Establishment of Used Lubricants and Oil Management System in Papua New Guinea

AUDIT REPORT

10th April 2017

PACIFIC POPS RELEASE REDUCTION PROJECT

Reducing Persistent Organic Pollutants (POPs) in the Pacific region through the improved management of solid and hazardous waste.

SPREP
Secretariat of the Pacific Regional Environment Programme

gef

UNEP

FAO FIAT PANIS

afd AGENCE FRANÇAISE DE DÉVELOPPEMENT

PAPUA NEW GUINEA
CONSERVATION AND ENVIRONMENT PROTECTION AUTHORITY

CONSERVATION AND ENVIRONMENT PROTECTION AUTHORITY

Papua New Guinea GEF Pacific POPs Release Reduction Project on Used Lubricants and Oil Management System

USED LUBRICANTS AND OIL AUDIT REPORT

Compiled by Bradlee FAILOU

10th April 2017

Executive Summary

The project on used lubricants and oil management is identified by the Global Environmental Facility (GEF). It encourages Papua New Guinea to participate in Pacific POPs release reduction through Improved Management of Solid and Hazardous Wastes through its executing partner, Secretariat of the Pacific Regional Environment Program (SPREP). Moreover, the project is facilitated in Papua New Guinea (PNG) through Conservation and Environment Protection Authority (CEPA).

According to National Profile of Chemical Management, 2000 and 2005, by David Mowbray, a general agreement was struck by all participating nations at the 1992 United Nations Conference on Environment and Development to achieve sound management of chemicals by the year 2000 (Mowbray & Wagi, 2000). Under these global conferences and treaties through implementation of conventions, GEF through its coordinating partners, SPREP and UNEP are executing the environment programs in the South Pacific Region. This allows Papua New Guinea to be one of the participant under GEF and UNEP in the environment and development to achieve sound management of chemicals. PNG adopted Stockholm Convention policy instrument in 2001 that had its entry into force in 2004. Stockholm Convention was implemented to address the issues into Persistent Organic Pollutants (POPs). On the update of this audit, SPREP and CEPA would like to achieve sound management of used lubricants and oil throughout their life cycle by the end of this project in PNG.

The actual project initiation commenced on **25th July 2016** and will last till the **25th July 2018**. This document provides a report on audit and/or survey and inventory conducted for used lubricants and oil at certain selected or represented sites and within regulatory organizations in PNG. The used lubricants and oil survey and inventory was executed at various categories of companies and organizations. The survey was further carried out to various levels of activities in Port Moresby and few from other centers of PNG.

Thus, the purpose of used lubricants and oil audit was to execute assessments on activities and services of organizations under sectors responsible in generating used lubricants and oil or its wastes in any regard. Used lubricants and oil (ULO) audit/ survey and inventory was executed under the requirements expected from the environmental audit protocol.

The ULO Audit/ Survey have investigated compliance of audited firms to the conventions PNG is either signatory or party to or both the signatory and party to. Waste Multilateral Environmental Agreements (MEAs) indicated PNG being both the signatory and party to the Stockholm Convention; only a party to the Basel Convention; and a signatory and party to Waigani Convention. Thus, throughout the audit participants learn to evaluate and identify status of their specific activities and operations governed and regulated through the conventions. Stockholm Convention captures the regulatory of POPs while Basel Convention accounts on the trans-boundary movement of hazardous chemicals. Waigani Convention is one way or the other subdue to Stockholm and Basel Conventions. However, it specifically provide regulations for compliance to illegal dumping or dumping of hazardous chemicals in the Pacific Island Countries.

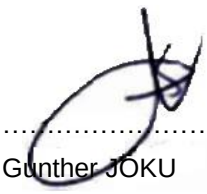
These, therefore provide substantial framework that assisted with the conduct of ULO audit/ survey that assessed and evaluated better strategies to develop a ULO management system in PNG. The audit/ survey executed complied with the Environment Act 2000, Operational Manual, and other regulatory documents. For the purpose of this report, stakeholders were prior guaranteed that reporting and/or publishing of names with statement regarded confidential to their operations would strictly be retained.

Acknowledgement

On behalf of the Government of Papua New Guinea, Conservation and Environment Protection Authority (CEPA), would like to extend sincere gratitude to the Global Environment Facility (GEF) for funding through the Secretariat of the Pacific Regional Environment Programme (SPREP). Representatives from both government and non-government organizations. The respective hierarchal heads to allow representatives from your organization to participate and assist during the survey. The following Government bodies: Bank of Papua New Guinea; Department of Works; Department of Commerce, Trade, and Industry; Internal Revenue Commission; Motor Vehicle Insurance Limited; National Statistics Office; National Airports Corporation; Investment Promotion Authority; Department of Petroleum and Energy; National Capital District Commission; and those from the following non-government or private organizations: Total Waste Management; Bige Petroleum; Puma Energy; Ok Tedi Mine Limited; Oil Search Limited; Niugini Oil Company; PNG Power Limited; Ela Motors; Helifix; Air Niugini; PNG Air; Islands Petroleum; East West Transport and others who also participated but were not mentioned here.

Individuals who supported the survey in various ways, especially to Professor David Mowbray and the 4th and 3rd Years Students, 2016, taking various courses combinations under Environmental Science and Geography, School of Natural and Physical Sciences, University of Papua New Guinea, who have took time to assist with the actual survey. Worthy of acknowledgement also to the following: Professor Frank Griffin (Hazardous and Waste Management Advisor to SPREP) for his liaison to initiate this project in PNG; Mr. Veari Kula (Manager – Infrastructure, Utilities, and Conventions) for directions and overall management to ensure accomplishment of the project components. Finally acknowledged are all officers in CEPA and individuals from various communities.

I (Gunther JOKU) as the Managing Director for Conservation and Environment Protection Authority on behalf of the Government of Papua New Guinea have recognized initiation of this project, and hereby approve this report be recognized by the Secretariat of the Pacific Regional Environment Program.



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Gunther JOKU

Managing Director – Conservation and Environment Protection Authority

Acronyms

Acronym	Name
ADG	Australian Dangerous Goods
AMC	Audit Management Committee
ALS	Australian Laboratory Services
BIP	Background Information Point
BPL	Bige Petroleum Limited
BPNG	Bank of Papua New Guinea
CAA	Civil Aviation Act
CEPA	Conservation and Environment Protection Authority
CPI	Consumer Price Index
DIY	Do-It-Yourselfers
DOW	Department of Works
DSP	Development Strategic Plan
EMP	Environmental Management Programme
ERP	Emergency Response Plan
GDP	Gross Domestic Product
GEF	Global Environmental Facility
HSM	Hazardous Substance Management
HS	Harmonize System
OHSE	Occupational Health and Safety Environment
ICCC	Independent Consumer and Competition Commission
IMDG	International Maritime Dangerous Goods
IPA	Investment Promotion Authority
LNG	Liquefied Natural Gas
MVIL	Motor Vehicle Insurance Limited
NAQIA	National Agriculture Quarantine and Inspections Authority
NCC	National Coordination Committee
NSO	National Statistics Office
OHS	Occupational Health and Safety
OIP	Operational Information Point
PNGEITI	Papua New Guinea Extractive Industry Transparency Initiative
PNG	Papua New Guinea
PNGPCL	Papua New Guinea Ports Corporation Limited
POPs	Persistent Organic Pollutants
PCB	Polychlorinated biphenyls
SPREP	Secretariat of the Pacific Regional Environment Program
SGS	Societe Generale de Surveillance
ULO	Used Lubricants and Oil
UNEP	United Nations Environment Programme
WMP	Waste Management Procedures

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1.0 INTRODUCTION

1.1 Audit Aim

The aim of used lubricants and oil audit/ survey and/or inventory together were focused to:

- Establish a baseline information for Used Lubricants and Oil in Papua New Guinea;
- Estimate rate and/or trend of used lubricants and oil generation in PNG;
- Identify the used lubricants and oil management alternatives in PNG, and
- Identify recommendations pointing to possible action plans for used lubricants and oil management in PNG.

It was carried out to provide substantial data on used lubricants and oil for development of a ULO legislation and national management system. Thus, these would allow review and update of proper used lubricants and oil management system be established in the country. This will be regulated through the office of Conservation and Environment Protection Authority.

The audit/ survey was performed to verify understanding of legislative and regulatory compliance; understand established internal policy and procedural conformance; establish current practice suit; and identify improvement opportunities in managing issues on used lubricants and oil in PNG.

1.2 Objective

Data and information from the audit through surveys and inventory was analyzed to examine:

1.2.1 – If Papua New Guinea **do not have** the capability to manage used lubricants and oil internally;

1.2.2 – If Papua New Guinea **have** the capability to manage used lubricants and oil internally;

1.3 Background

Papua New Guinea is a large island nation in the South Pacific region that is geographically diverse with various different levels of activities occurring since after its independence. There are basically three (3) levels of commerce and industrial activities regulated under the auspices of Conservation and Environment Protection Authority (CEPA) through the Environment Act 2000 and its supporting regulatory documents.

On the 18th November 2016, the National Coordination Committee (NCC) members to this project have agreed for audit questions be segregated and used lubricants and oil audit be carried out as surveys. Moreover, an inventory was developed to gather necessary information on quantity of imports and exports of any lubricants and oil and of their related products. These were assessed as categorized under range of harmonized system (HS) Codes and/or PNG Customs Tariff Items 2707.91.00 to 2710.99.00. Hence, generated used lubricants and oil, collection thereof, and exports and/or management of it was estimated afterward.

There were wide range of selected stakeholders, both large and small companies, private and government agencies consulted during the surveys and inventory. During the surveys, over fifty (50) different entities were consulted with providence of relevant representative information and data collected covering what should be expected from the whole country. Statistics on the purchasing, transportation, storage, and consumption of lubricants and oil; and generation, storage, and disposal of used lubricants and oil show a general increase in the trend over the last five (5) years.

The survey moreover was executed on categories of seven (7) broad waste generation sectors namely: domestic sector; commerce and retail trade; industrial and manufacturing; construction industry;

extractive industry; automotive and transport sector; agriculture, and food processing industry. Qualitative information and quantitative data collected were statistically analyzed using t-test: Two-Sample Assuming Unequal Variances, Linear Regression through determination coefficient (R^2), and other simple statistical applications to relate findings to the project requirements.

Data obtained through the surveys will assist CEPA maintain its propriety regulation and monitoring of all levels of activities involved in generating used lubricants and oil in PNG. Though there was no specific management system or mechanism established to address issues on ULO, CEPA together with other stakeholders and developers have managed ULO through various waste management approaches. Interestingly, most companies and stakeholders operating in PNG for more than five (5) years have several different used lubricants and oil management systems. There were at least eleven (11) different options identified for managing used lubricants and oil apart from: no options available, and/or exports. Already during the surveys, negotiations and liaison to collaborate with stakeholders to develop a national management system for used lubricants and oil was considered.

1.4 Definition of used or waste lubricants and oil

For the purpose of the audit/ survey conducted on used or waste lubricants and oil, the following definitions were identified through the Waigani and Basel Conventions. They were defined as follows:

Used Lubricants and oil (Waigani Convention) – Cleaner Pacific 2025: used oil is any semi-solid or liquid used product consisting totally or partially of petroleum-based or synthetic oil, oily residues from tanks and oil-water mixtures (Roadmap Technical Working Group, 2014). Used oil includes – but is not restricted to – used engine oils, transmission fluids, refrigeration oils, compressor oils, metal working fluids and oils, electrical insulating oil and hydraulic fluids (SPREP, Cleaner Pacific 2025, 2016).

Used Lubricants and oil (Basel Convention) – Technical Guideline on used oil re-refining or other uses of previously used oil: used oil means any semi-solid or liquid used product consisting totally or partially of mineral oil or synthesized hydrocarbons (synthetic oils), oily residues from tanks, oil-water mixtures and emulsions (Basel Convention, 1997).

Moreover, Annex I of both the Waigani and Basel Conventions list broad categories of waste streams and constituents that may be regarded as potential hazardous. Of these, used oil would fall into one or both of the following categories (SPREP, Waste Assessment Guide for the Export and Import of Used Lubricants and Used Oil, 2015):

- ✓ **Y8 Waste mineral oils unfit for their originally intended use**
- ✓ **Y9 Waste oils/water, hydrocarbons/water mixtures, emulsions**

Waste Oils (Customs Tariff Act 1990) - under Chapter 7 on Mineral Fuels, Mineral Oils and Products of their Distillation; Bituminous Substances; Mineral Waxes, Notes 2 and 3: “waste oils” means waste containing mainly petroleum oils and oils obtained from bituminous minerals, whether or not mixed with water. These include:

(a) Such oils no longer fit for use as primary products (for example, used lubricating oils, used hydraulic oils and used transformer oils);

(b) Sludge oils from the storage tanks of petroleum oils, mainly containing such oils and a high concentration of additives (for example, chemicals) used in the manufacture of the primary products; and

(c) Such oils in the form of emulsions in water or mixtures with water, such as those resulting from oil spills, storage tank washings, or from the use of cutting oils for machining operations (Papua New Guinea Customs, 2012 ed).

1.5 Used Lubricants and Oil Audit Compliance Guidelines

The audit/ survey was subjected under the Environment Act 2000; Operation Manual, and appropriate conventions that were quoted in the Environmental Audit Protocols, and Environmental Audit Check List. Prior to implementing the audit/ survey stakeholders were made aware that the survey was not intended to scrutinize their operations and/or activities. It was rather done purely to gather relevant information based on used lubricants and oil management in the country. Thus, it was explained further that information gathered would assist in developing a Used Lubricants and Oil Management System and Legislation for PNG.

1.6 Audit Scope

The areas covered during audit/ survey encompassed on:

- ✓ Used lubricants and oil generation, management, collection, storage, transportation and disposal practices;
- ✓ Environmental emergency prevention and preparedness;
- ✓ Staff awareness, participation and training on used lubricants and oil, and environmental issues;
- ✓ Air emissions and air quality;
- ✓ Public enquiry and complaints response, and
- ✓ Used lubricants and oil management system set up, suitability and performance.

In regard to the scope of the audit, there were seven (7) broad sectors identified being responsible for waste generation. Thus, used lubricants and oil management scoped to its specificity under these sectors were as follows:

1. ***Domestic Sector:*** Used lubricants and oil produced from this sector are minimum but collectively in a period of time can be high. These were mostly from individual car services or other means of generating used lubricants and oil at individual or domestic level;
2. ***Commercial and Retail Trade Sector:*** Used lubricants and oil (ULO) produced from – service stations during regular tank services, upgrade, and maintenance; and motors and workshops during car services (unleaded gasoline or petrol may contain unleaded anti-knocking compound sludge); and electricity services provider can be responsible also to produce used lubricants and oil (e.g. transmission fluids). Moreover, there were also other power generating small companies that may be involved apart from the major electricity services provider; engineering companies servicing heavy equipment machineries deal with used lubricants and oil upon services provided. Mainly, solid, liquid effluents and slurries containing range of organic and inorganic chemicals;
3. ***Industrial and Manufacturing Sector:*** this sector include manufacturers of various other items apart from consumable items such as food and beverages. Manufacturing of steel and infrastructure materials, household items, textiles, detergents, furniture and others that are of non-consumables could be classified hereunder this category.
4. ***Construction Industry Sector:*** Machineries used on civil and road works and building constructions by contractors – hence, during the transportation, storage, and disposal stages of consuming and using oils and lubricants; Department of Works heavy machineries and equipment repair and maintenance services (bituminous materials, *asphalt waste*, is the most common type);
5. ***Extractive Industry Sector:*** Mining developers and construction companies, contractors, and subcontractors generating used lubricants and oil from using wide range of heavy equipment and machineries;
6. ***Agriculture Sector:*** Heavy agricultural machineries and equipment repairs and maintenance services. This depends on the type of agriculture activity being carried out and the work loads and demands for machinery usage; and the type of organic or hydrocarbon byproducts being generated and considered recycling for fuel;
7. ***Food Processing Industry Sector:*** Mostly, used lubricants and oil are being produced from usage, repairs, services and maintenance of food processing machineries;
8. ***Automotive and Transport Sector:*** this sector include all transport equipment used in the three main modes of transportation (sea, land, and air) in PNG. Used lubricants and oil generated from transport equipment are mostly of engine and gear oils, hydraulic oils, transmission fluids, and marine lube oils.

2.0 METHODOLOGY

2.1 Audit Protocol

Prior to considering ULO Audit at represented sites or organizations in PNG, regulatory organizations and government departments were consulted. Moreover, there were several other private and business entities consulted to assist and participate during rollout of the project. This have now provided the audit with five (5) working phases:

2.1.1 PHASE 1 – SEEK DIRECTORATE INVOLVEMENT

Prior to proceeding into other processes of ULO Audit/ survey, official request letter from CEPA to various stakeholders were prepared and submitted. Hence, a minute with the audit/ survey plan was required sighted and certified by immediate hierarchies of the Environment Protection Wing specifically Veari Kula (Director Industry), and Michael Wau (Director Protection Wing). It was submitted afterward to Gunther Joku (Managing Director – CEPA) to establish understanding and provide guarantee for stakeholders to assist during rollout of the activity.

2.1.2 PHASE 2 – PRE-AUDIT

Under phase 2, there were 2 required stages:

Stage 1 – Regulatory Bodies were contacted;

- ✓ PNG Ports Corporation Limited,
- ✓ Motor Vehicle Insurance Limited (MVIL),
- ✓ National Statistics Office (NSO),
- ✓ Bank of PNG (BPNG),
- ✓ Department of Petroleum and Energy,
- ✓ Department of Transport,
- ✓ PNG Customs Services to assist in confirming, verifying and providing data or information on major distributors and suppliers of oil and lubricants in PNG based on the product type and quantity imported periodically, and
- ✓ University of Papua New Guinea (UPNG) was consulted in which a week of presentation was provided with assistance of Professor David Mowbray to Environmental Science and Geography (ESG) 4th Year Students that assisted with the survey; and

Stage 2 – initial site visits and arrangement of an introductory statement of the audit/ survey was conducted by oil management officer to:

- Explain purpose of audit to respective officers in charge;
- Assess whether background information gathered was up to date and accurate;
- Confirm thoroughness of audit scope, and
- Establish adequacy of resources for audit.

2.1.3 PHASE 3 – ON-SITE AUDIT

Phase 3 also involved a series of stages outlining the approaches required to fulfil the outcomes of the audit/ survey. This phase involved execution of ULO Audit on site to all or selected lubricants and oil major users and service providers audit representatives. There were 5 stages elaborated under this phase as follows:

Stage 1 – Based upon pre-audit visitation and introductory meetings with stakeholders, UPNG – ESG 3rd and 4th Years Students (2016) were distributed to selected sites for surveys while the oil management officer did a follow up together with inventory meetings to:

- Verify involvement of audit team members;
- Address questions or concerns of site personnel, and
- Rally staff support and assistance.

Stage 2 – Document review which the oil management officer requested for:

- Management policy
- Operational procedures
- Records (inventory, storage, monitoring, transportation, disposal approaches, training, etc…), and
- Previous audit reports if any;

This approach was done particularly to evaluate whether the records were: current, properly completed, signed and dated, consistent, and meet relevant requirements.

Stage 3 – Detailed site inspection was conducted with aid of on-site audit checklist/ survey questionnaires to look for evidence on:

- Used lubricants and oil management approach or system in place:
  - Compliance with legislative and regulatory requirements for importation of lubricating and oil products; and exportation of used lubricants and oil products;
  - Storage facilities, methods or system of lubricating and oil products, or of used lubricants and oil;
  - Inventory of lubricants and oil products, or of the used lubricants and oil generated;
  - Status of operational practice on management of used lubricants and oil, and
  - Staff participation in management implementation of used lubricants and oil.

Stage 4 – Interviewing of staff to obtain information on:

- Actual practices on collection, storage, and disposal of used lubricants and oil;
- Compliance with organizational requirements;
- Awareness of organizational requirements and expectations;
- Any form of ideas of improving quality of services being provided, and
- Comments and suggestion.

Stage 5 – Oil Management Officer did a reviewing of Audit to ensure adequacy of audit evidence at the conclusion of on-site audit through:

- Reviewing information gathered;
- Collecting additional information as required;
- Substantiate audit findings;
- Summarizing and documenting all findings and observations;
- Identifying issues requiring immediate attention/ mitigation, and
- Take note on outstanding issues requiring follow-up.

2.1.4 PHASE 4 – POST AUDIT

This phase involved oil management officer to evaluate findings and produce report with audit findings and recommendations. Moreover, this also allowed the oil management officer together with the National Coordination Committee (NCC) members to work towards evaluating and developing action plans for execution to achieve objectives and expected outcomes of other activities in this program. This phase was approached in 4 recommended stages.

Stage 1 – Collating of information and following up of outstanding concerns;

Stage 2 – Preparation of the audit report;

Stage 3 – Circulate draft audit report for editing and comments, and

Stage 4 – Correction of draft audit report, compilation, publication and submission.

Upon the completion of ULO Audit, a follow up was done to visited sites. Thus, prior to the summary or concluding sections of ULO Audit, report also included **action points** or key issues identified to develop a Used Lubricants and Oil Action Plan that will later be incorporated and developed into a ULO Management Plan.

2.1.5 PHASE 5 – ULO AUDIT FOLLOW-UP

Prior expected on the project schedule were 5 Activities dependable upon the outcome of this activity (Activity 2 – ULO Audit). Upon the endorsement of the audit report, an action plan was considerate to be incorporated with the appropriate targets and objectives. Hence, to develop used lubricants and oil management system in consultation by:

- ✓ A developed proposed used lubricants and oil stewardship system;
- ✓ Terms of References for Cost Benefit Analysis of management options for used lubricants and oil, and
- ✓ A developed proposed used lubricants and oil inventory and data entry for management plan.

2.1.6 IMPLEMENTATION OF THE ACTION PLAN

On the 18th November 2016, a National Coordination Committee was established which was comprised of ten (10) members both from the private and government sectors. The committee members were consulted during the audit/ survey and inventory assessments. Thus, after the final procedure of the audit/ survey review was done and action items were raised would further be evaluated during 2nd NCC meeting.

2.1.7 CHECKING AND MONITORING

During the audit/ survey several stakeholders requested for assistance in regards to management of used lubricants and oil that were prior considered for:

- ✓ Progress of actions on activities to be undertaken;
- ✓ Oil Management Officer liaised with relevant stakeholders' Environmental Officers and Occupational Health and Safety Officers (OHS), and NCC members for used lubricants and oil management approaches.

2.1.8 REVIEW ACTION PLAN

Review of action plan upon implementation of the action plan include elaboration on the following key points:

- ✓ Revision on the results of action plan implementation;
- ✓ Establish levels of performance improvement achieved;
- ✓ Recommend, address and determine possible need for considerations and changes on used lubricants and oil management system, and
- ✓ Request for continuous evaluation, review, and updating of the used lubricants and oil management system in PNG.

2.2 Statistical Assay

Samples analysed and data collected were statistically assessed to verify qualitative observations from the audit/ survey and quantify data obtained from the inventory. Data have undergone several models and designs to give a best output. T-test using two-Sample Assuming Unequal Variances was used to compare mean quantity of imports and exports of all oil products in PNG. Relationships of imports, exports, generation and/or collection, and disposal/ management of lubricants and oil, and their used/ waste products were determined by Linear Regression through determination coefficient (R^2). Other simple statistical methods were engaged where necessary to relate findings of the survey to verify significance of the overall responses from the audit/ survey.

