interviewed
TR 6	Jeng Yuan Reclaimed Rubber Sdn. Bhd.	Interviewed
TR 7	SPM Holdings Sdn. Bhd.	Not interviewed (do not recycle scrap tyres, only recycle metal / steel)
TR 8	Pollution Engineerings (M) Sdn. Bhd.	Not interviewed (do not recycle scrap tyres)
TR 9	Hin Getah (M) Sdn. Bhd.	Not interviewed (no longer uses scrap tyres)
TR 10	Green World Recycling Sdn. Bhd.	Not interviewed (no longer uses scrap tyres)
TR 11	E-Waste Management (M) Sdn. Bhd.	Not interviewed (no longer uses scrap tyres)
TR 12	Sri Cycle Sdn. Bhd.	Not interviewed (no longer in operation)
TR 13	Yong Fong Rubber Industries Sdn. Bhd.	Not interviewed (do not recycle scrap tyres, used rubber powder from supplier to produce reclaimed rubber products)

APPENDIX L
Summary from the Survey Conducted

APPENDIX L: SUMMARY FROM THE SURVEY CONDUCTED

Summary of survey findings conducted in Northern Peninsular Malaysia

1. Date: 11 April 2011

Location: Tanjong Malim, Slim River, Taiping, Simpang – Perak

Results from survey:

No	Description	No. of survey
1	Tyre shop / workshop	7
2	Tyre retreading shop	2
3	Motorcycle workshop	1
4	Reclaim tyre (Rubplast)	1
5	Customer	9
Total		**20**

Total no. of workshops / tyre shops not interviewed = **3 samples**

- Pusat Tayar Meng Fatt
- Pusat Tayar & Servis Kereta Ideal
- Pusat Servis Tayar Hoe Hup

Rubplast Sdn. Bhd.

Rubplast is a pioneer reclaim manufacturer in Malaysia. Currently, the plant houses about 200 tonnes of tyres. The plant collects rubber waste and produced a variety of end products from the reclaim processes such as Rubplas GRV, tyre reclaim, tyre dust, glove reclaim and tube reclaim. Besides producing reclaim, the environmental-friendly plant also recovers steel to be sold and used the oil extracted from burning the rubber waste as a fuel to run the plant.




2. Date: 12 April 2011

Location: Kampar, Ipoh, Nibong Tebal, Taiping – Perak & Pulau Pinang

Results from survey:

No	Description	No. of survey
1	Tyre shop / workshop	6
2	Tyre retreading shop	2
3	Tyre Depot	1
4	Landfill (Sungai Siput Selatan)	1
5	Customer	5
Total		**15**

Total no. of workshops / tyre shops not interviewed = **2 samples**

- 99 Car Link Sdn. Bhd.
- Pusat Servis Tayar & Bateri Wing Tick

Findings & observations:

(i) Most of the workshops were not yet open early in the morning. It was only after 9.00am to 10.00am that most of the workshops were seen opened.

(ii) Most of the tyre workshops do not know who the collectors of scrap tyres were and where the tyres were sent to.

(iii) One of the respondents claimed that the scrap tyres were sent to Cameron Highlands to be used in the prevention of landslides.

(iv) One of the respondents has also sent the scrap tyres to the Pulau Burong landfill when the tyres have accumulated and the collectors did not come to collect them.

Majlis Daerah Kampar (MDK)

MDK manages the Sungai Siput Selatan landfill. Similar to the above, the landfill did not specifically receive tyre waste and there was no segregation of scrap tyres if collected by the domestic waste trucks.

3. Date: 13 April 2011

Location: Pulau Pinang & Seberang Perai

Results from survey:

No	Description	No. of survey
1	Tyre shop / workshop	13
2	Collector	1
3	Transfer station (Batu Maung)	1
4	Customer	8
Total		**23**

Total no. of workshops / tyre shops not interviewed = **2 samples**

(i) Island Tyre Sdn. Bhd.
(ii) Michelin

Findings & observations:

During one of our surveys at a workshop, a person was noticed collecting commercial vehicle tyres. The collector was interviewed and he informed that he collects scrap tyres of commercial vehicles around Seberang Perai. The tyres collected will then be sent to a factory to be retreaded. Upon being retreaded, the tyres will then be sold to the workshop.

It was found out that there were no tyre shops / workshops in Batu Feringhi and Tanjung Bungah area.