2.2.1 DETERMINATION OF NET IMPORTS OF OIL PRODUCTS

Not only PNG imports oil products but also involve in exporting oil products. Thus, determination of Net Imports of oil products would assist estimation of flow of all oil products in and out of the country. Net imports was calculated as total imports minus total exports:

$$\textbf{Equation 1: } Net\ Imports = Total\ Oil\ Imports - Total\ Oil\ Exports$$

2.2.2 ESTIMATED USED LUBRICANTS AND OIL GENERATION FROM VEHICLES

Vehicles and transport equipment are built capital providing medium of transposition to nation's economy and to serve individual needs. Thus, movements of resources to do work and supplies of goods and services require transportation. However, in order to achieve sound movement of results from industrial and commercial activities, and trading of goods and services, vehicles and transport equipment require energy to do work. Thus, energy requirements provided are through oil products.

During the audit and inventory surveys, at most ten (10) years data for 38 vehicle class modes were provided by the respective motor vehicle regulatory body in the country. Information for both new and renewal vehicles registration were used. Data obtained was further segregated and filtered to represent common vehicle classes. This was purposed to estimate generation of used lubricants and oil per services by common classes of vehicles' oil storage capacity.

An average life of a vehicle is five (5) years. To cater for those vehicles that may have reached their average life expectancy, Net Vehicle Registration was determined via:

$$\textbf{Equation 2: } Net\ Vehicle\ Registration = Rerenewal\ Vehicle\ Registration - New\ Vehicle\ Registration$$

Moreover, estimation of used lubricants and oil was achieved through multiplying Net Vehicle Registration (NVR) with known identified expected used lubricants and oil generating capacity by vehicle classes and by service schedules per year.

$$\textbf{Equation 3: } Est.ULO\ Generation = (Service\ Frequency/\ year \times ULO\ Collection\ Capacity/\ Service) \times NVR$$

3.0 RESULTS AND DISCUSSION

Industrial and commercial activities occurring in the country is regulated by the Conservation and Environment Protection Authority (CEPA) under the Environment Act 2000. There are three levels of activities categorized under the Act. A person involved in Level 1 Activity upon critical assessments and evaluations does not require permit unless the Director has served a notice under Section 45 of the Act. However, Level 1 Activities are required to observe and abide by the appropriate environmental guidelines and codes of practices in accordance with requirements under the Act, Regulations, and Policies that were established under the Environment Act 2000. Level 2 Activity under the Environment (Prescribe Activities) Regulations 2002 are required to have an Environment Permit prior to commencement of work. Level 2 Activity is further categorized into Level 2 Category A and Level 2 Activity Category B. Level 2 Activity Category A are those activities exempted from notification and referral process because they do not pose a high risk of causing environmental harm. Level 2 Activity Category B require those activities to go through notification and referral requirements under the permit assessment process due to their high level of risk of causing environmental harm.

Level 3 activities are those activities that are of national importance and involve substantial capital investment. This category also include activities that pose a high risk of serious and material environmental harm due to the nature of the industrial and manufacturing process or the sensitivity of the environment they will be located in (Department of Environment and Conservation, January 2004). For a layman to differentiate between Level 2 and 3 activities based on general scope would be if any activities costing less than K50 Million are Level 2 Activity while those equal to or more are Level 3 Activity.

There were more than fifty (50) stakeholders requested to assist with the audit/ survey and inventory of which not all responses were positive. However, there was a fair representation of information and data collected from at least 50% of the total requested participants sufficient to portray demand, consumption, generation, and management of lubricating oil products and their wastes thereof.

This section describe overall assessment responses from participants on environment policy, environmental management systems, legal standards, and environment performance. Prior to understanding generation of used lubricants and oil in the country, estimated net import was evaluated based on total imports and exports of oil products in and out of the country. This aided overall observation on estimated generation of used lubricants and oil from information and data collected and segregated under the seven broad waste generating sectors. Interestingly, it was identified that there were several disposal and/or used lubricants and oil (ULO) management options practiced in the country apart from export or no disposal options. This was statistically assessed to verify significance of ULO management options considered on export to that managed internally through various other means.

Moreover, responses on environmental requirements from the survey were summarize from various small survey reports. This was purposed to evaluate and substantiate further recommendations, proposed action items, and the proposed ULO Stewardship System. General input and responses from stakeholders who participated concluded that there were yet more effort and participation from all sectors required to gather information from all over the country.

3.1 Determination of Net Lubricants and Oil Imports

Five years data in Table 1 for both imports and exports of all oil products based on HS Codes and/or PNG Customs Tariff Item 2707.91.00 to 2710.99.00 was evaluated and used to calculate net imports. It estimated the net inflow of all oil into Papua New Guinea. Figure 1 showed a general increase in the trend of net imports of oil at 1.45% per year with a significant difference (Table 2) on imports and exports of oil in and out of the country in 2015. The 1.45% rate of net inflow was estimated with increased quantity of 12,899,790.86 L/ year. However, there was a sharp decline by 29.40% on net imports of oil from 2014 to 2015 (Figure 1).

According to BPNG Quarterly Economic Bulletin, March 2016 Issue, there was decline in industrial production and retail sales in 2015. The fall reflected a sluggish growth in wages combined with the slow recovery of the global economy (Bank of Papua New Guinea T. , 2016). El Nino drought in 2015 was another significant factor for the decline in industrial production. According to BPNG bulletin, 2016 Issue, there was a continuous closure of Ok Tedi mine for most of the March quarter in 2015. There were also decline in productivity in other major sector users of lubricants and oil during the period. This was statistically verified via comparison of two means from total imports to total exports. Thus, to prove if the hypothesis that total imports and exports of oil in and out of the country do not vary over the five years period.

Table 1. Oil imports and exports summarized data.

LUBRICANTS AND OIL NET IMPORTS (5 YRS)						
YEAR	**TOTAL IMPORTS**	**% Total Imports**	**TOTAL EXPORTS**	**% Total Exports**	**TOTAL NET IMPORTS**	**% Total Net Imports**
2011	118,724,784.21	13.04	463,780.00	2.29	118,261,004.21	13.28
2012	144,578,753.43	15.88	573,708.10	2.83	144,005,045.33	16.18
2013	201,675,753.87	22.15	673,553.00	3.33	201,002,200.87	22.58
2014	355,084,195.40	39.00	10,754,725.62	53.12	344,329,469.78	38.68
2015	90,376,674.31	9.93	7,781,111.70	38.43	82,595,562.61	9.28
Sum	**910,440,161.22**	**100.00**	**20,246,878.42**	**100.00**	**890,193,282.80**	**100.00**
Mean	**182,088,032.24**	**20.00**	**4,049,375.68**	**20.00**	**178,038,656.56**	**33.33**

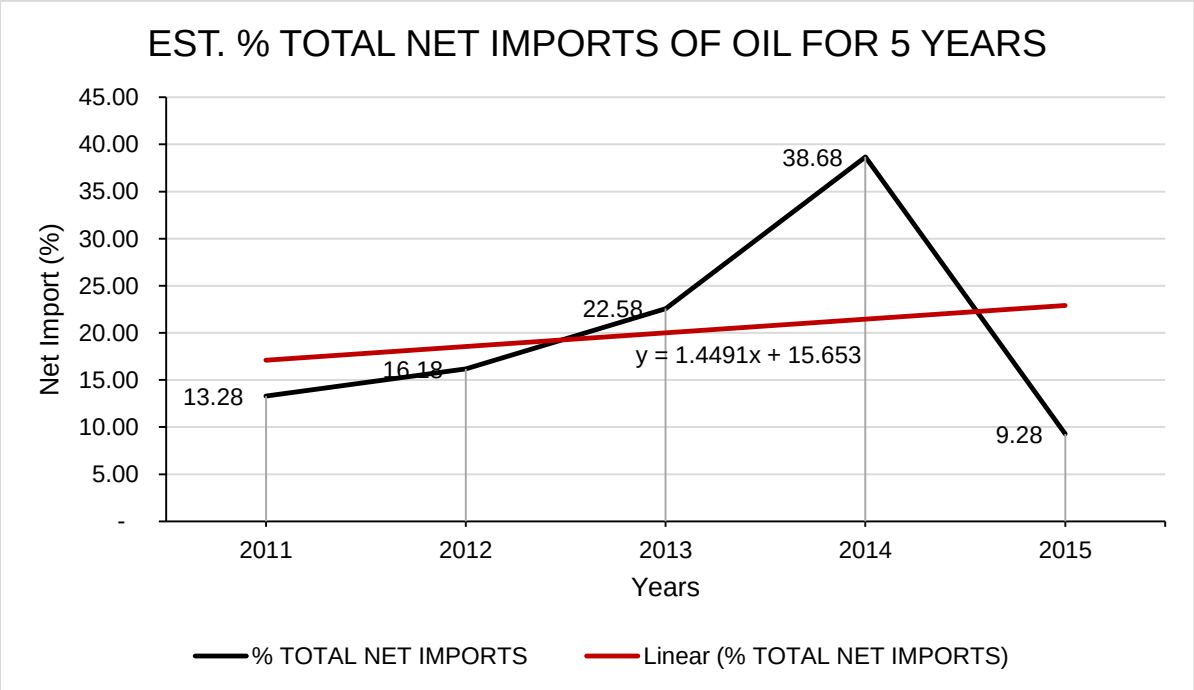


Figure 1. Estimated Net Imports of all oil from years 2011 to 2015.

Table 2. t-Test: Two-Sample Assuming Unequal Variances for oil imports and exports.

t-Test: Two-Sample Assuming Unequal Variances

	Total Imports	*Total Exports*
Mean	182088032.20	4049375.68
Variance	1.10×10^{16}	2.38×10^{13}
Observations	5	5
Hypothesized Mean Difference	1780386567	
df	4	
t Stat	**-34.07**	
P(T<=t) one-tail	2.21×10^{-6}	
t Critical one-tail	2.13	
P(T<=t) two-tail	**4.43×10^{-6}**	
t Critical two-tail	**2.78**	

- ✓ Null Hypothesis (H_0): There was no significant difference in the total imports of lubricants and oil products compared to that exported;
- ✓ Alternative Hypothesis (H_1): There was significant difference in the total imports of lubricants and oil products compared to that exported.

We reject H_0 if t Stat value is less than t Critical two-tail value when df = 4 or when P(T<=t) two-tail is less than P = 0.05 at 5% significant level. From the assessment on Lubricants and Oil Products import to export: t Stat = -34.07 < 2.78 (t Critical two-tail) while P(T<=t) two tail = 4.43×10^{-6} < 0.05 at 5% significant level.

It can be concluded that since t Stat = -34.07 < 2.78 (t Critical two-tail) and/or P(T <=t) two-tail = 4.43×10^{-6} < 0.05 we reject null hypothesis. There was statistical evidence to prove that there was significant difference in the total oil imports compared to that exported over the five years period. Thus, we reject the null hypothesis and accept the alternative hypothesis.

Variation on net imports was substantiated by BPNG bulletin issue that by sectors, sales declined in the manufacturing, retail, wholesale, and mineral sectors in the 2015 final quarter. On the other hand, there were increases in other sectors inclusively of agriculture/ fisheries/ forestry, finance/ business and other services, and transportation and construction. From the overall scenario, most of the major users of lubricants and oil products from the report show decline in productivity from 2014 to 2015.

The assessment over net import of all oil into the country show general increase over the past five years. However, these were dependent upon various factors: global economy, productivity input on major economic driving sectors in the country, and climate conditions. In addition, Section 3.2 assessed trend on generation and collection of used lubricants and oil within the same year period. Determination coefficient (R^2) was engaged to assess reliability of generated used lubricants and oil from the net import of all oil in the country.

3.2 Estimation of Used Lubricants and Oil Generation and/or Collection

The audit/ survey also have targeted findings into the seven identified broad waste generating sectors mentioned earlier in Section 1.6, Audit Scope. Data summarized in Table 3 on net import and used lubricants and oil generated and/or collected were provided by two different stakeholders: National Statistics Office and a national recognized waste management company from private sector respectively.

Observation of ULO generation and/or collection to net import show similar pattern of variations from 2012 to 2015 (Figure 2). This reflected norm that quantity of oil required by an engine capacity should produce almost similar quantity of used lubricants and oil afterward. Collectively, this have contributed to the overall observed pattern in the flux over the years thereof. In addition, overall results with assistance from responded participants on inventory have provided a fair representation of information for the year 2014. This highlighted generated quantity on seven broad waste generating sectors (Figure 5). Thus, it further explained major sector users of lubricants and oil in PNG and stance on the economic output.

Table 3. Summarized data for Net Oil Imports and estimated ULO generated.

YEAR	TOTAL NET IMPORTS	% TOTAL NET IMPORTS	EST. TOTAL ULO GENERATED/ COLLECTED	% EST. TOTAL ULO GENERATED/ COLLECTED
2012	144,005,045.33	18.66	2,075,767.00	10.81
2013	201,002,200.87	26.04	2,418,541.00	12.59
2014	344,329,469.78	44.61	10,212,701.00	53.18
2015	82,595,562.61	10.70	4,498,612.00	23.42
GRAND TOTAL	**771,932,278.59**	**100.00**	**19,205,621.00**	**100.00**
Mean	**192,983,069.65**	**25.00**	**4,801,405.25**	**25.00**
Mean Difference			**188,181,664.40**	**0.00**

Used lubricants and oil assessed under seven broad waste generating sector were in the form of: industry and factory plant oil; industry engine, electrical, and other oils; marine lubes; transmission and gear oils; and vehicle and transport engine oils (Figure 4). From discussion with engineers, mechanics, and other experts on used lubricants and oil generation, it was possible that almost same amount of lubricating oils used would be generated and/or collected from machinery items per services. This therefore, concluded that the mean difference of 188,181,664.40 L suggested an estimated unrecorded or unnoted data provided on lubricating oils generated and/or collected over the four years period. Apparently, record and data entries on used lubricants and oil was not considered by most stakeholders from survey interviews (further discussions in Section 3.4, Responses on Environmental Requirements).

Quantity of used lubricants and oil generated and/or collected generally should have a complementary relationship to quantity of net import of oil. However, this cannot be analyzed via regression analysis since both net import and ULO generation/collection were dependent variables upon various input to economic productivity factors over changing years. Regardless of this factor, observation on linear regression from determination coefficient (R^2 = 0.59), Figure 3, assuming ULO generation and/or collection as dependent variable on net import as independent variable show closeness of observations on these variables.

Thus, graph in Figure 3 does not prove significance on relationship of the two variables with progressing years, rather, it appraised uniformity in annual changes between net import and ULO generation and collection portrayed in Figure 2. This confirmed that whatever the amount of oil considered for consumption would also be generated afterward.

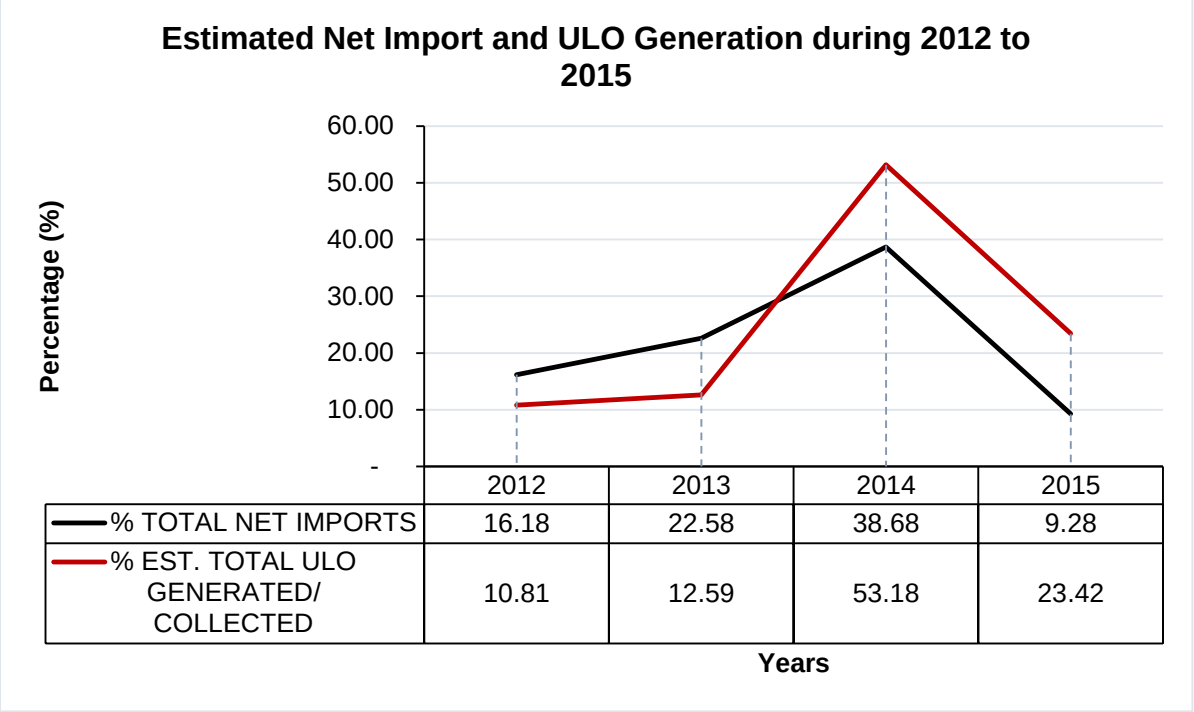


Figure 2. Graph by percentage of Net Oil Imports and ULO generated.

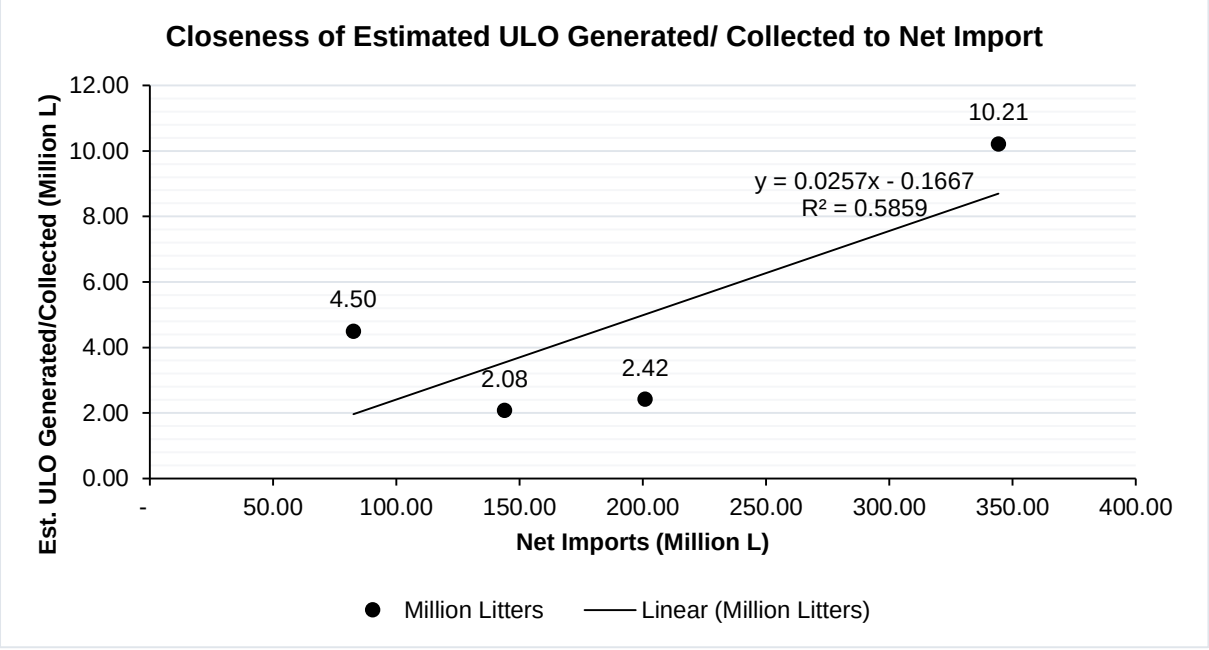


Figure 3. Postulate of model for estimated ULO generated/ collected to net oil imports.

Rate of estimated ULO generation and/or collection was suggested increasing at 0.0257 million liters or 25,700 L per amount of net import of oils per year. There was incomplete and/or insufficient data supplemented for ULO generation and/or collection for years 2011, 2012, 2013, and 2015 for the categorized waste generating sectors for further assessment. However, information and data on different used lubricants and oil by specific companies and their operations only provided data for 2014 that assisted with supplement evaluation below. Hence, Figure 5 provided a scene by percentage on quantity of ULO produced under the seven waste generating sectors in 2014.

3.2.1 GENERATION AND COLLECTION OF USED LUBRICANTS AND OIL BY SECTORS

Table 4. Quantity of ULO generated and collected by waste generating sectors.

2014 ULO Generation/ Collection by Sectors

Sector	ULO Quantity (L)	ULO Generated by %
Commerce & Retail Trade	2,396,000.00	30.14
Industrial & Manufacturing	380,000.00	4.78
Construction	834,000.00	10.49
Extractive	1,913,000.00	24.07
Agriculture	110,000.00	1.38
Food Processing	732,000.00	9.21
Automotive & Transport	1,584,000.00	19.93
Sum	**7,949,000.00**	**100.00**
Mean	**1,135,571.43**	**14.29**

Though few individuals were interviewed from the domestic sector, the survey did not eventuate further as most time was spent on major waste generating sectors. Therefore, generation of ULO under Domestic Sector cannot be supplemented in this report. Nevertheless, summarized data from Table 4 provided a decreasing order of ULO generated by sectors as: Commerce and Retail Trade > Extractive > Automotive and Transport > Constructive > Food Processing > Industrial and Manufacturing > Agriculture (30.14% > 24.07% > 19.93% > 10.49% > 9.21% > 4.78% > 1.38%).

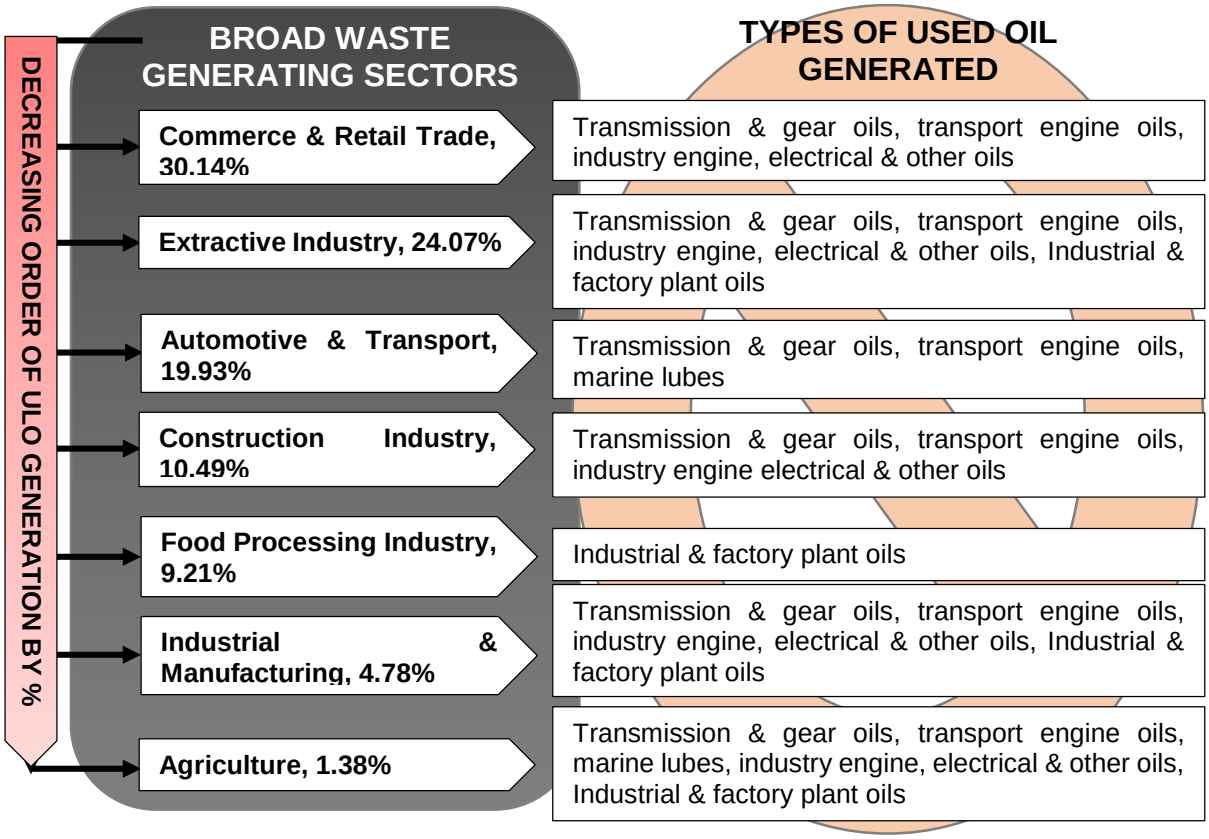


Figure 4. Broad waste generating sectors.

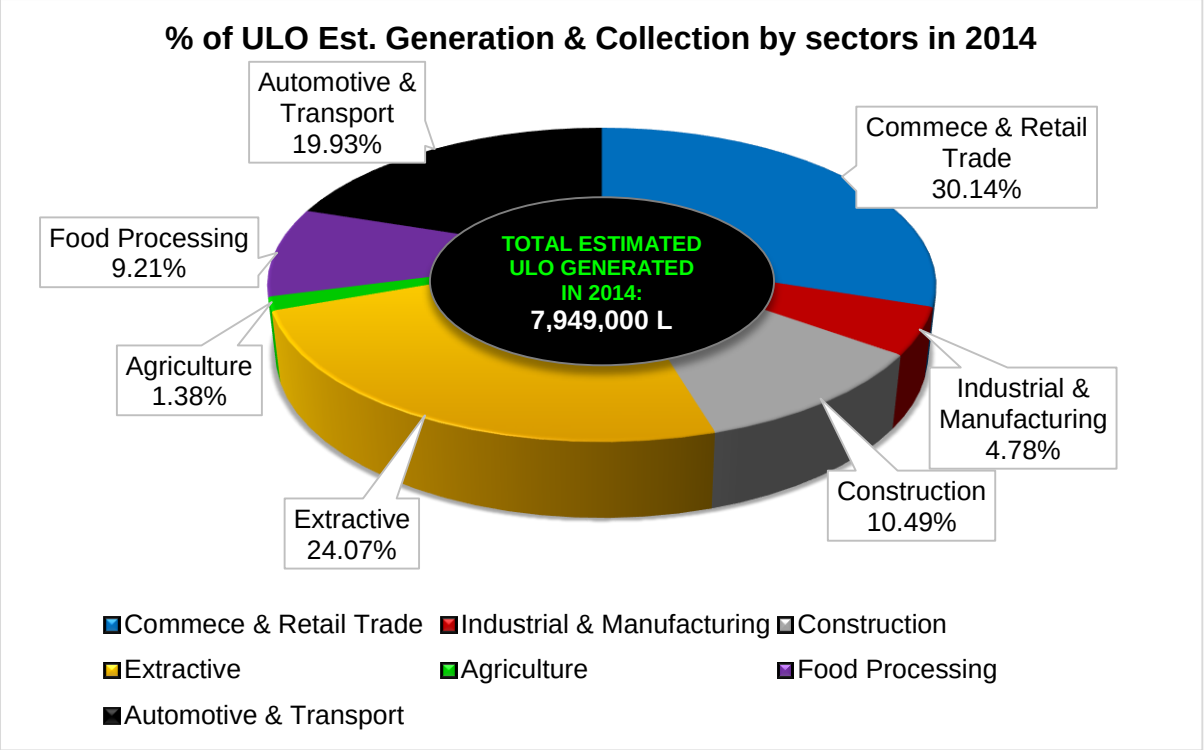


Figure 5. Estimated ULO generation by waste generating sectors.

As depicted in Figures 1 and 2, year 2014 show maximum quantities of net import of oil and generation and/or collection of used lubricants and oil. In that particular year alone Commerce and Retail Trade Sector generated used lubricants and oil at 30.14% followed by the Extractive Industry at 24.07% and to Agriculture Sector which was the least at 1.38%. Quantity of ULO generated were supplied to the waste management company that was recorded and provided. Most quantities of ULO generated and sent to the recognized waste collectors for management were either considered for recycling internally in PNG or sent overseas for re-refining. Mostly, the recognized collector send ULO to recycling companies in Australia for re-refining and further treatment.

Commerce and Retail Trade Sector: Commerce and Retail Trade Sector consisted of many entities thereunder. These were inclusive of retail trade, wholesale, financial/ businesses and other services. Also under this sector, the only major electricity supplier have the ability to supply electricity throughout the country mostly via hydro-generation while power generators are used in other centers and rural areas. Electricity supplies in PNG through the major electricity supplier works in almost four categories: (1) Generation involved in power generation either by hydro or electricity generators; (2) Transmission involved with higher electrical energy supplies from generation to transmitter stations that convert high electrical energy to energy sufficient for distribution for domestic uses; (3) Distribution which involved supply of sufficient electrical energy for industrial and commercial, and domestic uses, and (4) Commercial and retailing of which fees are paid by consumers to the electrical services provider.

There were also other small electrical companies who assist the major electricity supplier in electrical supplies in the country. Other businesses, commercial and retail trade, wholesale, and those categorized under this category use standby generators to supplement usage of electricity during blackouts or on occasion when located at the outskirts. Moreover, those that deal specifically with transport equipment services such as motors, workshops, hangars, and ship docks based on their specific activities would also fall under Commercial and Retail Trade waste generating sector. However, used lubricants and oil generated thereunder would be discussed in detail in Section 3.2.2, Automotive and Transport Sector.

Most types of used lubricants and oil categorized under this sector were of: Transmission & gear oils, transport engine oils, industry engine, and electrical and other oils. Mainly oils under these categories were from transport equipment, heavy machineries, transmitters, refrigerators and generators.

Extractive Industry Sector: activities under this sector consist of those industries engaged in minerals extractions, quarries, and petroleum in oil and gas (upstream). Small scale alluvial mining are example of Level 1 Activity under the Environment Act 2000. Other large scale mining and quarries may fall under Levels 2 and 3 Activities based on their respective assessment criteria. There were in existence nine (9) large scale mining projects in PNG extracting gold, copper, silver, cobalt and nickel reported by PNG Extractive Industry Transparency Initiative (PNGEITI), 2014 report. In addition, there were at least six identified other major mining projects under progress and construction while more than twenty (20) junior companies engaged in exploration in nineteen provinces and offshore, and thousands of other small-scale miners in PNG ((PNG Chamber of Mine, 2012).

In 2014, it was estimated according to PNGEITI Report that PNG crude oil reserve was at 2.53 million barrels, placing it at 99 out of 103 countries with proven reserves. Exploration started in the 1920s and went into production in 1992. However, there was a gradual steady decline in the production since then. Gas production, by contrast, was reported increasing due to PNG LNG exported its first shipment in May 2014 (PNG Chamber of Mine, 2012). It was further reported that PNG LNG project have designed capacity of 6.9 million tonnes of LNG per annum. In summary, there were both national and multinational oil and gas companies actively engaged in exploration and production in PNG. There were at least twelve (12) major players on this aspects identified while other ten (10) juniors are engaged in exploration both onshore and offshore (PNG Chamber of Mine, 2012).

Used lubricants and oil generated under from the sectors were categorized as: Transmission and gear oils, transport engine oils, industry engine, electrical and other oils, and industrial and factory plant oils. These were mostly generated from heavy machineries and transport equipment, mineral and petroleum extraction machineries, power generators, and plant processing machineries. Different machines and processing equipment have each respective service schedules based on engine requirements and rate of hours work. BPNG Quarterly Economic Bulletin, December 2014 Issue, recorded an overall increase of total merchandise export of K21,903.60 million in 2014, an increase of 64.1% from 2013 (Bank of Papa New Guinea, 2015). The significant increase was reported due to commencement and export of the Liquefied Natural Gas (LNG). Measure of productivity from work done through merchandise and commodity exports in 2014 from this sector reported that mineral receipts, LNG and condensate were K17,715.20 million and accounted for 80.80% of total merchandise exports in 2014, compared to 72.20% in 2013. Therefore, ULO collectively from all machineries in extractive industry in the country contributed the second highest percentage (24.07%) of ULO in the year 2014.

Construction Industry Sector: this sector consisted mainly of road works, building constructions, and other infrastructural developments. Generation and/or collection of used lubricants and oil from construction companies were mostly of: transmission and gear oils, transport engine oils, industry engine, electrical and other oils. These categories of ULO were common from heavy equipment and construction machineries, small standby generators, and drilling and metal cutting equipment. Majority of activities under construction industry were of non-mineral private sector.

There was a slower growth in construction of infrastructure projects, including health and education facilities in various regions, and the sporting facilities in National Capital District (NCD) in 2014 for 2015 Pacific Games reported in BPNG Quarterly Economic Bulletin, December 2014 Issue. This confirmed that 10.49% of ULO generated under this sector reflected slow growth in infrastructure projects despite its demand.

Food Processing Sector: included under this sector are mostly processing of: beverages (both alcohol and non-alcohol), canned food (both fish and/ or cattle) products, other processed protein products, assorted biscuits, rice, sugar, and several other processed food and beverage items. Common category of ULO generated under this sector identified were: industrial and factory plant oils. These oils were generated mostly from the food processing machineries and plant equipment. Measure of processed

or manufactured food and beverages was reflected from flux in Consumer Price Index (CPI). According to BPNG Quarterly Economic Bulletin, March to December 2014, most of the processed food items, non-alcohol or alcohol beverages and other food items had slightly increased during the year. There were not much differences in the changing CPI increasing percentage range of 1.7% in March, 2.2% in June, 1.0% in September, and 1.1% in December 2014.

Percentage differences between first and second quarters were 0.5% while there was an increased difference of 1.0% between second and third quarters, and 0.1% between the third and fourth quarters. This showed that CPI increased from first to third quarter and declined afterward to the final quarter of the year. This reflected demand in goods and services of which there was a high production during the first and second quarters of the year. Decline on CPI on the two final quarters suggested sufficient supplies of goods and services, therefore, also indicated decline in the production. This verified generation of used lubricants and oil during the year 2014 at 9.21%.

Industrial and Manufacturing Sector: this sector include manufacturers of various other items apart from consumable items such as food and beverages. Manufacturing of steel and infrastructure materials, household items, textiles, detergents, furniture and others that are of non-consumables could be classified hereunder this category. Used lubricants and oil generated under this category would be of: Transmission and gear oils, transport engine oils, industry engine, electrical and other oils, and industrial and factory plant oils. These oil categories are generated from manufacturing and plant processing equipment, automobiles, standby generators, and transport equipment.

BPNG Quarterly Economic Bulletin, March to December 2014 Issues, reported increase from final quarter of 2013 to first quarter of 2014, a decrease in the second quarter from 2014 first quarter, another increase from second to third quarter, and finally declined from third to the final quarter of 2014 under the Domestic Economic Conditions. This flux might pose a reason for this sector to have generated ULO with the second least percentage of 4.78% in the year.

Agriculture Sector: activities under this sector would also include those under forestry and fisheries. Under this sector, ULO considered generated and/or collected under are: transmission and gear oils, transport engine oils, marine lubes, industry engine, electrical and other oils, industrial and factory plant oils. These ULO categories would be traced generated from tractors, transport and agriculture equipment, vessels, agriculture and logging machineries and equipment, processing plant machineries and equipment, electrical generators and other accessory machineries.

Agriculture and fishing were the most common activities practiced from generation to generation and it is still practiced today. However, this time it have improved with much higher technology approaches. Some of the examples to production under this sector would be from: oil palm; sugar and cattle farming in Markham/ Ramu Plane; coconut oil production in Karkar Island, Madang Province, or in East New Britain; fresh vegetable harvests from Wahgi Valley; cocoa exports; tea nurturing; coffee production in Goroko, Eastern Highland Province; Vanimo Forestry in the Sandaun Province; and Tuna catch in the Bismarck Seas.

Report from BPNG Economic Bulletin for 2014 Quarters under Domestic Economic Conditions, suggested and overall increase in sales by 17.7% in final quarter of 2013 reflected higher production of agriculture and marine products. However, sales declined by 48.9% in the initial quarter of 2014. The decline was associated with the completion of a major replanting exercise undertaken by a palm oil company and lower harvest of tuna by a major fishing company (Bank of Papua New Guinea, 2014). Sales from agriculture/ forestry/ fisheries increased in the second quarter by 25.9% and declined again the third quarter of 2014 due to lower oil palm sales resulted from shipping delays (Bank of Papa New Guinea, 2015). Thus, it seemed generation of used lubricants and oil in this sector was obtained least at 1.38% due to the fluxes.

3.2.2 USED LUBRICANTS AND OIL GENERATED FROM TRANSPORT SECTOR

There are three main modes of transports in PNG of which movements of goods and services are transported via roads on vehicles, trucks, cars, Public Motor Vehicles (PMVs), and buses. There were at least two major air service providers together with several other minor ones. Portion of goods and services are transported via plane which were fastest than compared to road and sea transports. However, bulk amount of exports and imports and movements of goods and services depend on sea transports. Both sea and air transports are used nationally and internationally in the movement of goods and services.

Though survey was done on all three transport modes, only the motor vehicle regulatory body had provided ten (10) years data on vehicle registrations for new vehicles and those that were for renewals or re-registration. According to motor vehicle regulatory body, there were total of thirty eight (38) vehicle class modes. From the common vehicle class mode, it was further segregated and filtered to what can be found represented in Table 5. During those years, there were also registration of new vehicles. On average, life span of a vehicle can be estimated five (5) years. Therefore, to cater for those vehicles that might have ceased while accommodating new ones per year, Net Vehicle Registration was calculated from what was prior given in Equation 2. Table 5 show Net Vehicle Registration from using Equation 2 and data summarized and provided in Appendix II.

Table 5. Net vehicles registration classified accordingly to vehicle mode.

Ratings (Net Vehicles Rego)	**Net Vehicle Registered/ Year**				
	2012	**2013**	**2014**	**2015**	**2016**
SEDAN PRIVATE USE	7,071	7,292	6,763	6,941	7,228
SEDAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	4,237	3,943	3,498	3,652	3,182
VAN PRIVATE USE	334	360	373	362	356
VAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	394	433	436	439	411
STATION WAGON - SWB - PRIVATE USE	2,242	3,011	3,198	3,561	3,703
STATION WAGON - SWB - BUSINESSES/ COMPANIES/ ORGANIZATIONS	2,618	2,608	2,452	2,693	2,569
STATION WAGON - LWB - PRIVATE USE	2,974	3,636	4,518	5,886	7,128
STATION WAGON - LWB - BUSINESSES/ COMPANIES/ ORGAINZATIONS	8,278	9,766	11,328	11,846	11,612
UTILITY PRIVATE USE	4,805	4,385	4,676	5,765	5,912
UTILITY BUSINESSES/ COMPANIES/ ORGANIZATIONS	15,262	16,782	16,712	16,479	16,459
BUSES	5,259	5,977	5,508	5,649	5,328
PUBLIC MOTOR VEHICLES - PMV	3,726	2,865	3,417	4,331	4,985
TRADE PLATE/ MOBILE CRANES/ TRACTORS	3,645	3,987	3,911	3,941	4,004
MOTORCYCLES	673	752	742	835	966
TRUCKS/ TRAILERS	12,576	13,940	14,730	14,987	15,132
THREE WHEELERS	7	4	2	6	2
TOTAL	**74,101**	**79,741**	**82,264**	**87,373**	**88,977**
5 Years Net Vehicle Registration					**412,456**

Table 6. Estimated ULO generated from vehicles and transport equipment.

Ratings	Est. ULO Generated/ Year (LTR)				
	2012	**2013**	**2014**	**2015**	**2016**
SEDAN PRIVATE USE	84,852	87,504	81,156	83,292	86,736
SEDAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	101,688	94,632	83,952	87,648	76,368
VAN PRIVATE USE	5,344	5,760	5,968	5,792	5,696
VAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	12,608	13,856	13,952	14,048	13,152
STATION WAGON - SWB - PRIVATE USE	35,872	48,176	51,168	56,976	59,248
STATION WAGON - SWB - BUSINESSES/ COMPANIES/ ORGANIZATIONS	83,776	83,456	78,464	86,176	82,208
STATION WAGON - LWB - PRIVATE USE	71,376	87,264	108,432	141,264	171,072
STATION WAGON - LWB - BUSINESSES/ COMPANIES/ ORGAINZATIONS	397,344	468,768	543,744	568,608	557,376
UTILITY PRIVATE USE	115,320	105,240	112,224	138,360	141,888
UTILITY BUSINESSES/ COMPANIES/ ORGANIZATIONS	732,576	805,536	802,176	790,992	790,032
BUSES	84,144	95,632	88,128	90,384	85,248
PUBLIC MOTOR VEHICLES - PMV	89,424	68,760	82,008	103,944	119,640
TRADE PLATE/ MOBILE CRANES/ TRACTORS	54,675	59,805	58,665	59,115	60,060
MOTORCYCLES	5,384	6,016	5,936	6,680	7,728
TRUCKS/ TRAILERS	201,216	223,040	235,680	239,792	242,112
THREE WHEELERS - BUSINESS	168	96	48	144	48
TOTAL	**2,075,767.00**	**2,253,541.00**	**2,351,701.00**	**2,473,215.00**	**2,498,612.00**
5 Years Estimated ULO Generation					**11,652,836.00**

Used lubricants and oil generated was estimated using Equation 3, data in Table 5 and requirements in Table 13 in Appendix I.

Data evaluated for five (5) years in Table 5 was later used to determine estimated quantity of ULO generated during the years 2012 to 2016. With the positive growth of the country's economy over the last decade, an increasing number of people continue purchasing motor vehicles for personal use whilst the boom in the mining and mineral sectors has also increased the demand for heavy duty vehicles. Moreover, the importation of used vehicles over the internet has dramatically increased the number of vehicles around the country. Motor Vehicle Insurance Limited (MVIL) statistics indicated that the number of vehicles registered has increased by over 4,500 per annum over the last decade (Independent Consumer and Competition Commission, 2013). In the case of this survey, the total sum of registered net vehicles was 412,456 with increasing rate of 0.9064% estimated at 3,739 vehicles per annum.

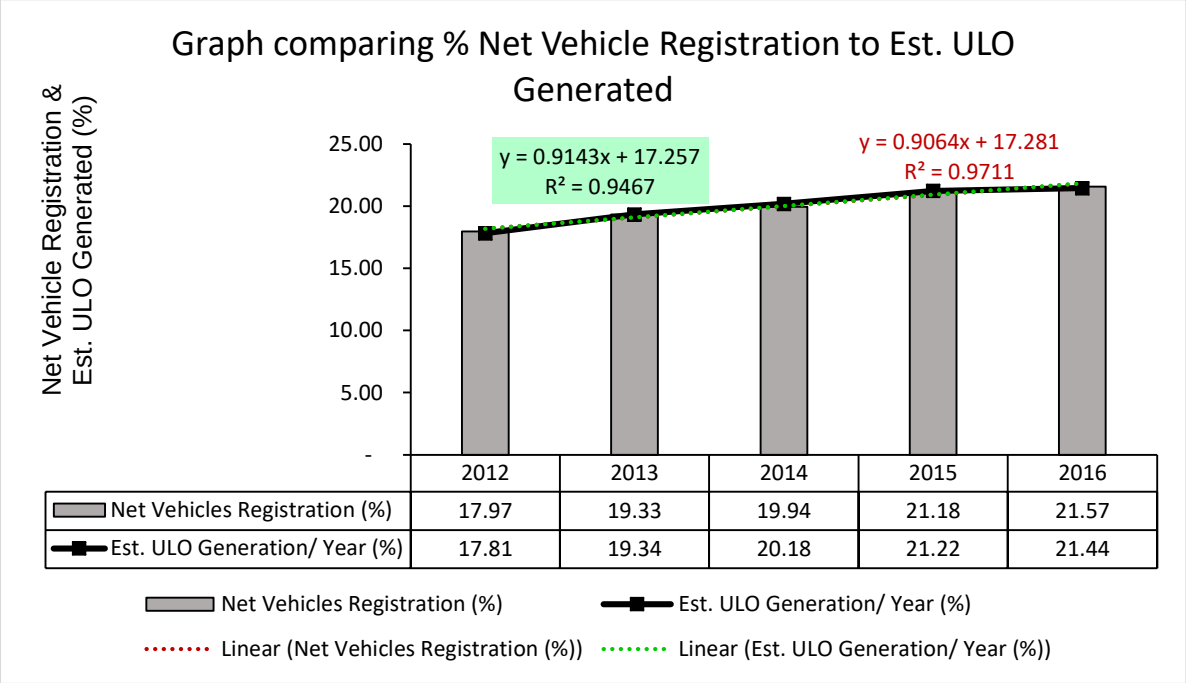


Figure 6. Net vehicle registration and estimated ULO generated.

It was statistically proven that used lubricants and oil generated from vehicle and transport equipment do not vary between 2012 and 2016. Moreover, linear regression via determination coefficient (R^2) also proved that there was better relationship of net vehicles registered (R^2 = 0.97) and quantity of ULO generated (R^2 = 0.95) during progressive years in the past five years with similar changing pattern.

Table 7. Single Factor ANOVA for ULO generated from registered net vehicles.

Anova: Single Factor

SUMMARY

Year	*Count*	*Sum*	*Average*	*Variance*
2012	16	2,075,767.00	129,735.44	35,217,247,351.73
2013	16	2,253,541.00	140,846.31	44,218,364,620.50
2014	16	2,351,701.00	146,981.31	47,599,500,712.36
2015	16	2,473,215.00	154,575.94	47,421,274,951.00
2016	16	2,498,612.00	156,163.25	46,781,348,977.53

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7493141535	4	1873285384	0.04	1.00	2.49
Within Groups	3.32×10^{12}	75	44247547323			
Total	3.33×10^{12}	79				

- ✓ *Null Hypothesis (H_0):* There is no significant difference in used lubricants and oil generated and/or collected from net vehicle and transport equipment registered during the past five years, and
- ✓ *Alternative Hypothesis (H_1):* There is significant difference in used lubricants and oil generated and/or collected from net vehicle and transport equipment registered during the past five years.

We reject H_0 if P value is less than 0.05 at 5% significant level. From Table 7, estimated ULO Generation/ Collection over 5 years period show that P = 1.00 > 0.05 at 5% significant level. Therefore, it can be concluded that there was NO significant difference between the quantities of Estimated ULO generated from the transport sector over the last five years. Thus, we accept the null hypothesis and reject the alternative hypothesis. This indicated that there was a constant increasing rate of 0.91% calculated as 106,541.88 L per year from the estimated total volume of 11,652,836.00 L of ULO generated from automotive and transport sector over the last five years. Moreover, ULO generation during the past years indicated a better relationship (R^2 = 0.9467) with changing years.

This can be predicted using the relationships that the trend of net vehicle registration would increase at the rate of 0.4071% which is 3,739 vehicles per year from total estimated of 918,372 over the outlook period. Moreover, it can also be projected that the generation of used lubricants and oil would continue to increase at the rate of 0.4102% (106,525.17 L) per year of the total expected ULO generation of 25,969,082 L over the outlook period between 2017 to 2021 (Figure 7).