Majlis Perbandaran Pulau Pinang (MPPP)

MPPP manages the Batu Maung Transfer Station which is located in Penang island. The transfer station did not specifically receive tyre waste unless sometimes when a few tyres which were collected during the normal domestic waste collection.

4. Date: 14 April 2011

Location: Sungai Petani – Kedah

Results from survey:

No	Description	No. of survey
1	Tyre shop / workshop	14
2	Motorcycle workshop	1
3	Collector	1
4	Recycler (G-Cycle)	1
5	Customer	11
Total		**28**

Total no. of workshops / tyre shops not interviewed = **0 sample**

Findings & observations:

There were no major findings and observations. From our surveys with the motorcycle workshops, it can be concluded that 90% of the scrap tyres will be disposed of into the dustbins and collected by the local council as domestic waste.

G-Cycle

G-Cycle was founded in 1971 as a small retailer of tyres, wheels, batteries and wheel alignment servicing in Kedah. In 2005, G-Cycle entered the tyre recycling business. Their plant has an area about 25,000ft^2. The plant receives and treats about 200 large scrap tyres per day from all around Kedah and Seberang Perai and other places in the northern part which were within 100km radius from their plant. G-Cycle produces rubber powder and recovers steel from the tyres.






5. Date: 15 April 2011

Location: Kangar – Perlis & Alor Setar - Kedah

Results from survey:

No	Description	No. of survey
1	Tyre shop / workshop	10
2	Motorcycle workshop	3
3	Landfill (Padang Siding)	1
4	Customer	8
Total		**22**

Total no. of workshops / tyre shops not interviewed = **0 sample**

Findings & observations:

As observed during the surveys on 12th April, 6 tyre shops / workshops in Alor Setar, Kedah were not yet opened when the survey was carried out.

The Perodua Service Centre in Perlis was surveyed and it was found out that no scrap tyres were generated in the centre as the centre only services the vehicles and did not provide the service of changing tyres for the customers.

Majlis Perbandaran Kangar (MPK)

MPK manages the Padang Siding landfill which is the only landfill in Perlis. It is an open dump and receives about 180 tonnes of waste per day. The landfill did not specifically receive tyre waste but whenever tyres were collected during the domestic waste collection, they will not be segregated but will be disposed of at the landfill.

Summary of survey from Northern Peninsular Malaysia

No.	Description	Perlis	Kedah	Pulau Pinang	Perak
1	Tyre shop / workshop	8	16	16	10
2	Motorcycle workshop	2	2	0	1
3	Depot	0	0	0	1
4	Collector	0	1	1	0
5	Retreader	0	0	0	4
6	Customer	5	14	8	14
7	Landfill / transfer station	1	0	1	1
8	Treatment	0	1	0	1
9	Tyre shop / workshop not interviewed	0	0	3	4
Total sample		**16**	**34**	**29**	**36**

Total samples collected = **108 samples** interviewed, **7 samples** rejected

Summary of survey findings conducted in Selangor, Peninsular Malaysia

Date: 8 April and 11 April 2011

Peninsular Malaysia- Central (Selangor, Wilayah Persekutuan KL)

Observation/Findings:

Shah Alam/Kelana Jaya-

(i) It was observed that most tire/workshop which covered under the survey in this area have been visited by one or more groups of collectors/traders.

(ii) Only few of the respondents informed that they have contacts of collectors who will come to remove the scrap tires that are piling up in the property upon request.

(iii) None of the respondents informed that they are charged for the pick-up request.

(iv) Most respondents do not care how much the scrap tires can be sold for, and would appreciate anyone to remove the scrap tire piles from the properties the sooner the better. Though they will not mind the collectors/traders paying them for the scrap tires in contrary to when they had to pay for removal of scrap tires many years ago.

(v) One particular tire/workshop only serves their membership customers who own sport cars and luxurious vehicles as depicted by the staff. This respondent informed that most scrap tires left behind from their customers are with tire warranty and thus will be delivered to the tire manufacturer for claim. Only a very small portion of used tires which were considered worn and expired may be let collected by those going around the surrounding area in search of scrap tires.

Summary of survey from Selangor, Peninsular Malaysia

No.	Description	Selangor	Kuala Lumpur
1	Tyre shop / workshop	29	11
2	Collector	1	0
3	Customer	21	0
4	Tyre shop / workshop not interviewed	14	1
Total sample		**63**	**12**

Total samples collected = **62 samples** interviewed, **15 samples** rejected

Summary of survey findings conducted in Southern Peninsular Malaysia

Date: 12-15 April 2011

Observation/Findings:

General-

(i) It was observed that ALL tire/workshop which covered under the survey have been visited by one or more groups of collectors/traders.

(ii) All respondents of tire shop/workshop do not know where and how the scrap tires are disposed.

(iii) Most respondents are rather keen on collectors offering higher price on the scrap tires, than to know how the scrap tires will be taken care of.

(iv) While respondents are aware that officers from Department of Health may turn up to investigate the tire piles subjected to mosquitoes breeding spot, most will still keep the tires for collector/trader who offers better price to get the scrap tires.

(v) Some have the intention to keep tires only to those collectors they acquainted, however, these group of respondents also tend to steer clear from releasing the contact information as well as providing basic information for our survey in fear of causing trouble to the collectors they associated with regardless of our intention on the study.

(vi) Since there is more than one group of traders/collectors, tire/workshop located in urban area tends to be visited every day to three days by collectors. Some tire/workshops in rural area may have less frequent visit, about once a month or every two months.

Melaka State-

(i) Majority of respondents in Melaka informed that they are paid by the collectors/traders; only a few responded that the tires may have been collected free of charge (neither they received payment nor paid to get rid)

(ii) Many do not know what the scrap tires will be used for. Few mentioned of there are local factories collecting the scrap tires for reprocess but could not confirm the whereabouts of these facilities.

(iii) All respondents, however, informed that the collectors/traders are mainly from Johor (i.e. Muar). None knows the exact destination the tires will be sent to.

(iv) These collectors/traders, usually offered RM 0.30~RM 0.50 per tire (car) and RM3.00 per tire (truck) at present.

Johor State-

(i) All cooperative respondents informed that the collectors/traders paid for the scrap tires they piled up.

(ii) Most of the respondents knew that there are factories/facilities that collect or recycle the scrap tires but the locations are either unknown to them or they are unwilling to disclose.

(iii) Many tire/workshop keep scrap tires within their properties inside the building after hours, except few whose space are limited for keeping the storage of scrap tires. The latter usually leave the tires out front, and may keep eyes on the scrap tires being picked up by scavengers during the night.

(iv) Respondents in this state are more prompted to sell the scrap tires than to simply let collectors to pick up for free.

(v) According to a respondent in rural area, their customers (only Malay) tend to reclaim the tires after replacement. Most of them are using the scrap tires for landscaping purposes. This trend however is not observed in urban area.

(vi) One particular respondent informed that he used to operate one of those facilities where liquid substances were extracted by compressing the scrap tires. He also stored excessive scrap tires for further transport. The facility/warehouse was forced to be shut down due to high operation cost and transportation cost that eventually compromised the profit. He does not have contact or address of any still operating facility but heard that there are in Kluang, and Johor Bahru(the interview was interrupted by the arrival of MPJBT officers, thus the detail of the process involved in his past facility was not acquired).

(vii) A collector informed that there are other groups of collectors like his, all are individuals that make living by collecting scrap tires and sell to factory. He does not know of any company that is out collecting the scrap tires. He sent the collected tires to factories of three locations depending on his last collection sites. He identified three factories in Muar, Kulai/Senai, Kluang but did not disclose the address or he does not know but the direction.

Negeri Sembilan State-

(i) Some of the respondent in rural area will bring the tires back for landscaping purpose after replacement.

(ii) Some of the lorries driver will bring the tyre to the workshop to retreat then reuse back the retreaded tyre

(iii) Most of the workshops informed that the collectors/traders collected the tyre free of charge

Voices/Concerns-

(i) Many especially those are unhappy with government expressed skepticism on how the study may benefit them. In fact, the current situation in which they have no worry that the tires will be left uncollected unlike the past when they needed to pay for collectors to clean up the piles and they also see the current ongoing scheme a feasible income from selling the “wastes” left behind by most customers.

(ii) Some critical respondents would question how the government may implement the scrap tires management policy with the outcome of this study as well as the objective of the study.

(iii) A few respondents are wondering why the rubber tubes within tire are not surveyed in this study as they are usually not collected by dump trucks and ended up together with scrap tires, although they are easier to be disposed with other solid waste in the dumpster (these tubes were used to be collected by certain collectors but were no longer an interest to collectors/traders today).