Table 8. Five years projection of net vehicle registration and estimated ULO generation.

Year	**Net Vehicles Registration**	**Net Vehicles Registration (%)**	**Est. ULO Generation/ Year**	**Est. ULO Generation/ Year (%)**
2012	74,101	8.07	2,075,767	7.99
2013	79,741	8.68	2,253,541	8.68
2014	82,264	8.96	2,351,701	9.06
2015	87,373	9.51	2,473,215	9.52
2016	88,977	9.69	2,498,612	9.62
2017	93,706	10.2	2,650,176	10.21
2018	97,445	10.61	2,756,713	10.62
2019	101,183	11.02	2,863,249	11.03
2020	104,922	11.42	2,969,786	11.44
2021	108,660	11.83	3,076,322	11.85
TOTAL	**919,372**	**100.00**	**25,969,082**	**100.00**

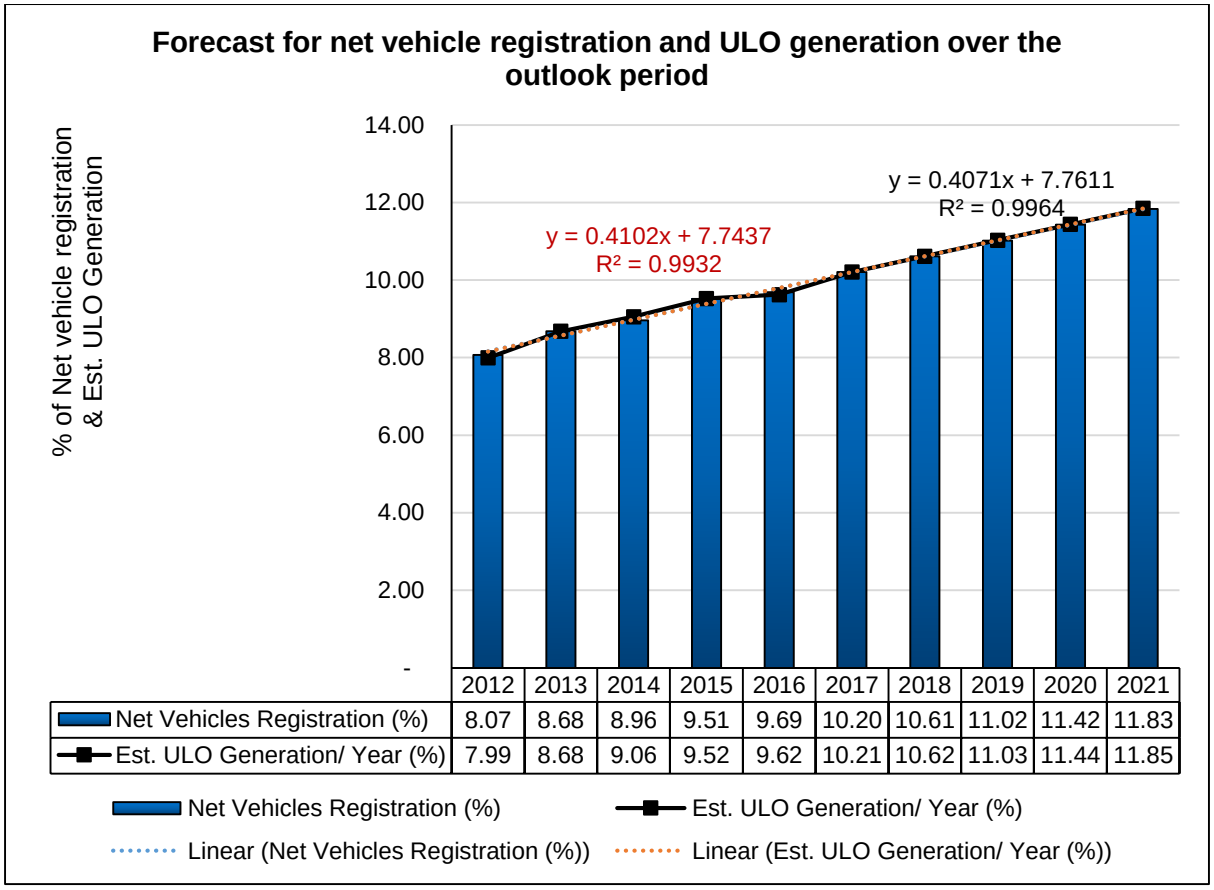


Figure 7. Five years forecast of net vehicle registration and estimated ULO generation.

With proper inventory and data management, projections over outlook period would assist appropriate planning for used lubricants and oil management. In addition, predicted increasing trend of ULO generation would suggest capability of maximizing it as a resource to initiate its own industry in PNG. It could further be estimated that the ratio of ULO generated from automobile and transport sector to all other sectors in commerce and retail trade and industrial sectors is 1:5. From data supplemented in inventory on ULO generated and/or collected, comparison by ratio was conducted for automotive and transport sector to commerce and retail trade and industrial sectors for years 2013, 2014, and 2015.

Table 9. ULO Quantity for transport and industrial sectors.

Year	Automotive & Transport (L)	Commerce & Retail Trade & Industries (L)
2013	130,000.00	115,000.00
2014	1,584,000.00	6,365,000.00
2015	91,000.00	2,000,000.00
Sum	**1,805,000.00**	**8,480,000.00**
Mean	**601,666.67**	**2,826,666.67**
Ratio	**1**	**5**

From the data evaluated and information obtained from several interviews during surveys, expected ULO generation capacities for different vehicle modes were listed in Table 13 in Appendix I. With the increasing trend of net motor vehicle registration at the rate of 3,739 vehicles per annum, ULO would be generated at 106,541.88 L per year. Used lubricants and oil from automotive and transport sector was estimated 1,805,000.00 L for years 2013 to 2015 compared to commerce and industrial sectors

with 8,480,000.00 L. Thus, the ratio of 1:5 suggested that commerce and industrial activities are constituted by far the largest consumption of lubricants and oil in PNG compared to automotive and transport sector.

3.3 Used Lubricants and Oil Management Approaches

In compliance with national policies and regulations, regional and international expectations, the most basic approaches under this project were considerate over environmental sustainability. Thus, it was realized that in defining concept of sustainability, the foundation lie on challenges of the environment and development. This was in consideration from all parties involved in the development be of: government, businesses and environmental groups in private and public sectors, responding to changes occurring to the environment due to processes of development.

There can be possible options collaboratively identified to assist management of Used Lubricants and Oil. The basic principle in attempting to manage waste that is also applicable to ULO is:

i) Do not produce it – one of the concept is pollution prevention means producing less of the pollutants or waste in the first place, or eliminating it, and is considered top of waste management hierarchy;

ii) If producing it cannot be avoided, then produce only a minimal quantity or on a supply – demand basis;

iii) Recycle it;

iv) If cannot recycle, treat it in a manner where it becomes non-hazardous;

v) If cannot render non-hazardous, dispose of it in a safe manner, and

vi) Once disposed – monitor it for its adverse effects.

There were at least twelve (12) different used lubricants and oil disposal options identified. Interviews and discussions were done regarding the waste management approaches. Observations were conducted on site and evaluation on cost and environmental impact assumptions were assessed and ranked. Both assumptions based on site observations and evaluations, and interviews with representatives from various stakeholders were ranked as: 1 = very high; 2 = high; 3 = average; 4 = low, and 5 = very low. These responses were based on individual assessments, business considerations, and evaluations on costs by stakeholders toward different ULO management approaches considered and practiced. Environmental Impact Assumptions were evaluated from actual environment impacts observed and assessed, and from interviews and discussions with HSO and/or Environment Officers.

Table 10 provided responses and observations from different options on ULO management which might be regarded common in practice. These responses and observations were further evaluated using the simple risk assessment matrix approach. Table 11 thus, supplement assessment over the identified approaches. Numbers on the top rows of the table represent scored responses from 1 (very high) to 5 (very low) for environmental impact assumptions. Second left column provide same scored ranges for cost assumptions. Numbers in between the matrix represent ULO disposal approaches in listed order from Table 10. Those squares heavily highlighted grey above left suggested approaches expensive and not environmentally friendly. Squares not highlighted were those options that might fall under average costs while regarding concerns on certain extents that might pose high or low impacts on the environment. Moreover, bolded numbers in red bolded squares under the category show options that might still be considered. However, they must be practiced in close monitoring for any chances of no proper management that might increase environmental concerns. Squares below right of the matrix show cost effective and environmentally sound ULO management approaches. This assessment was considered to be continued in detail under cost benefit analysis.

Table 10. Evaluation on twelve identified ULO Management Approaches.

No.	Disposal Options	Sectors Under	CA Rank Score	Cost Assumptions	EIA Rank Score	Environmental Impact Assumptions	Responded Stakeholders
1	Engage Bioremediation Technique	Some Stakeholders under Extractive Industry	**3**	Average	**5**	Very Low	1
2	Waste Oil recovering on site using an advanced technology of Mobil waste oil processing unit	Waste Management Companies	**3**	Average	**5**	Very Low	1
3	Collected and send to suppliers based on MOU	Some stakeholders under Transport & Workshop Sectors, & Logistics/ Suppliers	**5**	Very Low	**4**	Low	2
4	Used in Kilns and industrial boilers and burners	Some Stakeholders in Commerce & Retail Trade, Industrial & Manufacturing, Construction, Extractive, Agriculture, & Food Processing Industry	**5**	Very Low	**4**	Low	2
5	Supply to Industries for use in boilers/ burners upon request based on MOU	Lubricants and Oil Suppliers	**5**	Very Low	**4**	Low	1
6	Send to Waste Management Services/ Contractor in PNG	Some Stakeholders in Commerce & Retail Trade, Industrial & Manufacturing, Construction, Extractive, & Food Processing Industry	**3**	Average	**4**	Low	83
7	Export to Australia for further treatments and processes	Waste Management Companies (e.g. TWM)	**1**	Very High	**4**	Low	1
8	ULO used for fire fighting drills and trainings	Fire Services	**3**	Average	**4**	Low	1
9	Used on Sports Fields and/or as pest controls	Domestic (DIY), small workshops & auto parts	**5**	Very Low	**2**	High	2
10	Stockpile for ULO Decomposition and send to landfills and/or pour into drains	Some stakeholders under Automotive & Transport Sector	**4**	Low	**2**	High	4
11	No Options Available	Domestic (DIY)	**5**	Very Low	**1**	Very High	3
12	Stockpile only/ looking for ULO disposal options	Some stakeholders under Automotive & Transport Sector	**5**	Very Low	**1**	Very	1
TOTAL RESPONSES							**103**

Table 11. Simple risk assessment matrix approach on ULO management options identified.

		Environmental Impact Assumptions				
		1	**2**	**3**	**4**	**5**
Cost Assumptions	**1**				7	
	2					
	3			8	***6***	1 & 2
	4		10			
	5	11 &12	***9***		3; 4 & 5	

Evaluation matrix suggested that ULO Management Approach 7 by Exporting ULO to Australia for further treatments and processes, though was assessed environmentally sound yet it was considered very expensive. Approaches 6, 8, 9, 10, 11, and 12 were considered on average cost while they can pose high or low environmental impacts on certain circumstances.

Not all stakeholders have proper disposal options or have considered to develop a ULO Management Plan to facilitate proper management of ULO. Some might have identified other options but were undecided when and how to engage the approach(es) based on financial capabilities, considering regulators' interventions, business evaluations and constrains, and/or other reasons. ULO options 10, 11 and 12 involved most used lubricants and oil generated by stakeholders considered for storage and/or stockpiling. Stakeholders engaging Approach 10 recommended decomposition of ULO over certain period before sending them to landfill sites or poured into drains. Though it was thought and practiced as low to average cost approach, yet it is possible to pose high environmental impacts and concerns as most drains lead to ponds and other wetland areas, creeks, and rivers that may later end up in seas.

Furthermore, some, mostly domestic or do-it-yourselfers (DIY) and small workshops and auto-parts services providers do not have any management plan over ULO. Stakeholders and individuals engaging such approach (Approaches 11 and 12) store or stockpile them without any proper plans for handling, storage, transportation, and further disposal (Figure 8). Supplementary disposal options commonly engaged based upon requests were to: be used on sports fields, as pest controls, and supplied for fire fighting drills and trainings. Approaches 6, and 9 were also categorized being identified to have average costs and average environmental impacts. Approach 9, using ULO on sports field and/or as pest controls although cannot be seen appropriate, there were less amount of ULO used per year. These approaches can be considered worth engaging, however, there must be strict monitoring and proper management to ensure environment impacts are always low. In addition, contractual agreements and costs to ULO generators by waste management contractors must be flexible to encourage more engagement and supplies.

Figure 8. An example of Do-It-Yourselfers.

Approaches 1, 2, 3, 4, and 5 were regarded cost effective and environmentally sound. Approaches 1 and 2 use high technology considering ULO as a resource but not as waste. Both approaches encouraged sustainable management through recycling, repairing, and recovering. Approach 2 in a way engage waste oil recovering on site using an advanced technology of mobile waste oil processing unit. From this technique the recovered products can be reused again (Appendix II). This approach is mobile and can be applied to all levels of activities in the country. Approach 1 on engaging Bioremediation Technique was discussed during a presentation and meeting with the stakeholder but the facility was not visited. However, this technique involve passing of ULO into a high technology equipment that convert ULO to fertilizer for agricultural purposes. This approach was considered and used only by specific major oil and gas developer in the country.

Approaches 3, 4, and 5 were somewhat connected as evaluated from interviews and discussions during the survey. There are several stakeholders based on Memorandum of Understanding (MOUs) resend or return used lubricants and oil generated back to their suppliers (Approach 3). The approach is very cost effective and environmentally sound to the generator(s) as long as it is out of their bounds. Despite this fact, the suppliers and/or waste management contractors or collectors would face yet another challenge during handling, transporting, storage, and disposal or management over it. From interviews on Approaches 4 and 5, suppliers that collect ULO from their clients transport them for storage via roads on trucks, and seas on vessels. ULO from stockpiles are then supplied to other economic sectors upon requests through MOUs. These were then used in industrial boilers and burners. Most major stakeholders from extractive and other industries have waste management plan(s) compulsory to certify regulatory requirements under regulatory bodies, especially CEPA prior to carrying out any activities. Thus, they have their own approaches to deal with ULO. An example was to pass ULO into kilns and used for backfilling.

Considering the fact from this assessment and evaluation, Papua New Guinea have the capability to manage ULO in the country than considering export. This was mentioned being expensive from an interview with a waste management company representative. This could be supported through data obtained in ULO inventory from waste management company. Statistical assay was done for years 2012 to 2015 for ULO export and estimated quantity collected and managed internally in the country (Table 12). The statistical treatment to data was purposed to verify what was discussed earlier in the preceding paragraphs.

Table 12. Estimated Quantity of ULO Generated or Collected and disposed.

YEAR	EST. TOTAL ULO GENERATED/ COLLECTED	EST. TOTAL ULO EXPORTS	Est. Other ULO Disposal Approaches
2012	2,075,767.00	160,000.00	1,915,767.00
2013	2,418,541.00	354,600.00	2,063,941.00
2014	10,212,701.00	1,101,606.00	9,111,095.00
2015	4,498,612.00	178,740.00	4,319,872.00
GRAND TOTAL	**19,205,621.00**	**1,794,946.00**	**17,410,675.00**
Mean	**4,801,405.25**	**448,736.50**	**4,352,668.75**
Ratio		**1**	**10**

Table 13. t-Test: Two-Samples Assuming Unequal Variances on ULO Management.

t-Test: Two-Sample Assuming Unequal Variances		
	Est. Total ULO Export	***Est. Other ULO Disposal Approaches***
Mean	448,736.50	4,352,668.75
Variance	1.97×10^{11}	1.13×10^{13}
Observations	4	4
Hypothesized Mean Difference	3,903,932.25	
df	3	
t Stat	**-4.61**	
P(T<=t) one-tail	0.01	
t Critical one-tail	2.35	
P(T<=t) two-tail	**0.02**	
t Critical two-tail	**3.18**	

- ✓ Null Hypothesis (H_0): There is no significant difference in the estimated quantity of ULO being exported over four years compared to that managed internally using other management options, and
- ✓ Alternative Hypothesis (H_1): There is significant difference in the estimated quantity of ULO being exported over years to that managed internally using other management options.

We reject H_0 if t Stat value is less than t Critical two-tail value when df = 3 or when P(T<=t) two-tail is less than P = 0.05 at 5% significant level. Statistics on ULO Exported to Other Management Options suggested that, t Stat = -4.6107 < 3.1824 (t Critical two-tail) or P(T<=t) two tail = 0.02 < 0.05 at 5% significant level. One can conclude that there is statistical evidence to show that there is significant difference in the estimated quantity of ULO being exported over years compared to that managed internally using other management options. Thus, we reject the null hypothesis and accept the alternative hypothesis. This indicated that there was evidence that not all ULO generated and collected are exported for recycling or re-refining. There are other ULO Management Options that could be utilized and used internally in the country to manage disposal of ULO. Moreover, the ratio of those ULO

exported to that managed internally in the country is 1:10. It indicated that more quantity of ULO is managed internally in the country using other management options than compared to ULO quantity exported overseas. Thus, from this assessment, it can be noted that Papua New Guinea have great potential in managing used lubricants and oil than to exporting them overseas.

3.4 Responses on Environmental Requirements

Environmental requirements covered during the survey were guided from the developed audit checklist. This was categorized into four (4) main sections namely:

1) Company Environment Policy;
2) Environment Management Systems;
3) Legal Standards, and
4) Environment Performance.

The four main categories were further divided into sub-categories respectively with several key questions thereunder. Sections 3.4.1 to 3.4.4 provide summaries to the overall responses that could be found obtained from Appendix VII.

3.4.1 COMPANY ENVIRONMENT POLICY

Since most people do not have time to master the details of every environmental problems and proposed solutions, there are certain principles that can guide development of policies. It is hoped that such principles and guidelines would help decision-makers to create policies that will satisfy most people while minimizing environmental harm.

Survey questions under this category were designed to identify if: the company have a stated environment policy that captured management of used lubricants and oil; if the policy have been communicated within and outside the organization; if it complies with Environment Act 2000 and/or other Acts and Regulations; if it conforms to other national and international guidelines and standards; if the company insist that its suppliers adhere to accepted environmental standards; and if the company review changes in environmental legislation. From the overall responses 36% have company environmental policies, 17% do not have company environmental policies in place, 2 % were uncertain, and 45% did not responded. There was 64% inclusively of responses: NO, Uncertain, and Unanswered compared to 36% of Yes.

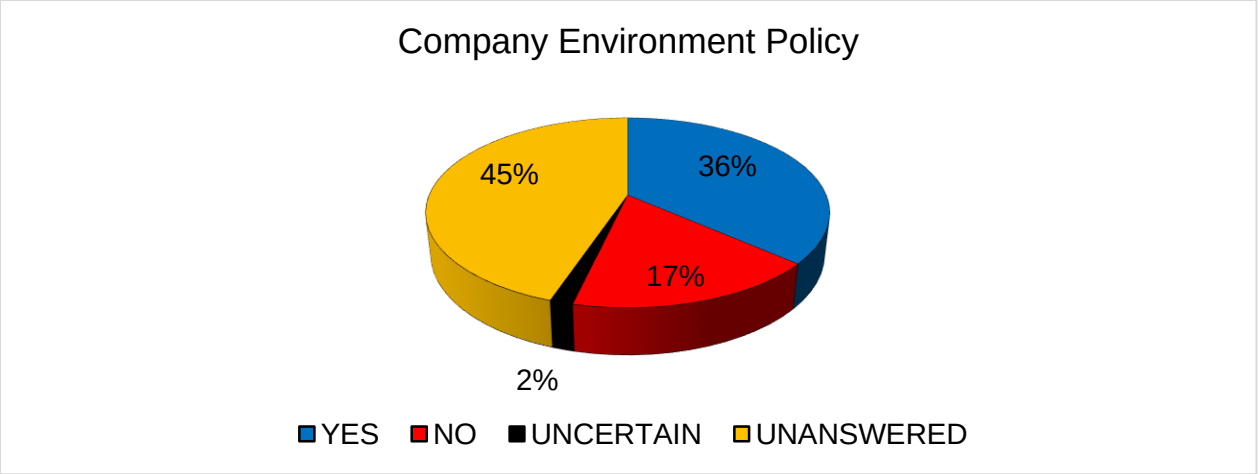


Figure 9. Responses by percentage on Company Environment Policy.

Some of the Environmental Policy and Standard documents identified used were of: PTB Plant Manual for workshop management; ISO 14001, and other Australian and New Zealand Standards. Other stakeholders have indicated that development of environmental policy was considered while some stated it is in development progress. However, the overall responses suggested that there is yet a need to make awareness for companies to capture specific ULO management in their environment policies. This can initially be included during development of inventory and ULO Management System Database. Prior to doing so, it is mandatory through CEPA for all established and emerging companies to supply such information for data entry, monitoring and reviews, and regulation during regulatory processes to acquire company licenses and permits, or acquire recognition to continue activities. Stated below are few recommendations that can be considered for evaluation and further action.

Recommendation:

- *Consider the following principles: The reversibility principle; precautionary principle; net energy principle; polluters pay principle; public access and participation principle; human rights principle, and environmental justice principle to set platform to develop ULO Management Policy and Legislation (Section 4 – Recommendation);*
- *Liaise with officers in CEPA – Policy and Legal Unit on historical regulatory documents in place for waste management, and*
- *Further consult other key stakeholders and government regulatory bodies on their policies and regulatory documents. Hence, to ensure mutual relationship in regulatory processes is captured during development of ULO management system plan and legislation.*

3.4.2 *ENVIRONMENTAL MANAGEMENT SYSTEM*

One of the primary reasons for the problems with current methods of environmental management is the issue of scientific uncertainty—not just its existence but the radically different expectations and modes of operation that science and policy have developed to deal with it. If we are to solve this problem, we must understand and expose these differences about the nature of uncertainty and design better methods to incorporate it into the policy-making and management process (Costanza, et al., 2015). Considering established management system of used lubricants and oil, there were six sub-categories engaged during the survey: environmental management structure; environmental management program; education and training; internal and external communication and reporting; planning and resources; and record keeping, documentation and data control. Discussions hereunder are based on responses summarized and tabulated as shown in Table 14 and Figure 10.

Table 14. Responses by on Environmental Management System.

AUDIT/ SURVEY ITEMS	RESPONSE			UNANSWERED	TOTAL
	YES	*NO*	*UNCERTAIN*		
Environmental Management Structure	31.25	16.67	3.47	48.61	**100**
Environmental Management Program	22.92	10.42	12.50	54.17	**100**
Education and Training	31.67	11.67	4.17	52.50	**100**
Internal and External Communication and Reporting	20.83	23.33	9.17	46.67	**100**
Planning and Resources	16.20	14.81	5.09	63.89	**100**
Record Keeping & Documentation & Data Control	35.12	11.31	5.36	48.21	**100**

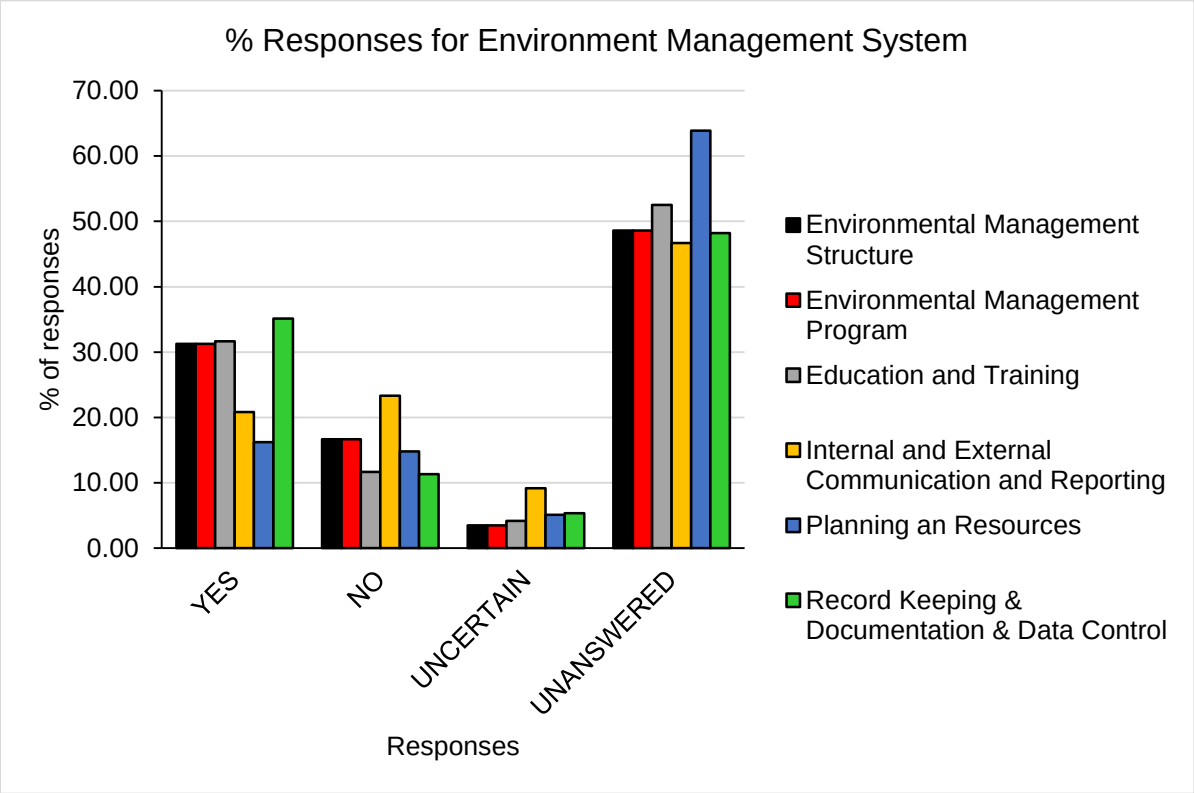


Figure 10. Responses by percentage on Environment Management System.

3.4.2.1 – Environmental Management Structure

In reference to responses recorded in Appendix VII and summarized in Table 14 and Figure 10, despite years of operations, some stakeholders have Environmental Management Structure still in draft that might require reviewing. Environmental Officers, Occupational Health and Environment Safety Officers, and Yard and Workshop Managers were identified persons in those organizations responsible to address concerns for the organization to comply with set international and national environmental regulations, policies and guidelines. Several others have reported still working to develop environmental management structure. Hence, that should discourse waste management approach for their organization in highlighting ULO as part of the Environmental Management Structure. Those responses were therefore acknowledged and considered to be included to what could later be captured in development process of used lubricants and oil management system plan.

Recommendation:

Hence, further recommendations forecasted specifically under this section would be to:

- *Ensure to understand key functions of those stakeholders and seek establishment of mutual relationship to capture ULO under waste management, and*
- *Consult respective officers in CEPA on Environmental Management Structure to merge ULO Management thereunder.*

3.4.2.2 – Environmental Management Programme

Environmental Management Programme (EMP) under the *Environment Act 2000* refers to a programme to manage all environmental risks of an activity, which program shall include identification of risks,

internal and external monitoring and reporting, contingency planning and plans for corrective action (Independent State of Papua New Guinea, 2001).

It is a requirement under *Environment Act 2000* and mandatory through CEPA that all stakeholders and/or developers in the country should present an EMP together with other necessary documents prior to carry out any activities. Thus, most stakeholders from interviews responded have gone through the process. Moreover, other government regulatory organizations, example Department of Works (DOW), on behalf of CEPA do assist in similar role in monitoring and regulating mostly road works and constructions based on specific scope of activities by developers. There were others who recommended review of EMP from their organizations. Meanwhile, representatives interviewed from few other stakeholders were uncertain on availability of EMP. Nevertheless, it was assumed that CEPA together with other regulatory bodies in the country should have records on this regard that could be utilized when developing ULO Management System plan and legislation.

Recommendation:

- *Liaise with CEPA relevant officers and/or other regulatory organizations to utilize available information to assist in cost benefit analysis and later development of ULO Management System Plan and Legislation.*

3.4.2.3 – Education and Training

Any organizations are on its own, system(s) that have certain principles set as foundation recognized in a particular environment. Within organizations human can be regarded as workable unit having input that cause organizations to function or to bring about certain results. On the other hand, as in the ever changing environment and society to meet demand in requirement for livelihood, few or certain things to specifically address the changes require updating. Education and training are foremost one way of updating personal experiences supplementing encounters to changes occurring around us.

These should be set through an established training program for staffs and employees. Advanced approaches to address issues on environment impacts, waste management, pollution controls, and management of used lubricants and oil through specific trainings is required on scheduled basis or occasionally. It seemed that from results, most organizations and stakeholders have set education and training programs. Especially, in the demand for industrial activities, Environmental Officers, Occupational Health and Environment Safety Officers, Plant and Workshop Managers, and other technical staffs should attend periodical trainings when arises or set on schedules. Trainings specifically on used lubricants and oil should cover, established regulations and MEAs on used lubricants and oil management, handling requirements, transportation and storage requirements and procedures, disposal and waste management, data entry, inventory and record keeping, communication system, and emergency responses. It is also recommended that specific trainings addressing issues on used lubricants and oil should be held apart from general waste and hazardous waste management.

Recommendation:

- *Toward the end or after the establishment of this project, workshop on used lubricants and oil management should be held. This is to make aware all sectors using oil products and involve in generating ULO understand requirement of this project outcome. Moreover, workshop held should also aim to get equal participations and establish contacts and common understanding on what had been developed through this project that will come into effect once gazetted and certified to be implemented.*

3.4.2.4 – Internal and External Communication and Reporting

A cost effective and environmentally sound ULO management approach would not be achieved to promote best environment practices unless there is an effective communication system. Communication is not restricted to only talking and listening, writing and reading, or performing and observing, it is as well the art and process of creating and sharing ideas. Effective communication

depends on the richness of those ideas. There were few guiding questions developed under this section that assisted with assessment as follows: if company or stakeholders do report and/or notify regulatory bodies on any cases of pollution incidents; keep records and register complaints; if company or organization have open channel of communication with interested and affected parties; and if the company have regular audits.

From survey, there was less percentage representation (20.83%) of responses from those who have established communication system compared to those who does not have any, or were uncertain, or not even suggested any ideas at all. Responses have indicated slightly over half of ULO Management Approaches (3, 5, 8, 9, 10, 11, and 12) in Section 3.3 might not have been discussed with CEPA or other regulatory bodies earlier. Though stakeholders and companies might have considered further options internally, these options require proper discussions with all regulatory bodies monitoring and/or regulating their activities thereof. Moreover, it would be best if those stakeholders and/or companies report and seek further recommendation(s) on any specific ULO Management Approach(es) considered or proposed to concerned regulatory bodies. Hence, to avoid raise of any conflict in future from unconditional circumstances.

Despite companies and stakeholders providing quarterly bulletin reports on business progresses and promotions, environment and waste management capturing ULO should also be of focus in those reports. Most major companies comply and maintain communication internally and between the regulators while few others, some medium scale operations, and other small scale activities have feeble communication system.

Recommendation:

- *It would be better to uplift quarterly bulletin reports on ULO Management Approaches by all stakeholders published and have them available for CEPA and other regulatory bodies, and general public accessibility;*
- *CEPA to update and have availability of quarterly ULO bulletins once management system is in place, and*
- *Conduct awareness on causes and effects, emergency responses, and proper management of ULO in schools, protected areas, and at different community levels.*

3.4.2.5 – Planning and Resources

The Independent State of Papua New Guinea in 2009 have developed a National Strategic Plan, Vision 2050, for the country. There were seven (7) key pillars mentioned under the plan that supported focus to achieve country's vision which is to *"be a Smart, Wise, Fair, and Happy Society by 2050."* Environmental Sustainability and Climate Change is the fifth (5th) pillar that address issues on environment and climate change in the country. Conservation and Environment Protection Authority (CEPA) and Office of Climate Change were the main government organizations focused on improving environmental performance highlighted Key Pillar 5. The country have developed prior plans that lead up to Vision 2050 of which were: National Development Strategy, 1976 –1985; National Development Plan, 1986–1990; Development Plan, 1989–1997; Medium Term Development Strategy, 1997–2002; Medium Term Development Strategy, 2003–2007; Medium Term Development Strategy, 2005–2010; PNG Development Strategic Plan 2010–2030; Medium Term Development Plan 2011–2015, and finally Vision 2050. The objectives of these plans, in general, were to achieve economic growth and social development through the development of health, education, infrastructure, minerals (such as, gold and copper) and fossil fuels (petroleum and gas), and maintaining law and order in the country (Department of National Planning and Monitoring, 2014).

According to StaRS, the Development Strategic Plan, 2030, was designed to translate the focus areas of PNG Vision 2050 into concise directions for socio-economic development, spelling out sector interventions with clear objectives, quantitative targets, and baseline indicators. In addition, the plan prescribed a growth strategy that simply followed a consumption driven natural resources intensive high carbon producing *'brown'* economic growth path that the industrialized world followed (Department of National Planning and Monitoring, 2014).

Department of National Planning and Monitoring in 2013 have suggested a paradigm shift from what was captured in the Development Strategic Plan (DSP) – 2030 on '*brown economy'* towards a sustainable clean energy and resource using low or zero carbon-generating *'green'* or *'clean'* inclusive economic growth path. This was aimed at strengthening PNG's strategic positioning and economic competitiveness in the world, while at the same time able to contribute to a high quality and better life for all Papua New Guineans now and in the future. According to United Nations Environmental Program (UNEP) 'a green economy is one that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities'. In its simplest expression, a green economy is one that is low carbon, resource efficient and socially inclusive (Department of National Planning and Monitoring, 2014).

These therefore, have substantiated few guiding questions used during survey if the organization or company have plans, strategies or techniques established for: ULO collection system; collection and transportation (responsibilities, requirements for drivers and vehicles, and transportable containers); ULO storage and processing; ULO facilities; compliance of ULO with MEAs and national regulatory waste management requirements, and if there was already in place ULO Management System in their organization.

Figure 11 show a general percentage responses from representatives of stakeholders interviewed. Time and willingness to participate and assist during survey were few factors that have contributed to highest percentage (64%) of some questions not answered. Second highest percent (20%) was from both no and uncertain responses compared to yes responses of 16%.

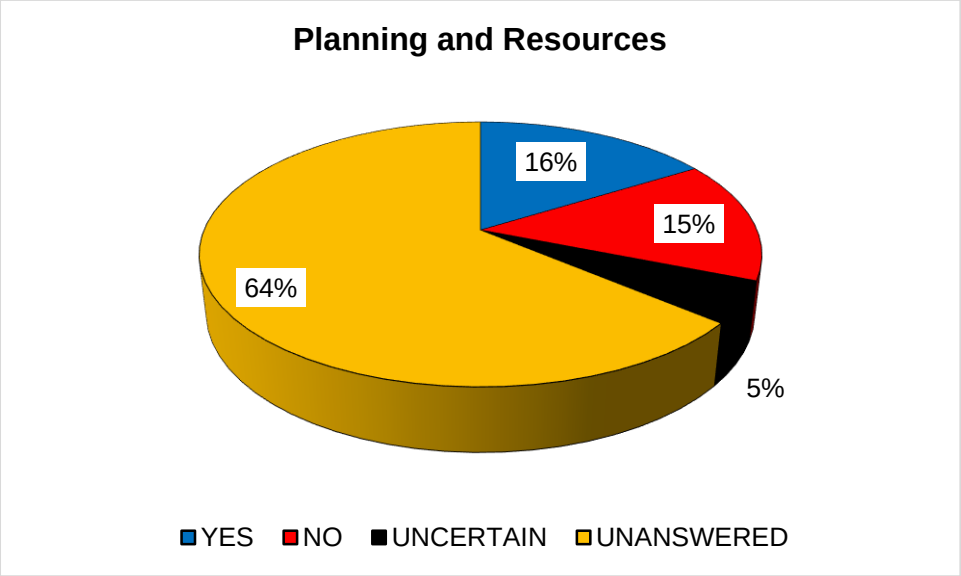


Figure 11. Responses by percentage on planning and resources.

Portion of responses indicated high regard for ULO project personal and management to work closely with other CEPA staffs and Department of National Planning and Monitoring to develop a sustainable used lubricants and oil management system for PNG. This approach should not restrict continuous consultation with stakeholders and other intellectual communities. All in all, there were already several options that identified ULO as a resource under waste sector that can be utilized in a more environmentally friendly, and sustainable approach.

Recommendation:

- *Utilize established government agencies (IPA, ICCC, and Secretariat of Research Science and Technology) to collect, evaluate and provide information on costs involved in the identified ULO*

Management Approaches, and evaluate impacts to the environment with possible benefit to society, and

- *Periodically, consult Department of National Planning and Monitoring, National Statistics Office, and Mapping Bureau to frame ULO Management System for PNG. The approach should not be restricted to close consultation and interview with stakeholders and GIS Expert in CEPA.*

3.4.2.6 – Record Keeping, Documentation and Data Control

Prior in making any decision for expansion and considering ULO Management Approach(es) in PNG, it should be considered that there needs to be proper records, documentation and data control for the following:

- Multilateral Environment Program (MEA) regulatory documents (Conventions, etc.) guiding movement of all oil products;
- National regulatory documents governing entries, exists, distribution, trading, and usage of all oil products, and disposal of their associated waste afterward;
- Main importers and exporters of all oil products;
- Detailed information (defined in the specific material data sheet) of all oil products entering and exiting shores of PNG. This should be well categorized by an experienced professional;
- Main distributors and suppliers of all oil products in the country;
- Detailed information of all oil products distributed and supplied in the country;
- Detailed information of all oil products purchased by an industry, company, or stakeholder;
- Total oil products required per service schedule by an industry, company, or stakeholder;
- Information on sales of all oil products by wholesalers and retailers to consumers;
- Detailed information on all types and categories of used lubricants and oil generated per schedule and/or year by ULO generators, and
- Information on ULO management approaches (inclusive of approved standards and guidelines).

At the moment, there are still yet many stakeholders interviewed required to keep proper records, document and develop proper data control of used lubricants and oil generated and disposed of.

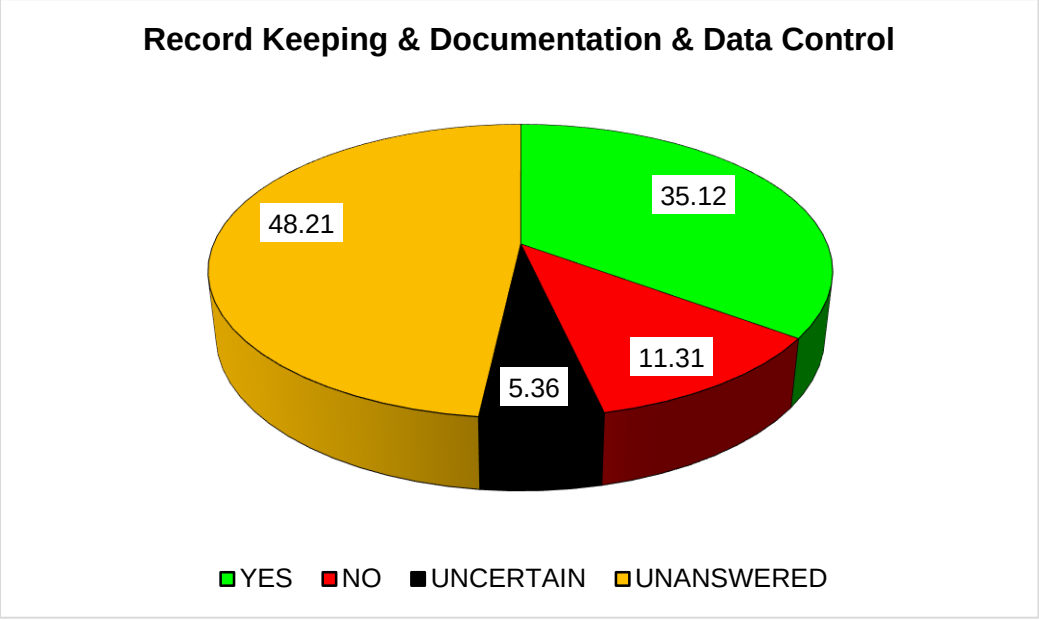


Figure 12. Responses by percentages on record keeping, documentation and data control.

Recommendation:

- *Acquire and do literature review on Environmental Contaminant Act 1978; Environmental Planning Act 1978; Water Resources Act 1982; and Environmental Code of Practice for Vehicle/ Machinery*

Workshops and Petroleum Storage/ Resale/ Usage Sites. These together have been used to develop Environment Act 2000. Thus, the purpose is to set Legal Basis linking with Regulatory and Monitoring System which should later be captured in ULO Management System and Legislation;

- *Develop an inventory and database system for entries of records on all items listed above;*
- *Liaise with PNG Customs, PNG Ports, MVIL, NAC, Department of Transport, ICCC, NSO, Mapping Bureau and other regulatory organizations to support all data entries, records, documentation and data control to assist CEPA with monitoring and regulation and management of used lubricants and oil generated, collected, handled, transported, and disposed in any recognized approach(es) in the country, and*
- *Liaise with CEPA's Information Technology Manager and Geographic and Information System Manager to assist in developing used lubricants and oil database system.*

3.4.3 LEGAL STANDARDS

Legal standards provide set guidelines that support regulation and monitoring of operations and activities. Thus, in CEPA *Environment Act 2000* was enacted by parliament in 2000 while repealing *Environmental Contaminant Act 1978, Environmental Planning Act 1978, and Water Resources Act 1982* in 2003. This made way for gazettal of implementation of *Environment Act 2000* in 2004 (Mowbray D. L., 2015). It also brought about the national environmental regulatory document empowering CEPA to carryout monitoring, regulatory, and enforcement. To assess employees from a particular organization or company from understanding practices required by their respective operation, the following guiding questions were used: if the organization or company kept aware of its environmental liabilities; how does the organization or company comply with the relevant legislation and regulations; are copies of permits, exemptions, relaxations, and other pertinent legal documents kept by the organization or company; if there a list of all the legal standards with which the organization or company needs to comply; if the organization or company regularly negotiate standards with the authorities and jointly review performance on a regular basis; and if the organization or company have a list of principal contacts with regard to legal compliance in the case of regulatory bodies.

Twenty one percent (21%) responses of YES from the survey (Figure 13) indicated that some organizations and companies are being kept aware of their environmental liabilities through following Australian/ New Zealand Standards and not specifically for PNG. Few are kept aware through the provision of environmental advisory services by Environmental and Social Safeguards Unit (ESSU) within the organization. Several others depend on CEPA for information and through their legal team.

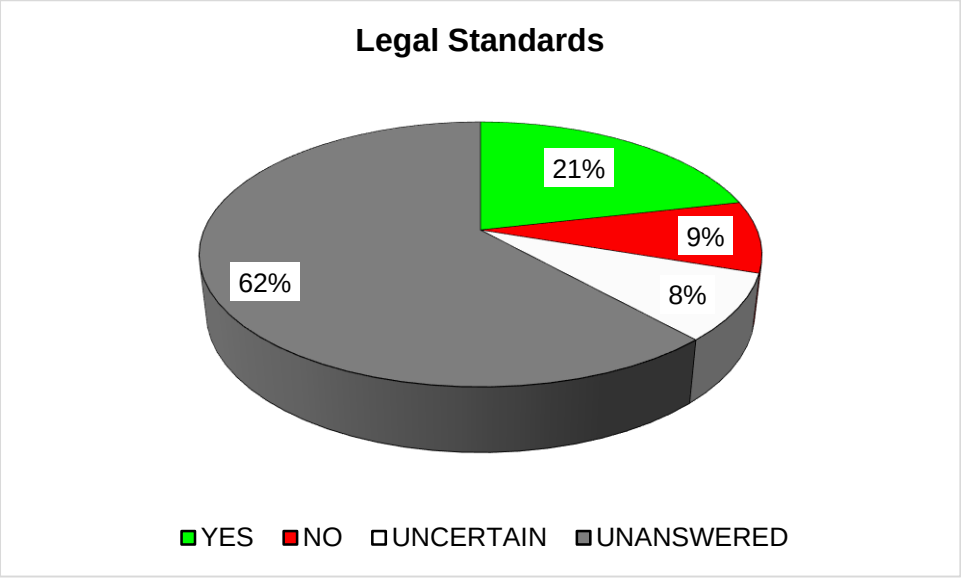


Figure 13. Percentage responses on legal standards.

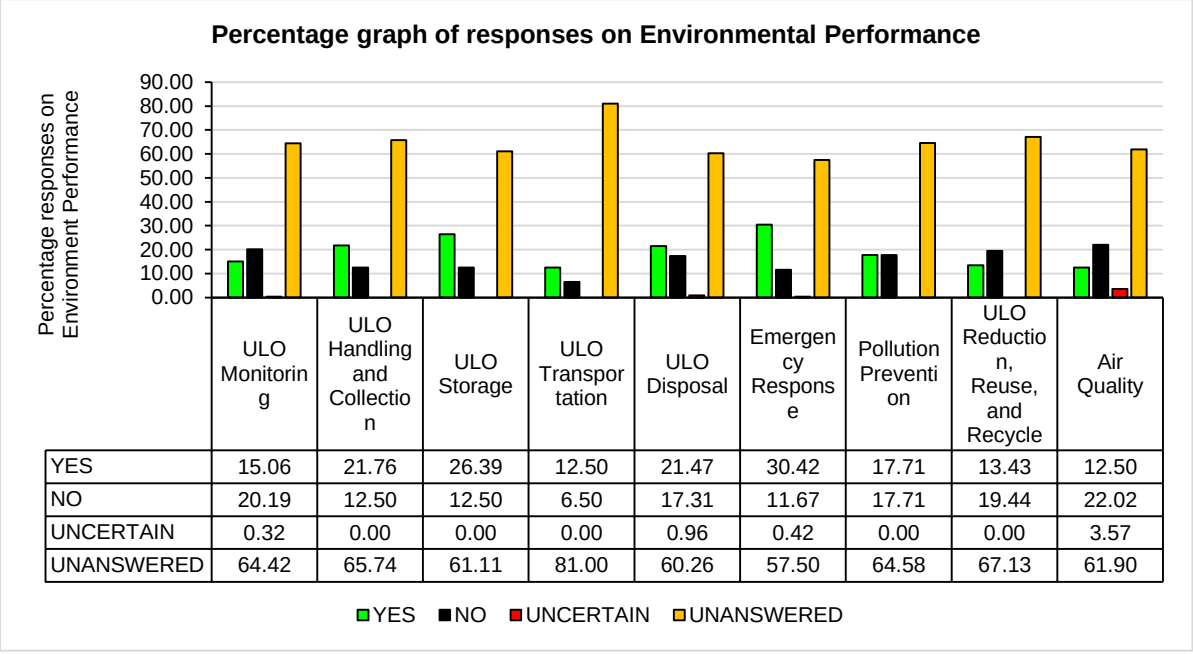
Despite positive responses, there were still at large those who responded not aware of any legal standards (9%) in their companies, few were uncertain (8%), while remaining percentage (62%) did not have time to continue with the interview. Few factors affecting responses from interviews identified were: lack of internal communication, lack of coordination within working environment, and minimal enthusiasm to assist. Most responses were from small to medium scale operations such as service station outlets, small auto parts and motor repairs.