Summary of survey from Southern Peninsular Malaysia

No.	Description	Melaka	Johor	Negeri Sembilan
1	Tyre shop / workshop	11	16	5
2	Motorcycle workshop	0	0	1
3	Retreader	0	0	1
4	Customer	2	1	5
5	Collector	0	1	0
6	Tyre shop / workshop not interviewed	2	3	0
Total sample		**15**	**21**	**12**

Total samples collected = **43 samples** interviewed, **5 samples** rejected

Summary of survey findings conducted in Eastern Peninsular Malaysia

1. Date: 11 April 2011

Location: Kota Bharu, Kelantan

Results from survey:

No	Description	No. of survey
1	Tyre shop / workshop	12
2	Tyre retreading shop	1
3	Depot	1
4	Customer	5
Total		**19**

Jabatan Perkhidmatan Perbandaran & Kesihatan, Kota Bharu

(i) Interview Mr. Mat Seman (Head Department) and Mr. Mohd. Dazuki (Health Officer) for understanding on the collection of scrap tyre in landfill.

(ii) They informed that there was no segregation of tyres in the landfill. They are mixed with household waste.

(iii) They charged RM20 for less than 5T and RM40 for more than 5T lorry load as tipping fees.

(iv) High demand from Fishery Department for fish farming few years ago.

Syarikat Seng Soon Hin Sdn Bhd, Kota Bharu (Retreader)

(i) Interview Mr. Lee Kok Peng (Factory Manager) for understanding on retreading of commercial tyres.

(ii) He informed that scrap tyres were collected for the usage in road construction by JKR.

Findings:

(i) Unlike before where they had problems disposing the scrap tyres, all scrap tyres are being collected nowadays by collectors FOC and unscheduled (but generally daily or few times a week).

(ii) They just leave the scrap tyres outside of the shops and the next day (or few days) later, they are collected.

(iii) Most informed that the scrap tyres are sent outside of Kelantan and Terengganu but they are not exactly sure where they are sent to. Some “heard” that they are sent to Perak, KL or Johor for recycling – to make into rubber powder, oil and recover steel.

Observation:

A few scrap tyres were seen in the MPKB waste bin.
Date: 12 & 13 April 2011

Location: Terenggannu

Results from survey:

No	Description	No. of survey
1	Tyre shop / workshop	19
2	Depot	1
3	Customer	11
Total		**31**

Jabatan Kerja Raya, Terengganu

(i) Interview Mr. Mat Noor (JKR Depot Officer)

(ii) He informed us that JKR vehicles are sent to the tyre shops for repair.

(iii) Eventhough they have garage in the depot and will eventually leave the scrap tyres in the tyre shops. The 2 tyre shops are Pusat Servis Tayar Ramaco and Hin Long Hang Sdn Bhd.

Sungai Ikan Landfill, Kuala Terengganu

(i) Interview the landfill gate keeper for understanding on the collection of scrap tyres in landfill.

(ii) He informed that the landfill only receive waste from the municipal waste trucks. Besides, he added that only few tyres (motorcycle scrap tyres) will send to the landfill together with other domestic waste.

Findings:

(i) We were informed that scrap tyres are used in palm oil estate. The scrap tyre is used to protect the palm oil seedling from wild boars.

(ii) Villagers take scrap tyres from the tyre shops (outskirts of KT) for landscaping and burning purposes.

(iii) Majority of the tyre shop personnel informed us that their scrap tyres were collected by the same collector from Bukit Payung.

(iv) We were also informed that the scrap tyres are sent to Penang for recycling.

Date: 14 & 15 April 2011

Location: Kuantan & Pekan, Pahang

Results from survey:

No	Description	No. of survey	
		Kuantan	Pekan
1	Tyre shop / workshop	11	2
2	Collector	0	1
3	Customer	1	0
Total		**12**	**3**

Majlis Perbandaran Kuantan (MPK), Jalan Bukit Ubi

(i) Interview Mr. Abdul Halim bin Yusoff (Monitoring Unit Officer from Bahagian Perkhidmatan Perbandaran and Keselamantan.

(ii) According to him, MPK's vehicles (MPV, lorries and trucks) are sent to Yamotor Tyre Service Sdn. Bhd.

(iii) He then lead us to Jabor Jerangau Landfill.

Jabor Jerangau Landfill, Pahang

(i) The landfill is operated by Terang Bersih Sdn. Bhd.