Recommendation:

- *Acquire and review all regulatory documents under CEPA and frame legal basis for ULO Management;*
- *Identify MEAs, international environment standards and guidelines addressing issues on hazardous and waste management and in particular ULO, and*
- *Identify gaps and links between the national regulatory documents and suggest where ULO Management can fit in accordingly.*

3.4.4 ENVIRONMENTAL PERFORMANCE

Discussed earlier in Sub-section 3.1.2.5 – Planning and Resources, CEPA is mandatory through *Environment Act 2000* to ensure PNG improve its environmental performance indicated in Vision 2050, Pillar 5 on Environmental Sustainability and Climate Change. From an improved approach on brown economy to green economy according to StaRS, greening of economy is not a drag on economic growth but rather a new engine for growth. It is a net generator of decent jobs, and is also a vital strategy for the elimination of poverty and the achievement of development goals such as Millennium Development Goals, human development and sustainable development goals (Department of National Planning and Monitoring, 2014). From this outlook it was indicated that investment is needed to create decent jobs and increase income in environmentally significant sectors including; Renewable energy: Hydro, Solar, Wind, Bio-gas, biodiesel and geothermal, Green Agriculture, Greening of transport system, Waste management, Small and medium enterprise development, and Greening of buildings, cities and towns.



	ULO Monitoring	ULO Handling and Collection	ULO Storage	ULO Transportation	ULO Disposal	Emergency Response	Pollution Prevention	ULO Reduction, Reuse, and Recycle	Air Quality
YES	15.06	21.76	26.39	12.50	21.47	30.42	17.71	13.43	12.50
NO	20.19	12.50	12.50	6.50	17.31	11.67	17.71	19.44	22.02
UNCERTAIN	0.32	0.00	0.00	0.00	0.96	0.42	0.00	0.00	3.57
UNANSWERED	64.42	65.74	61.11	81.00	60.26	57.50	64.58	67.13	61.90

Figure 14. Percentage responses on Environmental Performance.

There were total of nine (9) factors with specific questions under each used to assess general environmental performance on ULO by stakeholders. It was challenging to actually determine measurement on environmental performance from the assessment. Hence, results (Figure 14) show

that not all sections were thoroughly completed. The overall environmental performance was evaluated as follows: H = high magnitude; M = medium magnitude, and L = low magnitude. On the other hand, rate of performance was evaluated as: 1 = poor, urgent remedial action required; 2 = substandard, remedial action necessary; 3 = improvement advised; 4 = maintenance required, and 5 = excellent, minimal maintenance required. Furthermore, in the case where all responses under each questions were evaluated together, magnitudes were given the following values: H = 1, M = 2, and L = 3. These were averaged and evaluated as H, M, or L according to the final magnitude value.

3.4.4.1 – Used Lubricants and Oil Monitoring

Prior defined earlier in this report from Annex I of Basel Convention in waste streams Y8 and Y9, used or waste oil fall under categories of waste to be controlled. Waste contained in Annex VIII of Basel Convention are characterized as hazardous under Article 1, paragraph 1 (a) of the Convention. Used or waste oils can further be captured under Annex VIII, A4 – Wastes which may contain either inorganic or organic constituents. Included thereunder specifically is A4060 Waste oils/water, hydrocarbons/water mixtures, and emulsions. Therefore, ULO monitoring in terms of quality testing and certification should prior be engaged before considering disposal or further management approach.

Questions under this sub-category was developed to ensure stakeholders dealing with lubricants and oil products and ULO generated understand well some indicative measures on ULO. Mostly inclusive hereunder were measures to test constituents of used lubricants and oil and qualitatively quantify its significance prior to making further decisions on managing it (Appendix VII). Used lubricants and oil might become contaminated with polychlorinated biphenyls (PCBs), heavy metal and other elements, and degradation of its set physical properties during combustion and hours of work disallowing its normal functions. Results have indicated that only 15.06% from the total surveyed stakeholders engage laboratories from either abroad or internally to test oil and ULO samples. Some of the recognized laboratories who test oil and ULO samples mentioned were University of Technology – Applied Chemistry Laboratory in Lae, Intertek in Port Moresby, Australian Laboratory Services (ALS) in Australia, and Societe Generale de Surveillance (SGS) in Geneva, Switzerland.

In contrast to those who considered oil and ULO sample tests, there were others (20.19%) who indicated that the approach was not considered. Meanwhile, 0.32% from responses were uncertain of such approach while 64.42% did not indicate any status. Most who engage oil and ULO sample tests were from major stakeholders in the petroleum (oil and gas) sector. The remaining larger portion of uncertainties or no indication were mostly from few larger, medium, and small ULO generators under the seven broad waste generating sectors surveyed. However, not all stakeholders from all over the country were interviewed. This would mean that there is still yet detailed survey and pilot study required to cover all industrial sectors around PNG industrial sites.

Recommendation:

- *Detailed Pilot Survey nationwide required to assess ULO monitoring and management options;*
- *Capture and highlight ULO monitoring during cost benefit analysis of ULO Management Options, and*
- *Workshop required to segregate and indicate who, how, where, and when oil and ULO testing be applied to cater for small, medium, and few large scale generators of ULO prior to taking further management and/or disposal options.*

3.4.4.2 – Used Lubricant and Oil Handling and Collection

Considering movement of used lubricants and oil within the country and/or between Papua New Guinea and other countries, proper management capturing handling and collection is prior required. Most major companies and stakeholders operating in PNG do have specific guides and regulations on handling and collection of waste. Proper handling and storage would assist minimize accidents and injuries, and environmental issues. There are several regulatory documents set by CEPA provided to guide and ensure developers comply with national requirements under the Environment Act 2000. Environmental

Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage Sites published in 1997 is one providing guidelines aimed at improving and maintaining level of environment performance in industrial sectors. It further aimed at providing industry participants to basic technical knowledge/ guidelines to assist environmental impacts associated with daily activities and operations, decision makings and reviewing of environmental impacts.

Responses from survey show that 21.76% have set guidelines they comply with. Most of these stakeholders use guidelines that were set from international standards. Some companies use material safety data sheets for handling of chemicals responding to emergencies. Others refer to handling requirements outlined in Hazardous Substance Management (HSM) and Waste Management Procedures (WMP). However, there were still yet others who suggested improvement on handling and collection of ULO procedures. Few were uncertain on any existence of handling and collection guidelines while a portion stated that the current practices are not effective. Larger percentage (65.74%) did not provide any feedback due to various unknown reasons mainly due to schedule. The overall performance of responses show medium level of impact while requiring improvement advises. This have indicated a point to consider when developing ULO legislation.

Table 15. Performance rating on ULO handling and collection[1].

QUESTIONS	A1	A2	A3	A4	A5	B	C	D	E
Magnitude Impact	M	M	M	M	M	M	M	M	M
Performance Rate	3	3	3	3	3	3	3	3	3

Recommendation:

- *Form a committee that could review and evaluate Environmental Contaminant Act 1987, Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage Sites, and Environment Act 2000 prior to adopting and developing specific ULO Code of Practice enforced under ULO legislation that would be developed later during the project.*

3.4.4.3 – Used Lubricants and Oil Storage

Around the world, a number of very serious accidents involving massive damage to property and multiple fatalities have been traced back to improper storage of hazardous, and in particular, incompatible chemicals (Global Environmental Facility, 2016). Cases of accidents in other countries especially on oil spills provide clear warning examples highlighting the need for proper storage, take proper account of environmental risk involved in storage facilities, quantity of storage, detailed information on quality of ULO being stored including labels, period of storage, storage requirements and guidelines for ULO, storage handling procedures, reliability of storage conditions, appropriate storage handling equipment, and reliability of allocated budget for ULO storage. The combined challenges of lengthy procurement processes, provision of appropriate storage facilities and maintenance of such facilities where they do exist, lack of appropriate disposal options, cost of proper disposal, lack of knowledge and training and lack of regulatory frameworks all add to the issue of safe storage of chemicals in the Pacific Islands (Global Environmental Facility, 2016).

Responses from interviews suggested that a fair representation (26.39%) of those who consider storage of ULO as a requirement. Used lubricants and oil are stored mostly in 200 L drums or 4,000 L tanks and kept in waste management areas as example in Figure 15. Moreover, some companies have no specific requirements but in concern over environment issues advise contractors to store ULO in enclosed areas. Few others have efficient storage facilities while complying with Material Safety Data Sheet (MSDS) and instructions from manufacturers. Although these companies do regular checks,

[1] Performance Ratings were evaluated from Appendix VII

there were yet not proper storage and handling procedures, guidelines, and standards established within companies interviewed (refer to Appendix VII). At the moment, some stakeholders do not separate ULO from different usage due to costs, however, store all ULO in one storage container.

Figure 15. Example of a clean Oil and ULO storage area in a small workshop.

Table 16. Performance rating on ULO storage factors[1].

QUESTIONS	A1	A2	A3	A4	A5	B	C	D	E	F	G	H
Magnitude Impact	M	L	M	L	L	M	M	H	M	M	H	H
Performance Rate	4	4	4	4	4	4	4	4	3	4	5	5

Generally, most ULO storage requirements show low to medium environmental impacts, therefore, stakeholders ensure good storage practices are performed despite lack of proper storage documents and guidelines. However, these still require further improvement as suggested to for proper record keeping, data control, and guides to properly manage issues of ULO.

Recommendation:

- *Develop guideline for proper handling, storage, record keeping, and transporting of ULO based on Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage Sites.*

3.4.4.4 – Used Lubricants and Oil Transportation

Transport by air, sea or road is regulated by various international and/or national standards such as the UN Model Regulations, the Australian Dangerous Goods (ADG) Code and International Maritime Dangerous Goods (IMDG) Code (Global Environmental Facility, 2016). In Papua New Guinea, the following are Acts and Regulations regulating activities relating to transport sector:

- LAND TRANSPORT – National Road Safety Council Act 1997;
- MOTOR TRAFFIC REGULATION – Licencing of Heavy Vehicles Act 1977, Licencing of Heavy Vehicles Regulation 1977;

- OFFICE OF TRANSPORT SECURITY – Merchant Shipping Act 1975, Merchant Shipping (Maritime Security) Regulation 2005;
- SMALL CRAFT REGULATION – Small Craft Act 2009;
- NATIONAL MARITIME SAFETY AUTHORITY ACT – National Maritime Safety Authority Act 2003, National Maritime Safety (Regulatory Functions Levy) Regulation 2006, and
- CIVIL AVIATION ACT (CAA) – Civil Aviation Act 2000.

Previously discussed in Section 3.3 – Used Lubricants and Oil Management Approach, options 3, 5, 6, 7, and 10 mostly require transportation of ULO between generators and contractors or suppliers, and between contractors to recyclers, disposers, or end users. Prior to movement of ULO and other general wastes, certain factors considered during interviews include: existence of transport requirements and rules relating to ULO for both international/ national; compliance with up-to-date standards; efficiency of compliance to national and international transport regulations; budget efficiency to transport and logistics of ULO; efficiency of transport equipment and facilities; reliable means of transporting ULO; existence of tracking procedures; and information on physical characteristics of ULO being transported.

Though responses on performance rating was poorly recorded, interviews indicated that 12.50% follow certain transport requirements and comply with standards of transport operation. For transportation of ULO, suppliers of oil and contractors transporting ULO mentioned complying with Part 92 of the Dangerous Goods Transport which is a requirement by CAA. Others rely on other waste management services requirement while few depend on contractors, and very few were uncertain on practices subdue to any guidelines and/or code of practices (Figure 16).

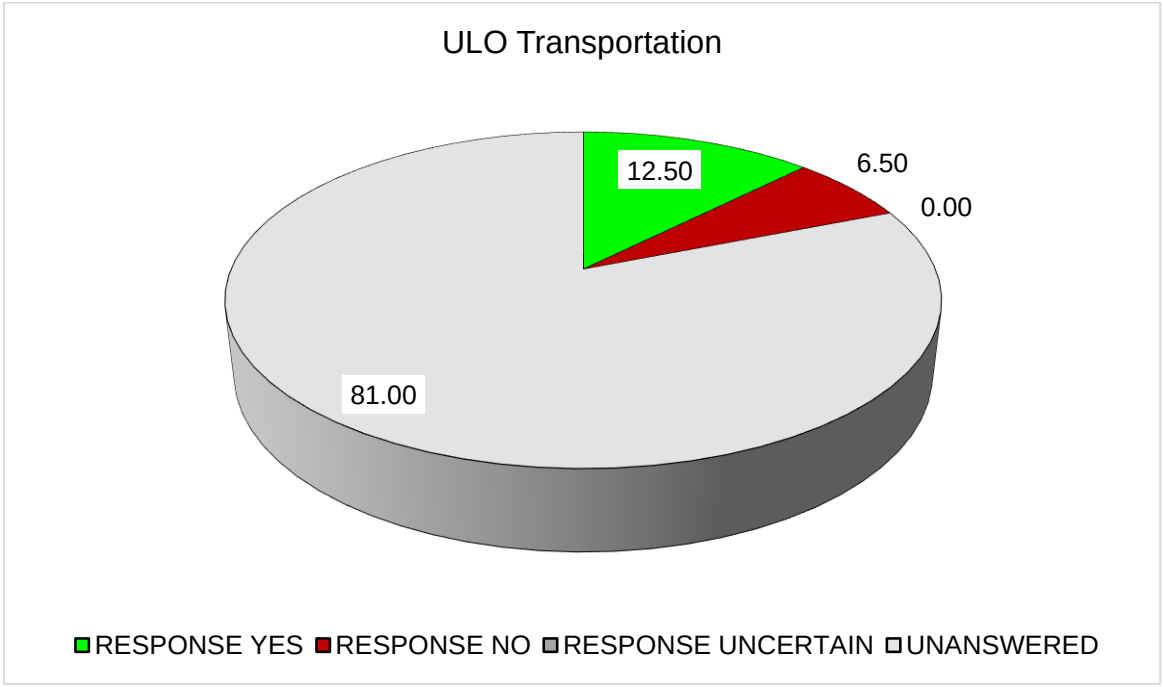


Figure 16. Percentage responses on Environmental Performance.

Most ULO are transported via roads and sea while majority of big companies and developers have tracking systems which those who responded were through chain of custody form. In most occasions, ULO are transported in the form of liquid, sludge, and solid when at times mixed with soil. Most times, ULO when transported on roads consider local weather conditions that might increase possibility of accidents. Larger portion (81%) of those who never commented were due to various other inconsistent factors: reluctant to further provide information, continuous postponing of follow-up visit to complete interviews, and person in charge never turned up during follow-up for interviews. Despite these responses, it was determined that any movement of all goods and services should comply with all Acts and regulations listed above.

Recommendation:

- *Review and capture ULO Transportation during cost benefit analysis;*
- *Do a literature review on all national transportation Acts and Regulations together with those Multilateral Environment Agreement (MEAs) governing trans boundary movements of hazardous wastes;*
- *Compile and further recommend best practices of transportation of ULO in line with Environment Act 2000 and other of its regulatory documents.*

3.4.4.5 – Used Lubricants and Oil Disposal

Section 2 of the *Environment Act 2000* have interpreted prohibiting to establish on land a site where disposal of wastes may become unduly offensive to human or that does not comply with any standard prescribe for the contaminant. Under this survey, ULO disposal is commonly regarded as ULO management options in which twelve options were identified. There might be several other management options practiced elsewhere not covered in this survey. However, most options identified were orientated toward recycling, reuse, and recovering. All ULO disposal and/or management options must comply with *Environment (Prescribed Activities) Regulation 2000* in accordance with *Environment Act 2000*.

Factors assessed under this category were focused on: promotion of environmental friendly and/or sustainable approaches to disposing or managing ULO; conduct ULO awareness internally and/or to outside communities; compliance with national and international regulations and requirements; and reliability of company to address concerns of disposal approaches with regulatory bodies and surrounding communities. Table 17 provide summary of responses that can be obtained in table of this section in Appendix VII.

Table 17. Summary of responses on ULO disposal.

Factors	Summarized Responses	Recommendations
A. Promoting environmental friendly and/or sustainable approaches to disposing or managing ULO	▪ Those who have disposal standards and guidelines suggested improvement; ▪ There were others especially several medium and minor companies does not have any disposal strategies, while ▪ Others promote reusing of ULO	▪ Expand from those ULO Management Approaches that are cost effective and have lower chances of increasing environmental impacts (Approaches: 1 – 6); ▪ Consider establishment of ULO Approaches 1 and 2 setup in those high industrial activity areas to cater for ULO from all other sectors generated, and ▪ Consider thorough assessment of CBA into the recommended approaches.
B. ULO Awareness	▪ Some stakeholders carryout awareness internally through inductions and reporting while others visit different community levels but conduct awareness on all hazardous substance apart from ULO, while ▪ Few others do not engage in any awareness activities.	
C. Compliance with national and international regulations and requirement.	▪ Responses suggested that most companies considered CEPA approved waste management companies/ contractors to manage their ULO, while few were uncertain;	

D. Reliability to address concerns of disposal with regulators and surrounding communities	▪ Responses from most small, and several medium scale companies do not get reports nor have records of complains from disposal of ULO	

3.4.4.6 – Emergency Response

Environmental Contaminant Act 1987, Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage Sites contains descriptions on practices of risk management and emergency response. Considerable factors assessed for this purpose under emergency responses were: availability of emergency response plan (ERP); compliance to ERP; reliability of ERP equipment; and effectiveness of communication during emergency responses.

Table 18. Summarized responses on Emergency Response.

Factors	Summarized Responses	Recommendations
A. Emergency response plan availability with stakeholders	▪ Responses have indicated that 30.42%[2] from interview have Emergency Response Plan (ERP) to handle chemical incidents including oil/ ULO spills; ▪ There were also availability of emergency responses kits but not documented in Company Safety Manual; ▪ Most major companies interviewed have ERP available and accessible to staffs while those smaller ones do not have any ERP.	▪ Duties of respective stakeholders to consult and ensure to maintain effective communication with regulatory bodies during emergency responses.
B. Compliance of emergency plan to national and international standards and guidelines	▪ Despite those stakeholders who have ERP, they have commented requiring regulatory documents and guidelines from CEPA	
C. If employees or staffs fully equipped, certified, and prepared for oil/ ULO emergency responses	▪ Most industries promote safety as priority, and have basic emergency kits and personal protection equipment available on site with basic trainings conducted.	
D. Effectiveness of communication during emergency responses	▪ Though most companies have effective communication system established internally, they still require effective communication established between regulatory bodies.	

[2] Appendix VII – Emergency Response

3.4.4.7 – Pollution Prevention

Pollution prevention can be referred to as producing less of the pollutant or waste in the first place, or sometimes eliminate it (Section 3.3). In considering waste management, pollution prevention should be at the top of waste management hierarchy. Pollution prevention (P^2) can involve changing a process so that it produces less pollution, or sometimes none at all (Hill, 2010). There were four factors associated with interviews and survey on pollution prevention as indicated summarized below:

Table 19. Summarized responses on Pollution Prevention.

Factors	Summarized Responses	Recommendations
A. If company meet and discuss regularly on measures to consider on pollution control.	▪ Most major stakeholders capture discussion on this factor in baseline reports, while others meet regularly on monthly basis for Health and Safety Environment updates and on daily toolbox talks; ▪ Those who deal with logistics in mine sites and industrial areas adhere to Safety Management Systems adopted in OHSE, while ▪ Those from some small and few medium scale stakeholders rarely meet to discuss pollution control measures.	▪ Identify cost effective measures, low environmental risk factors, and better social benefits to the identified ULO management approaches based on the waste management hierarchy prior to considering expansion in the country.
B. Have pollution control measures been implemented to minimize the potential effect/s of used lubricants and oil contamination on: land surface, surface water, ground water, and sea surface?	▪ Responses from few stakeholders indicated that evaluations and consideration of improvement on pollution controls are based on hazardous incident reporting, while ▪ Others are not aware of any measures mainly due to lack of regular meetings and discussions.	
C. Is/ are there any contingency plans available or have been implemented by the stakeholder?	▪ Those who have guidelines and Code of practices are guided by the documents to promote Environmental Best Practice while others though have ERP, it does not specify information on oil/ ULO.	

3.5 Summary of Results

From the overall audit/ survey more than fifty participating stakeholders were requested and consulted to assist with the survey and inventory. Not all responses were positive and neither all questions on the checklist were completed (Table 20). However, almost fifty percent (50%) or twenty four (24) of the total requested stakeholders assisted to the successful completion of ULO survey during the scheduled timeframe. Surveys and questions covered four main areas namely: environment policy; environmental management systems; legal standards; and environment performance. Responses from set questions under the categories (Appendix VII) were checked YES, NO, UNCERTAIN, while those unanswered were recorded as UNANSWERED.

Table 20. Overall participation from the audit and inventory surveys.

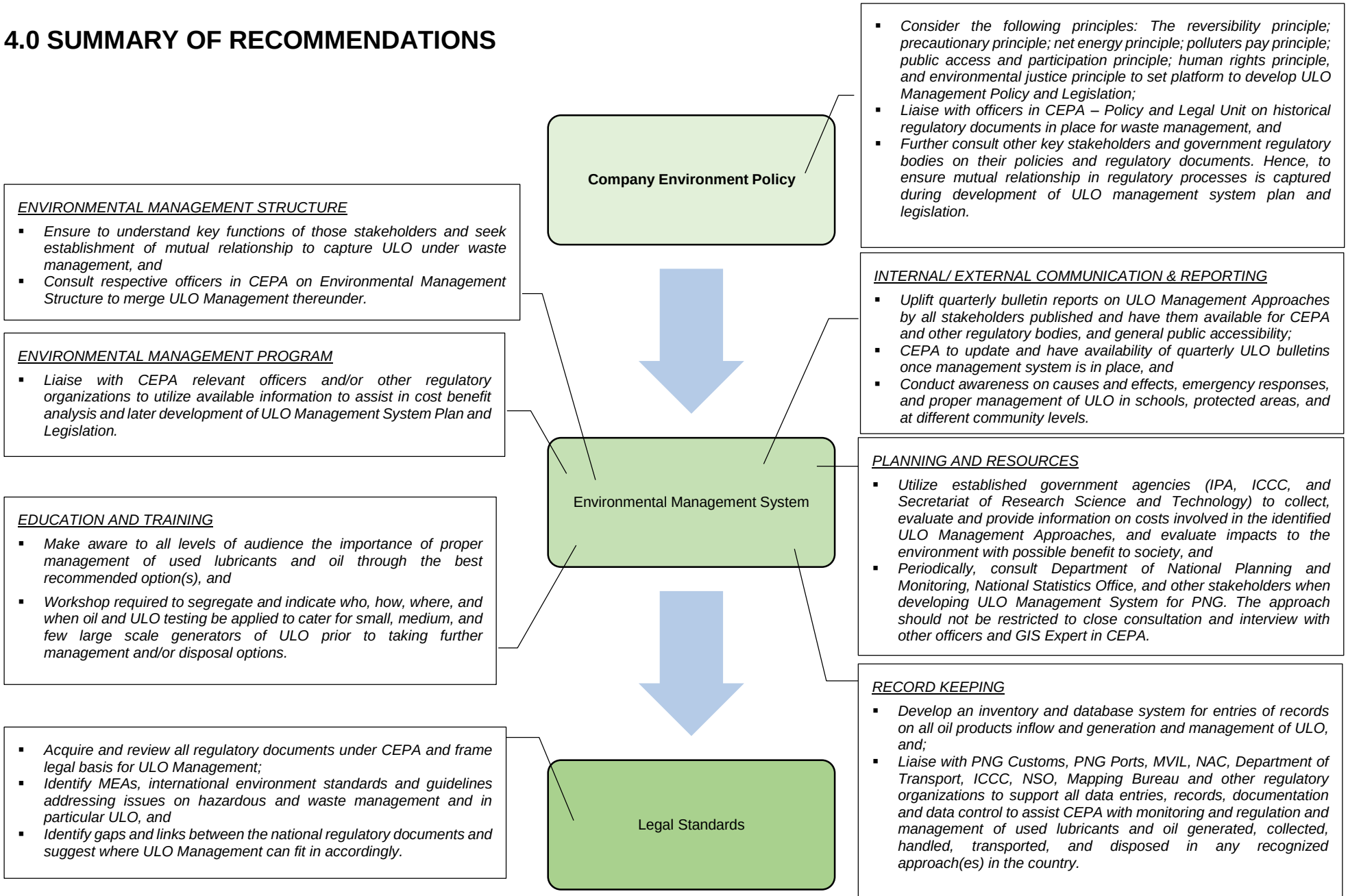
OVERALL PARTICIPANTS: AUDIT & INVENTORY			
	TOTAL	RESPONDED	NOT RESPONDED
COUNT	50	24	26
PERCENTAGE	100	48	52
% DIFFERENCE	4		

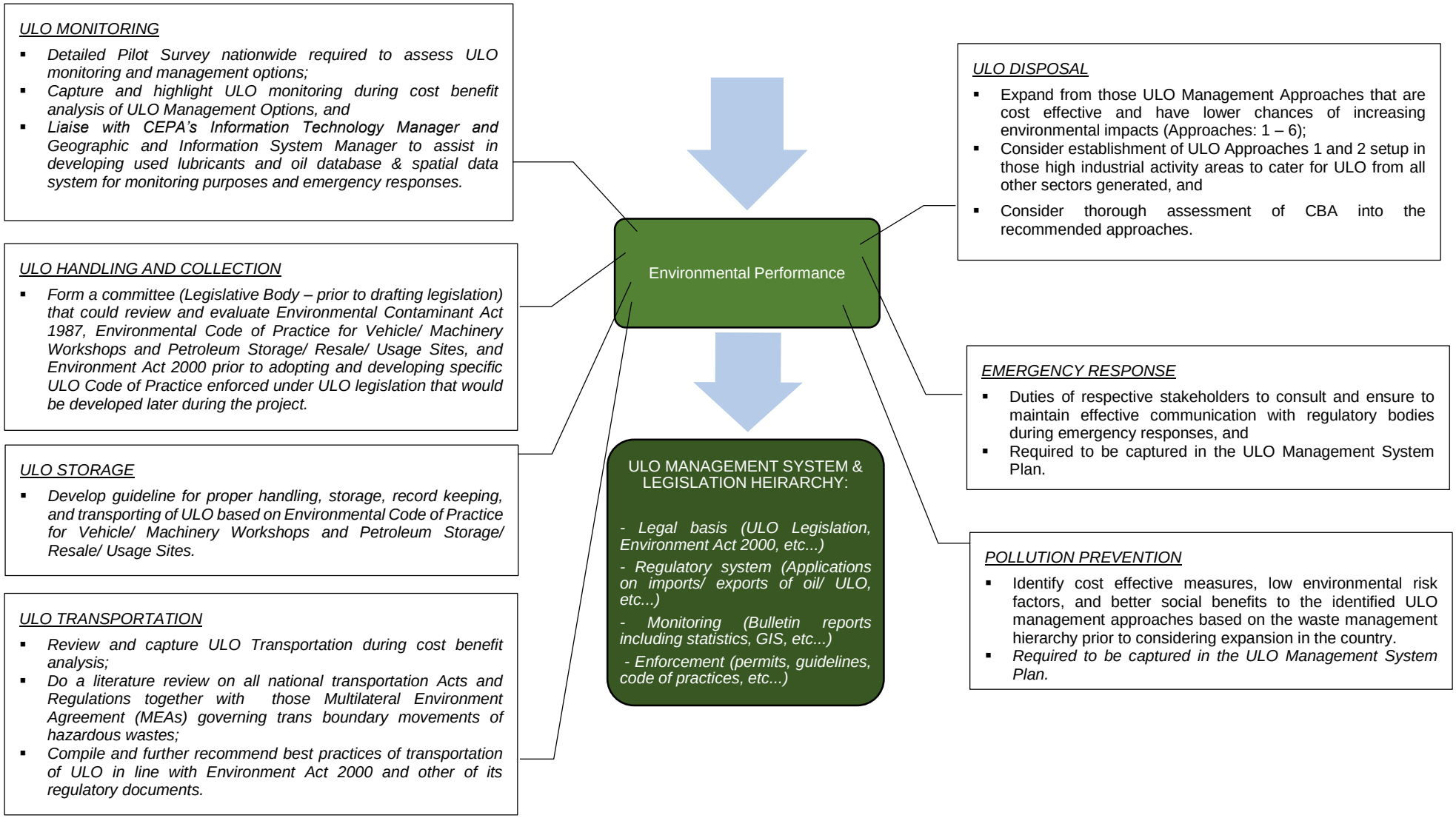
This survey was only done in Port Moresby while at least three participating stakeholders from Lae (Niugini Oil Company) and Ok Tedi Mine Limited in Western Provinces took part through emails, and brief interviews when in Port Moresby on duty travels. Oil Search Limited though have the office located in Port Moresby have participated as well through a representative who attended the first National Steering Committee Meeting in November 18th 2016 while on work break. Representatives of these stakeholders are sincerely acknowledged. Despite survey being Port Moresby based, other government departments and regulatory bodies, and a recognized waste management company assisted chiefly with statistics and information representable for the country.

Demand for oil products in Papua New Guinea depend on productions from various industrial sectors. These sectors were considered also as waste generating sectors of which generation of ULO thereunder significantly fluctuate with usage of oil products. Statistical evaluation and responses from survey on net oil imports and ULO generated from industries have shown increase over the past five years despite sharp decline in 2015. However, estimated ULO determined for automotive and transport sector specifically for road transport equipment proved ($R^2 = 0.95$) to increase steadily by 0.41% or 106,541.88 L/ year. It was estimated that ULO from road transport equipment for current year, 2017 to 2021 forecasted would continue to increase at the same estimated rate over the outlook period. Thus, comparing ratio of transport equipment used oil to industrial used oil of 1:5 suggested that industrial activities in PNG are constituted by far largest consumption of lubricants and oil compared to transport sector.

In considering management approaches of used lubricants and oil generated, there were already twelve (12) ULO Management Approaches identified in PNG. These were assessed and evaluated based on cost assumptions and environmental risk assumptions using simple risk assessment matrix. Approaches 1 (engage bioremediation technique) and 2 (waste oil recovering on site using advanced technology of mobile waste processing unit) were highly ranked best approaches. As they both promote paradigm shift from ‘brown economy’ to ‘green economy’ as mentioned earlier in Sub-section 3.4.2.5 on Planning and Resources. ULO Approaches 3 to 6 though were emphasized sending ULO to contractors and suppliers, most end up in industrial boilers and burners. Most companies in mines have other specific disposal approaches according to their respective Environmental Management Plan. However, the most common approach was to use in industrial boilers and burners, or in kilns. In general, there is yet a need for a pilot survey or workshop be conducted to acquire collective information from other centers in PNG as well.

4.0 SUMMARY OF RECOMMENDATIONS




ULO MONITORING
Detailed Pilot Survey nationwide required to assess ULO monitoring and management options;
Capture and highlight ULO monitoring during cost benefit analysis of ULO Management Options, and
Liaise with CEPA's Information Technology Manager and Geographic and Information System Manager to assist in developing used lubricants and oil database & spatial data system for monitoring purposes and emergency responses.
ULO HANDLING AND COLLECTION
Form a committee (Legislative Body – prior to drafting legislation) that could review and evaluate Environmental Contaminant Act 1987, Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage Sites, and Environment Act 2000 prior to adopting and developing specific ULO Code of Practice enforced under ULO legislation that would be developed later during the project.
ULO STORAGE
Develop guideline for proper handling, storage, record keeping, and transporting of ULO based on Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage Sites.
ULO TRANSPORTATION
Review and capture ULO Transportation during cost benefit analysis;
Do a literature review on all national transportation Acts and Regulations together with those Multilateral Environment Agreement (MEAs) governing trans boundary movements of hazardous wastes;
Compile and further recommend best practices of transportation of ULO in line with Environment Act 2000 and other of its regulatory documents.
Environmental Performance
ULO MANAGEMENT SYSTEM & LEGISLATION HEIRARCHY:
- Legal basis (ULO Legislation, Environment Act 2000, etc...)
- Regulatory system (Applications on imports/ exports of oil/ ULO, etc...)
- Monitoring (Bulletin reports including statistics, GIS, etc...)
- Enforcement (permits, guidelines, code of practices, etc...)
ULO DISPOSAL
Expand from those ULO Management Approaches that are cost effective and have lower chances of increasing environmental impacts (Approaches: 1 – 6);
Consider establishment of ULO Approaches 1 and 2 setup in those high industrial activity areas to cater for ULO from all other sectors generated, and
Consider thorough assessment of CBA into the recommended approaches.
EMERGENCY RESPONSE
Duties of respective stakeholders to consult and ensure to maintain effective communication with regulatory bodies during emergency responses, and
Required to be captured in the ULO Management System Plan.
POLLUTION PREVENTION
Identify cost effective measures, low environmental risk factors, and better social benefits to the identified ULO management approaches based on the waste management hierarchy prior to considering expansion in the country.
Required to be captured in the ULO Management System Plan.

5.0 PROPOSED ACTION ITEMS

Based on the survey outcome, the following Action Items listed were duly discussed and finalized via the National Coordination Committee (NCC) Members during the 2nd NCC Meeting on 6th June 2017. Thus, the action items were certified executable for the 3rd Project Component, Cost Benefit Analysis, based on experiences and challenges encountered during rollout of the ULO audit and inventory survey:

5.1 – Complete and submit request letter of participation, TOR, and CBA Survey Guides and Questions to IPA, ICCC, Secretariat of Research Science and Technology, and all other stakeholders and individuals to assist with cost benefit analysis.

5.2 – Involve stakeholders to provide brief reports capturing main points on Cost Benefit Analysis on used lubricants and oil disposal and/or management approaches in practice;

5.3 – Seek assistance within CEPA to collate specific information provided by stakeholders on oil products requirement, used lubricants and oil generation, and management and disposal afterward, and

5.4 – Consult managers and relevant officers in CEPA to assist with reviewing and providing guidance to develop a proper ULO Regulatory Framework in accordance with *Environment Act 2000* and its regulatory documents prior to building up a ULO Management System Plan.

6.0 PROPOSED USED LUBRICANTS AND OIL STEWARDSHIP

Evaluation from this survey have preferred the first six (6) ULO Management Approaches over the others. Based on brief interview and responses from those who practice these approaches, they are cost effective and have minimum chances of increasing environmental impact. It is hereby, considered over how they are applicable with SPREP's proposed ULO stewardship program for the Pacific Islands. Hence, this will further be utilized during cost benefit analysis survey. Meanwhile, this was used to propose and develop ULO stewardship system suitable to be considered in PNG (Figure 18). The Proposed ULO stewardship system for PNG is purposed to capture the notion of *Extended Producer Responsibility (EPR)* as reflected also from SPREP proposed used oil stewardship system. The advantages of ULO stewardship system include:

- ✓ *Environmental Benefits* – a well-established and managed Stewardship system will encourage the user to return used oil and not dispose in an un-environmentally friendly manner, and
- ✓ *Equitable Cost Distribution* – A financial incentive for the consumer to return used oil and the funds to manage collection and disposal/ export of used oil (SPREP, Used Oil Stewardship Program for the Pacific Islands, 2015).

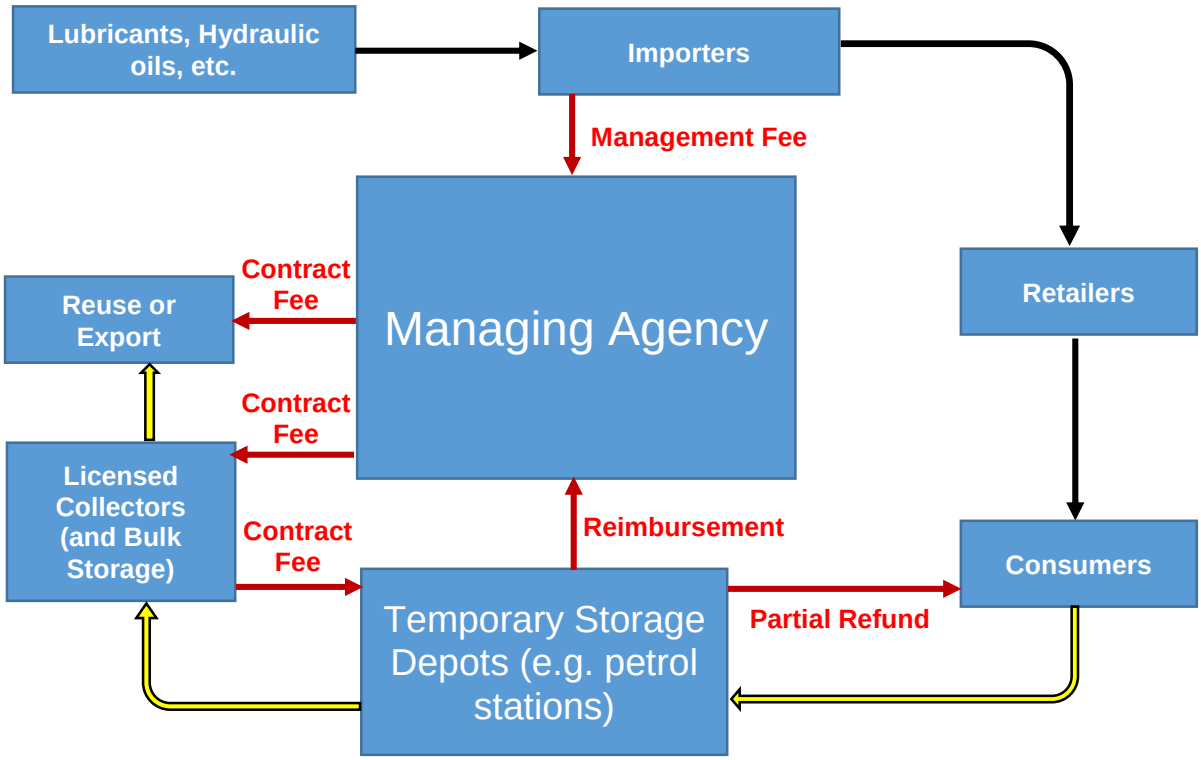


Figure 17. Used oil stewardship system proposed by SPREP for the Pacific Islands.

Cost involved from importation (inflow) and the trading through various entities of lubricants, hydraulic oils, and of the related products are represented by the black arrows. Consumers of lubricants and oil products are also regarded as the used or waste oil generators. For this reason, ULO stewardship system is developed to ensure that used oil generated must be managed appropriately by collecting and supplying to temporary storage depots, and further supply to licensed collectors or bulk storage for reuse or exports as depicted with yellow arrows. During the inflow of lubricants and oil products, and outflow of used lubricants and oil, established managing agency/agencies is/are responsible to regulate movement of the flows through various management fees as portrayed with red arrows (Figure 17). From surveys larger and few medium companies manage ULO in their own accord. However, majority would be from individuals, small, and some bigger industries who would still require proper options to dispose or manage ULO. Therefore, the proposed ULO Stewardship for PNG was developed and later will be properly evaluated and finalized during development of ULO Management System.

Black: Increased Cost (Inflow of Lubricants and Oil related products)

Red: Contract & Service Fee, and Partial Refund (ULO Management Approach)

Blue: Management Fee and Reimbursement

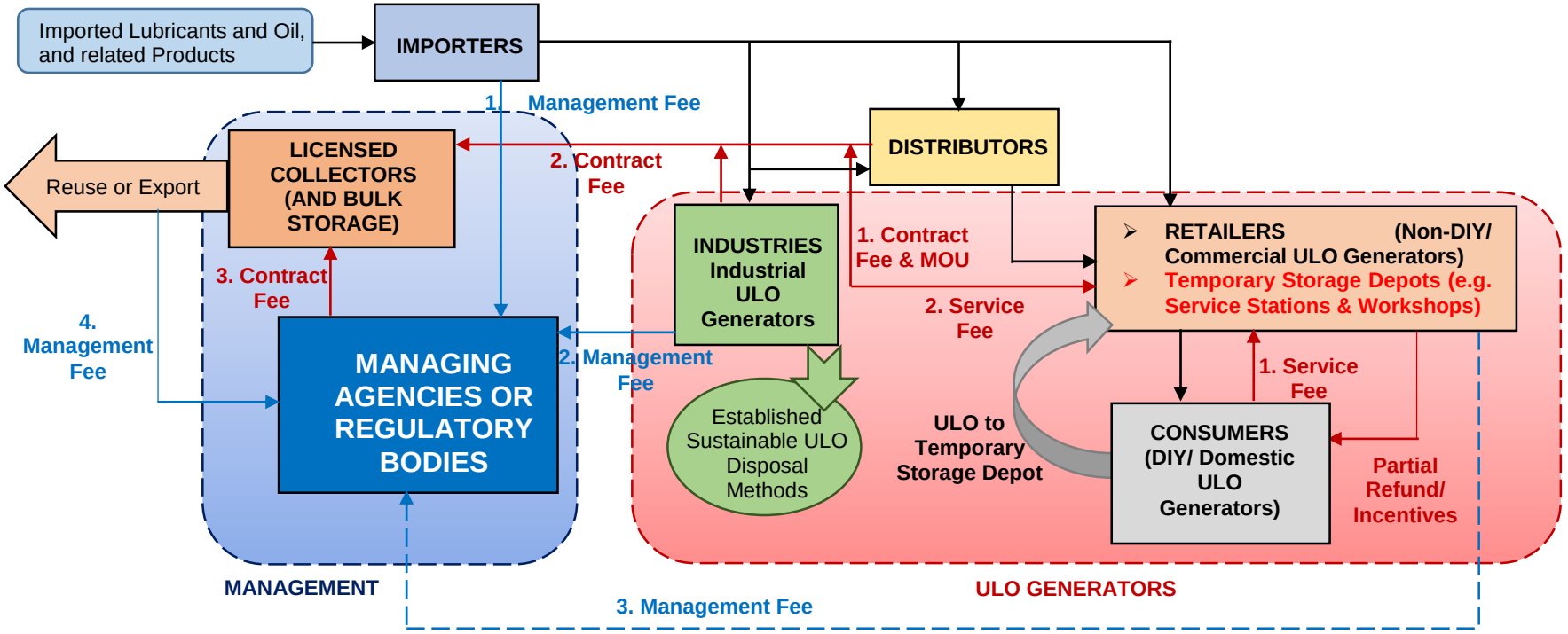


Figure 18. Proposed Used Lubricants and Oil Stewardship System for Papua New Guinea.

Proposed Used Lubricants and Oil Stewardship System for Papua New Guinea

Cost Benefit Analysis guided by the proposed ULO Stewardship system for PNG will incorporate some of the Economic Instruments captured in the Application of Economic Instruments to Solid Waste Management in Pacific Island Countries and Territories by SPREP.

In the solid waste management context, economic instruments (EI) refer to a set of tools that makes use of monetary incentives and deterrents in addition to market measures in order to influence waste management behavior. In short, they provide a country with the means to control the generation and disposal of solid wastes. They can also be voluntary and based on Memoranda of Understanding (MOUs), or can be introduced through regulations (Richards, 2009).

There are already established regulatory and management system by the National Government through its agencies, institutions and organizations. Regulating and managing agencies in this assessment can be categorized under: (1) Imports/ Exports Agencies; (2) Internal/ External Trade Agencies; (3) National Commercial and Industrial Operating Managing Organizations, and (4) Waste Management Regulators. Description of proposed ULO Stewardship System for PNG is captured in *Box 1.*

Box 1. Description of Proposed ULO Stewardship System for PNG.

Black Arrow: represents importation of lubricants and oil and related products into PNG. Moreover, it captures fees imposed from external (international) and internal (national) trade regulated by national government agencies such as Bank of PNG, Treasury and Finance Departments, ICCC, and IRC. These monetary mediating agencies support monitory evaluations provided by imports/ exports regulating agencies including PNG Customs, NAQIA, PNG Ports, and Logistical agencies on entries and exits of all goods and services. Monetary evaluations on imported lubricants and oil and related products measured against consumption, outputs and productivity determine flux in retail values in a period of time.

Red Arrow: reflect fees imposed on internal trades and delivery of used or waste lubricants and oil products and services to managing agencies for proper disposal. Fees inclusive under this category are of contract and service fees, and partial refund(s). *There are three categories under temporary storage depot: (1) ULO Recycle buyers are those only focused in opportunity to commercialize ULO; (2) DIFM Generators focused only in collecting and storing ULO from motor vehicle services and maintenance, and (3) Those involve in both commercializing ULO and collecting and temporary storing ULO as under category 2.*

(1) ***Partial Refund*** basically should encourage returning of ULO targeting the DIY generators to temporary storage facilities (e.g. allocated ULO recycle buyer, service stations or workshops and motors). A similar scenario in PNG can be observed from empty cans, plastic bottles, and bottles being collected by consumers and sold to recycle buyers for recycling. This is a non-existing ULO system practiced in PNG. **[Available component – requires implementation]**

(2) ***Service Fee (1)*** reflects DIFMs paying service fees to workshops and motors (DIFM Generators) for oil change. This is a current working system that should be considered absorbed into this ULO Stewardship System. **[Existing component]**

(3) ***Service Fee (2)*** indicates fee payable by Licensed Collectors to temporary storage depot operating under temporary storage depot Category 1 as part of ULO trade. **[Non-existing component at the moment] – a business opportunity**

(4) ***Contract Fee (1) and MOU*** reflects fee payable by ULO Generators under temporary storage depot Category 2 to Licensed Collectors for disposal (reuse or export); or MOU for those who resend ULO to their lubricants and oil suppliers. **[Available component – requires implementation]**

(5) ***Contract Fee (2)*** suggest fees payable by distributors and some industrial ULO Generators to Licensed Collectors. This system is currently practiced in PNG that should be captured as part of this stewardship system**. [Existing component]**

(6) ***Contract Fee (3)*** suggests fee payable by Managing Agency/ies Category 3 to Licensed Collectors for ULO collection/s from Temporary Storage Depots Category 3 for disposal (reuse/ export). This system is also practiced in PNG. **[Existing component]**

Blue Arrow: reflect management fees imposed taxes and fees payable to managing agencies by importers and ULO generators. Fees inclusive under this category are basically Management Fees:

(1) ***Management Fee 1*** imply to fees payable by importers of lubricants and oil products via import duties as part of the fiscal operations of the Central Government**. [Existing component]**
(2) ***Management Fee 2*** refer to fees payable to respective managing agencies by Industrial ULO Generators who have the established ULO Management System. These industries should be assessed and charged accordingly through applicable technique sound to minimize environment disturbance. **[Existing component]**
(3) ***Management Fee 3*** suggest fees payable to Managing Agency/ies Category 3 by temporary storage depots Category 3. This fee is subsidized through Contract Fee 3 to licensed collectors for ULO collection from temporary storage depots under Category 3. **[Non-existing component] – a business opportunity**
(4) ***Management Fee 4*** refer to fees payable by waste management companies to managing agencies or regulating bodies based on all aspects and/or approaches contributing to environmental friendly and sustainable output to the particular environment of disposal.