(ii) Interviewed Mr. Hj. Mohd. Fadzli bin Darus (Landfill Engineer) for understanding on the collection of scrap tyres in landfill.

(iii) According to him, approximately 8 hectares of land were proposed sanitary landfill.

(iv) According to their statistic, apart from the 500T of waste receive daily, 1% of the waste are rubber waste (mostly motorcycle scrap tyres)

(v) They informed that there is no segregation of scrap tyres with other domestic waste in the landfill as it is costly and require large area (bulky).

(vi) They charged RM18 for 1T of domestic waste as tipping fees.

(vii) Besides, he informed that most of the scrap tyres sent in were from the government agencies (e.g. Malaysia Maritime Academy) and workshops.

(viii) He informed that scrap tyres in landfill affected the performance of compactor thus affected the structure of landfill. Moreover, scrap tyres in landfill obstruct drilling process and caused the collection of rain water.

Majlis Daerah Pekan (MDP), Pahang.

(i) Interview Mdm. Cheam Siew Kan (Penolong Pegawai Kesihatan Persekitaran).

(ii) According to her, MDP's vehicles (MPV, lorries and trucks) are sent to tyre shops for repair purposes.

(iii) Previously they do store used tyre in depot but due to the current 5S Programme, all the scrap tyres were disposed.

(iv) She informed that Keledang Landfill received 30T of waste per day.

(v) She then lead us to a scrap tyre collector in Kg. Pelak (45 mins drive from Pekan)

Scrap tyre collector in Kg. Pelak.

(i) Interview collector name Pak Mee

(ii) He collect scrap tyres from Kemaman, Kemasek (Terengganu) to Kuantan with his 1T covered lorry.

(iii) He stores the scrap tyres outside his house and send them to a pyrolysis plant nearby.

(iv) Previously he supply scrap tyres to the Go-Kart track in Pekan.

(v) According to him, the pyrolysis plant uses scrap tyre to produce 'tar oil' used in road construction. He added that the plant is owned by the Chinese and operated by the Nepals.

(vi) He informed that there are another 2 pyrolysis plants operating in Perak and Johor.

Go-Kart Track in Taman tasik Sultan Abu Bakar, Pekan

(i) Large amount of scrap tyres are used in the tracks as safety barriers.

(ii) For further enquiries, call Mr. Azizul (013-900 3140)

Summary of survey from East Coast of Peninsular Malaysia

No.	Description	Kelantan	Terengganu	Pahang
1	Tyre shop / workshop	12	19	13
2	Motorcycle workshop	0	0	0
3	Retreader	1	0	0
4	Customer	5	11	1
5	Collector	0	0	1
6	Depot	1	1	0
7	Tyre shop / workshop not interviewed	0	0	0
Total sample		**19**	**31**	**15**

Total samples collected = **65 samples** interviewed, **0 samples** rejected

APPENDIX M
Summary Total No. of Samples Collected by State

APPENDIX M: SUMMARY TOTAL NO. OF SAMPLES COLLECTED BY STATE

No	Type of respondent	Total No of sample												Total
		Selangor	Kuala Lumpur	Pahang	Kelantan	Terengganu	N9	Melaka	Johor	Perak	Penang	Kedah	Perlis	
1	Tyre Workshop	29	11	13	12	19	5	11	16	10	16	16	8	166
2	Motorcycle workshop	0	0	0	0	0	1	0	0	1	0	2	2	6
3	Tyre retreading workshop	0	0	0	1	0	1	0	0	4	0	0	0	6
4	Tyre Depot	0	0	0	1	1	0	0	0	1	0	0	0	3
5	Customer	21	0	1	5	11	5	2	1	14	8	14	5	87
6	Recycling Plants	4	0	0	0	0	0	0	0	1	0	1	0	6
7	Collector	4	1	2	0	1	0	1	1	2	2	2	0	16
8	Transfer station/ Landfill	0	0	0	0	0	0	0	0	1	1	0	1	3
9	Rejected	14	1	0	0	0	0	2	3	4	3	0	0	27
	Total (without rejected)	**58**	**12**	**16**	**19**	**32**	**12**	**14**	**18**	**34**	**27**	**35**	**16**	**293**
	Total (with rejected)	**72**	**13**	**16**	**19**	**32**	**12**	**16**	**21**	**38**	**30**	**35**	**16**	**320**