References

Bank of Papa New Guinea. (2015). *Bank of Papua New Guinea Quarterly Economic Bulletin, December 2014 Issue.* Port Moresby: Bank of Papua New Guinea.

Bank of Papua New Guinea. (2014). *Bank of Papua New Guinea Quarterly Economic Bulletin, June 2014 Issue.* Port Moresby: Bank of Papua New Guinea.

Bank of Papua New Guinea. (2014). *Bank of Papua New Guinea, Quarterly Economic Bulletin, March 2014 Issue.* Port Moresby: Bank of Papua New Guinea.

Bank of Papua New Guinea, T. (2016). *Bank of Papua New Guinea Quarterly Economic Bulletin, March 2016 Issue.* Port Moresby: Bank of Papua New Guinea.

Basel Convention. (1997). Technical Guidelines on Used Oil Re-Refining of Other Re-Uses of Previously Used Oil. Châtelaine, Switzerland.

Costanza, R., Cumberland, J. H., Daly, H., Goodland, R., Norgaard, R. B., Kubiszewski, I., & Franco, C. (2015). 3.6.3 Uncertainty, Science, and Environmental Policy. In R. Costanza, J. H. Cumberland, H. Daly, R. Goodland, R. B. Norgaard, I. Kubiszewski, & C. Franco, *An Introduction to Ecological Economics, 2nd Edition* (p. 167). London: CRC Press, Taylor and Francis Group.

Department of Environment and Conservation. (January 2004). *Environment Act 2000, Operational Manual.* Port Moresby: Department of Environment and Conservation.

Department of National Planning and Monitoring. (2014). *NATIONAL STRATEGY FOR RESPONSIBLE SUSTAINABLE DEVELOPMENT FOR PAPUA NEW GUINEA, StaRS 2nd Edition.* Port Moresby: Department of National Planning and Monitoring.

Global Environmental Facility. (2016, March). Pacific Persistent Organic Pollutants Release Reduction Project. *Chemical Management Training Manual*. Secretariat of the Pacific Regional Environment Programme.

Hill, M. K. (2010). The waste management hierarchy (WMH). In M. K. Hill, *Understanding Environmental Pollution* (p. 34 and 45). New York: Cambridge University Press.

Independent Consumer and Competition Commission. (2013). *REVIEW OF THE COMPULSORY THIRD PARTY MOTOR VEHICLES INSURANCE REGULATORY CONTRACT.* Port Moresby: Independent Consumer and Competition Commission (ICCC).

Independent State of Papua New Guinea. (2001). *Environment Act 2000.* Port Moresby, Independent State of Papua New Guinea: Department of Environment and Conservation.

Mowbray, D. L. (2015, August 10). IEA CREP, Environmental Government in PNG. Port Moresby, National Capital District, Papua New Puinea.

Mowbray, D., & Wagi, S. (2000). *National Profile of Chemical Management.* Port Moresby: Environmental Management and Development, National Centre for Development Studies, Australian National University, and Biology and Environmental Science, University of Papua New Guinea.

Papua New Guinea Customs. (2012 ed). Papua New Guinea Import and Export Customs Tariff. Port Moresby, National Capital District, papua New Guinea.

PNG Chamber of Mine. (2012). *PNG Chamber of Mines and Petroleum*. Retrieved from PNG Chamber of Mines and Petroleum Web Site: http://www.pngchamberminpet.com.pg

Richards, E. (2009). *The Application of Economic Instrument to Solid Waste Management in Pacific Island Countires and Territories.* Apia: The Secretariat of the Pacific Regional Environment Programme.

Roadmap Technical Working Group, i. (2014). *Strategy for climate and disaster resilient development in the Pacific.* Retrieved from http://www.pacificdisaster.net:8080/Plone/roadmap.

SPREP. (2015, July 13th-17th). Used Oil Stewardship Program for the Pacific Islands. Majuro, Republic of Marshall Islands.

SPREP. (2015). Waste Assessment Guide for the Export and Import of Used Lubricants and Used Oil. Apia, Samoa.

SPREP. (2016). Cleaner Pacific 2025. *Pacific Regional Waste and Pollution Management Strategy 2016–2025* (p. 29). Apia: Secretariat of the Pacific Regional Environment Programme.

Total Waste Management. (n.d.). Waste Oil Processing Unit. Port Moresby, National Capital District. Retrieved from http://www.twm.com.pg

Appendix I

Table 21. Summarized data of imported oil products.

HS CODES	HS DESCRIPTIONS	UNIT	2011	2012	2013	2014	2015
27079100	Creosote oil	LTR	4.00	4.00	1.00	-	-
27079900	Oils and other products of the distillation of high temperature coal tars; similar products in which the weight of the aromatic constituents exceeds that of the non-aromatic constituents (excl. chemically-defined compounds, benzol "benzene", toluol "toluene", xylol "xylenes", naphthalene, aromatic hydrocarbon mixtures of subheading 2707.50, and creosote oils)	LTR	-	15,364,964.70	1,595,882.00	1,813.96	86,993.05
27090000	Petroleum oils and oils obtained from bituminous minerals, crude.	LTR	33,821,197.91	8,053,229.75	12,689.00	77,810,710.21	24,925,125.34
27101260	Lubricating oils and greases	LTR	11,755,818.19	13,137,509.20	7,321,037.55	7,118,603.33	9,375,085.07
27101270	Liquids for hydraulic brakes	LTR	-	284,363.00	177,591.00	133,053.07	259,227.99
27101280	Non-lubricating oils (cleaning, transformer oils, etc.)	LTR	335,795.50	671,676.08	367,437.00	586,146.11	881,265.08
27101290	Other light oils and preparations	LTR	5,195,431.00	23,597.16	100,172.49	49,829.23	80,614.19
27101920	Fuel oils, heavy	LTR	67,613,812.61	105,293,061.79	154,105,265.12	213,081,180.81	54,426,151.03
27101930	Gas oils	LTR	2,725.00	14,288.50	8,649,969.00	52,458,224.45	421.22
27101990	Other Medium oils and preparations, of petroleum or bituminous minerals, not containing biodiesel, n.e.s.	LTR	-	1,734,505.62	29,340,945.71	3,843,354.26	341,481.34
27109100	Waste Oil Containing polychlorinated biphenyls (PCBs), polychlorinated terphenyls (PCTs) or polybrominated biphenyls [PBBs]).	LTR	-	2.00	4.00	40.00	3.00
27109900	Waste oils containing mainly petroleum or bituminous minerals (excl. those containing polychlorinated biphenyls [PCBs], polychlorinated terphenyls [PCTs] or polybrominated biphenyls [PBBs])	LTR	-	1,551.63	4,760.00	1,239.97	307.00
TOTAL		**LTR**	**118,724,784.21**	**144,578,753.43**	**201,675,753.87**	**355,084,195.40**	**90,376,674.31**

Table 22. Summarized data of exported oil products.

HS CODES	HS DESCRIPTIONS	UNIT	2011	2012	2013	2014	2015
27079100	Creosote oil	LTR	-	-	-	-	-
27079900	Oils and other products of the distillation of high temperature coal tars; similar products in which the weight of the aromatic constituents exceeds that of the non-aromatic constituents (excl. chemically-defined compounds, benzol "benzene", toluol "toluene", xylol "xylenes", naphthalene, aromatic hydrocarbon mixtures of subheading 2707.50, and creosote oils)	LTR	-	5,632.00	8.00	2.00	10.00
27090000	Petroleum oils and oils obtained from bituminous minerals, crude.	LTR	-	328.00	30.00	9,922,761.00	12.00
27101200	Light oils and preparations, of petroleum or bituminous minerals which >= 90% by volume "incl. losses" distil at 210°C "ASTM D 86 method" (excl. containing biodiesel)	LTR	-	-	-	-	-
27101260	Lubricating oils and greases	LTR	12,522.00	469.00	613.00	247,008.87	84,165.00
27101270	Liquids for hydraulic brakes	LTR	-	2.00	-	-	-
27101280	Non-lubricating oils (cleaning, transformer oils, etc.)	LTR	-	-	747.00	1,502.00	67.50
27101290	Other Light oils and preparations, of petroleum or bituminous minerals which >= 90% by volume "incl. losses" distil at 210°C "ASTM D 86 method" (excl. containing biodiesel)	LTR	5.00	-	17.00	18,005.00	7,056,114.50
27101920	Fuel oils, heavy	LTR	416,250.00	291,300.00	317,525.00	565,211.00	95,001.00
27101930	Gas oils	LTR	-	-	-	174.75	-
27101990	Other Medium oils and preparations, of petroleum or bituminous minerals, not containing biodiesel, n.e.s.	LTR	35,003.00	115,977.10	13.00	55.00	392,011.70
27109100	Waste Oil Containing polychlorinated biphenyls (PCBs), polychlorinated terphenyls (PCTs) or…	LTR	-	-	-	-	-
27109900	Waste oils containing mainly petroleum or bituminous minerals (excl. those containing polychlorinated biphenyls [PCBs], polychlorinated terphenyls [PCTs] or polybrominated biphenyls [PBBs])	LTR	-	160,000.00	354,600.00	6.00	153,730.00
TOTAL		**LTR**	**463,780.00**	**573,708.10**	**673,553.00**	**10,754,725.62**	**7,781,111.70**

Appendix II

Table 23. Filtered data of renewal vehicles categorized by vehicle ratings or codes.

Ratings Vehicle Renewals	Year				
	2012	**2013**	**2014**	**2015**	**2016**
SEDAN PRIVATE USE	9,298	8,676	8,457	8,629	8,407
SEDAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	4650	4348	4016	4203	3562
VAN PRIVATE USE	482	476	448	434	398
VAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	560	567	529	527	468
STATION WAGON – SWB – PRIVATE USE	3151	3692	3974	4130	3987
STATION WAGON – SWB – BUSINESSES/ COMPANIES/ ORGANIZATIONS	3171	3065	3035	3172	2850
STATION WAGON – LWB – PRIVATE USE	4430	4920	5755	6968	7893
STATION WAGON – LWB – BUSINESSES/ COMPANIES/ ORGAINZATIONS	11088	12445	13863	14300	13384
UTILITY PRIVATE USE	6,010	5,602	5,735	6,606	6,440
UTILITY BUSINESSES/ COMPANIES/ ORGANIZATIONS	17730	19285	19078	18602	17937
BUSES	6362	6995	6555	6754	6407
PUBLIC MOTOR VEHICLES – PMV	5,366	4,390	5,389	5,501	5,542
TRADE PLATE/ MOBILE CRANES/ TRACTORS	5330	5164	5131	4976	4833
MOTORCYCLES	1,126	1,132	1,153	1,247	1,290
TRUCKS/ TRAILERS	16877	17289	17724	17737	17300
THREE WHEELERS	9	4	5	19	3

Table 24. New vehicles registration categorized from the common vehicle modes.

Ratings (New Vehicles Rego)	Year				
	2012	**2013**	**2014**	**2015**	**2016**
SEDAN PRIVATE USE	2,227	1,384	1,694	1,688	1,179
SEDAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	413	405	518	551	380
VAN PRIVATE USE	148	116	75	72	42
VAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	166	134	93	88	57
STATION WAGON – SWB – PRIVATE USE	909	681	776	569	284
STATION WAGON – SWB - BUSINESSES/ COMPANIES/ ORGANIZATIONS	553	457	583	479	281
STATION WAGON - LWB - PRIVATE USE	1456	1284	1237	1082	765
STATION WAGON - LWB - BUSINESSES/ COMPANIES/ ORGAINZATIONS	2810	2679	2535	2454	1772
UTILITY PRIVATE USE	1205	1217	1059	841	528
UTILITY BUSINESSES/ COMPANIES/ ORGANIZATIONS	2468	2503	2366	2123	1478

BUSES	1103	1018	1047	1105	1079
PUBLIC MOTOR VEHICLES - PMV	1,640	1,525	1,972	1,170	557
TRADE PLATE/ MOBILE CRANES/ TRACTORS	1685	1177	1220	1035	829
MOTORCYCLES	453	380	411	412	324
TRUCKS/ TRAILERS	4301	3349	2994	2750	2168
THREE WHEELERS	2	0	3	13	1

Table 25. ULO generation capacity by vehicle model types per services per year.

Ratings	Service Duration (Months)	Service Time/ Year	Expected ULO Collection/ Service (LTR)
SEDAN PRIVATE USE	6	2	6
SEDAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	3	4	6
VAN PRIVATE USE	6	2	8
VAN BUSINESSES/ COMPANIES/ ORGANIZATIONS	3	4	8
STATION WAGON - SWB - PRIVATE USE	6	2	8
STATION WAGON - SWB - BUSINESSES/ COMPANIES/ ORGANIZATIONS	3	4	8
STATION WAGON - LWB - PRIVATE USE	6	2	12
STATION WAGON - LWB - BUSINESSES/ COMPANIES/ ORGAINZATIONS	3	4	12
UTILITY PRIVATE USE	6	2	12
UTILITY BUSINESSES/ COMPANIES/ ORGANIZATIONS	3	4	12
BUSES	6	2	8
PUBLIC MOTOR VEHICLES - PMV	6	2	12
TRADE PLATE/ MOBILE CRANES/ TRACTORS	12	1	15
MOTORCYCLES	6	2	4
TRUCKS/ TRAILERS	12	1	16
THREE WHEELERS - BUSINESS	3	4	6

Appendix III

SCENES DURING SURVEY

<table>
<tr><th colspan="2">PHOTOS</th><th>DESCRIPTIONS</th></tr>
<tr><td colspan="2"> 

 </td><td>ULO Management Approach 2:

Waste Oil recovering on site using an advanced technology of mobile waste oil processing unit with courtesy from a recognized waste management company project profile. “This equipment is innovative and technologically. The unit is fitted with a process and blend option that allows waste oils and fuels to be processed to fuel grade standard that is then blended with higher grade fuels (such as diesel) to provide a supplementary fuel that meets OEM standards. This is a highly cost effective way of creating a true closed loop option to manage hydrocarbon wastes in situ (Total Waste Management).”</td></tr>
<tr><td colspan="2">   </td><td>ULO Management Approach 8:

Pictures on the left portray training facilities for firefighting drills and trainings. Used lubricants and oil are used as fuel with addition of woods and tires to maximize flame intensity. According to information from survey interview, training and drills occur less frequently. It means that less quantity are required per year for this training.

Most ULO are burned off while those unburnt would have chances of leaking out through to nearby drains or over soil surface.</td></tr>
</table>

		**ULO Management Approach 10:** An example of stakeholders stockpiling ULO to allow decomposition before sending off to landfills or passing them through drains. If there would be no proper ULO storage facilities, these can easily leak or spill to nearby surroundings that can cause deterioration as example scene on the left.
		**ULO Management Approach 11:** Most domestic ULO generators or DIYs and several small workshops, motors and auto parts services providers do not have any proper ULO management or disposal options. As an example, a 200 L drum of used lubricants and oil left unattended almost for over eight (8) months. Flux in weather conditions have already caused grass to wither exposing bare soil in the scene due to ULO spill from drum surface. Others under this management approach consider supplying them to requested participants to use as pest controls or rule lines/ marks on sports fields.

		**ULO Management Approach 12:** Other stakeholders showed concern on disposing ULO generated in a more environmentally sound manner. There were several other approaches considered when interviewed: (1) Sending it to waste management contractors/ companies; (2) Export but was evaluated expensive; (3) Adopt another ULO Management technique from elsewhere. Moreover, with various other reasons such stakeholders were stockpiling ULO while working on identifying a cost effective and environmentally sound disposal approach.
		During the survey period, there was an oil spill from one of the major oil company. There was an immediate response from the company to address this issue. Cleanup crew and emergency responses from the company. Photo on the right show soaked materials with oil that was gathered during cleanup.

		Photo on the left portray scene of an oil refinery in PNG. Scene on the right depicts an oil tanker supplying oil to midstream terminal of a major oil company in the country.

Appendix IV

SAMPLE INVENTORY – LUBRICANTS AND OIL IMPORTED PRODUCTS

Importing Company (Importer): _____

Person in charge (Contact): _____

No.	*Main Suppliers/ Distributors*	*Transportation/ Logistical Company to Suppliers and Distributors*	*Name/ Label of product/s as printed on the container*	*UN Identification Number*	*Purpose of use*	*Quantity Imported (specify units of measurements)*	*Hazardous Classification*	*Expiry date*	*Storage Location*
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Appendix V

SAMPLE INVENTORY – LUBRICANTS AND OIL PRODUCTS INTAKE AND EXPENDITURE

Main Supplier/ Distributor: _____

Person in charge (Contact): _____

No.	***Quantity Obtained/ Week from importer (specify units of measurements)***	***Consumers***	***Name/ Label of product/s as printed on the container***	***Molecular formulae (if any)***	***Registry Number (CAS)***	***Quantity Supplied/ Day to consumers (specify units of measurements)***	***Hazardous Classification***	***Expiry date***	***Storage Location***
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									

Appendix VI

SAMPLE INVENTORY – USED/ WASTE LUBRICANTS AND OIL GENERATION

Consumer/ Used Lubricants and Oil Producer: _____

Person in charge (Contact): _____

No.	***Name/ Type of used/ waste lubricants and oil being generated***	***Quantity Generated/ Day (specify units of measurements)***	***Hazardous substance/ possible contaminant being identified (if certified tested: YES and State; NO)***	***Molecular formulae (if any)***	***Collection Point/s***	***Quantity Stored/ Day (specify units of measurements)***	***Storage Capacity (specify units of measurements)***	***Storage Location***	***Disposal Method/s***
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

Appendix VII

RESPONSES TO ENVIRONMENTAL REQUIREMENTS

1. Company Environment Policy					
ITEMS	**RESPONSE**			**UNANSWERED**	**COMMENTS**
	YES	*NO*	*UNCERTAIN*		
a. Does the organization/ company have a stated environmental policy? (Capturing and considerate over used lubricants and oil management system?)	12	3	0	9	▪ Sign displayed in all business canters ▪ Yet to develop an Environmental Policy\ ▪ 2.2 PTB Plant Manual for Workshop Management
b. Has this been communicated internally?	13	2	0	9	▪ Communicated through induction procedures in other centers ▪ 2.2 Department of Transport & CEPA needed to be confirmed ▪ 3.1 External communication to CEPA when submitting EMPs for Permits
c. Has this been communicated externally?	10	4	0	10	
d. Do the policies on environmental issues adopt and comply with Environmental Act 2000 or other Acts and Regulatory Documents? (Provide a list)	5	6	1	12	▪ Not specific to Environment Act 2000 but to Aus/ NZ Standard which is the bench mark ▪ Environmental Act 2000 and its Regulations, Oil and Gas Act, National Water Supply and Sewage Act, Public Health Act, Water Resources Act ▪ Have a General Policy
e. Do they conform to the guidelines and standards of other (local or international organizations)?	7	4	1	12	▪ SIME DARBY Industrial ▪ Applicable Aus/ NZ Standards, ISO 14001, & Applicable National Regulations
f. Do any of the organization or company's customers insist that the company adhere to accepted environmental standards?	9	2	1	12	▪ Contractor Management ▪ The company's EMS is ISO 14001 certified ▪ YES, with Oil Search Ltd in Kopi & Gobe ▪ Company's Oil and Gas Clients, the company adheres to clients policies when operating on the field especially Seismic
g. Does the company insist that its suppliers adhere to accepted environmental standards?	8	5	0	11	▪ Best Practice Required on Site ▪ Only purchase what is available ▪ Stakeholder assess their suppliers while environment standards are requirements
h. Does the company review changes in environmental legislation?	6	7	0	11	▪ Not PNG specificity ▪ Done through legal team
TOTAL SCORES				**192**	
% OF THE TOTAL SCORES	**36**	**17**	**2**	**45**	**100**

1. Environmental Management Systems						
SUB-CATEGORY	**ITEMS**	**RESPONSE**			**UNANSWERED**	**COMMENTS**
		YES	*NO*	*UNCERTAIN*		
Environmental Management Structures	a. Is an environmental structure in place?	10	4	0	10	▪ Draft Environment Management Plan
	b. Does the environmental management structure provide for:					▪ EMP currently in Draft ▪ Stakeholder have EMMP & Waste Management Plan that covers the requirements. Environment Officers ensures company comply with requirements
	Air Quality Management	6	5	1	12	▪ EMP currently in Draft
	Water Quality management	7	4	1	12	▪ EMP currently in Draft
	Used Lubricants and Oil management	7	4	1	12	▪ EMP currently in Draft
	Environmental Communication	7	4	1	12	▪ EMP currently in Draft ▪ Via Workshop Manager
	Environmental Legal Monitoring (Who is responsible for each of these tasks?)	8	3	1	12	▪ EMP currently in Draft ▪ Safety Officers & Yard Managers
Environmental Management Program	Has the EMP been accepted by the relevant authorities?	6	2	3	13	▪ REGIONAL HO IN AUSTRALIA
	Does the accepted EMP adequately address issues on used lubricants and oil?	5	3	3	13	▪ The organization/ department is the consent authority for approvals of all EMPs submitted by contractors on behalf of CEPA. Thus, it is usually captured in the EMP submitted by contractors ▪ Outdated and require review ▪ EMP was submitted and Environmental Permit was issued ▪ Rely on NAC's waste management program/ services
Education and Training	Is there are program in the organization or company to improve the environmental awareness of staff?	8	3	0	13	▪ EMP in Draft ▪ Program is dependent on Funds ▪ Captured in the Induction Program and Awareness Campaign capture environmental issues. Organization have communication plan and commemorate international days such as the World Environment Day ▪ Safety Meetings & Tool Box Meetings
	Is there a formal environmental manual covering:					▪ Out of ate and requires review
	All operating and maintenance tasks on site?	9	2	1	12	
	Emergency response procedures?	9	2	1	12	

	National and International regulatory processes?	7	3	2	12	
	How often is the manual reviewed and updated, and by whom?	5	4	1	14	▪ ANNUALLY ▪ Not reviewed since publication though some sections have been reviewed and updated ▪ HSE Manual is reviewed based on critical of its components. Critical Components are reviewed annually.
Internal and External Communication and Reporting	When necessary, does the organization or company notify the appropriate external agencies/ government departments of pollution incidents?	4	4	4	12	▪ Unsure of any incident(s) reported ▪ No proper reporting mechanism ▪ Minor accidents are also reported
	Does the organization or company keep an up-to-date register of all pollution incidents? Who is responsible for keeping this registered?	4	6	2	12	▪ Internal Reporting Process ▪ Company have incident reporting database ▪ Safety Officers & Managers
	Does the organization or company keep a complain registered to record all complains from outside complainants? (Who keeps the register?)	3	7	3	11	▪ The Department/ organization follows GRM. Register is regularly maintained by the contractor who reports to the organization. ▪ Only keeps first aid record ▪ Company update complains and registered them monthly. HSE Department in the company keeps the registry ▪ Open Channel of Communication
	Does the organization or company have an open channel of communication with interested and affected parties?	7	4	2	11	▪ Legal Teams ▪ Compliance Monitoring Conducted monthly by ESSU on a yearly basis for the duration of the project ▪ There is no registration of complains, rather through verbal agreement between the complainants and the department
	Does the organization or company have a regular environmental audit? (Nature and frequency of audits?)	7	7	0	10	▪ Monthly Inspections and Annual Audit ▪ Annual Internal and External Audits, External audit is mainly Quality (ISO 9001) and Environment (ISO 14001) Audits.
Planning and Resources	*A. Does the organization or company have plans, strategies or techniques for:*					
	Used Lubricants and Oil collection system?	5	5	2	12	▪ Oil collection process involves DRAINING; BURNING & RECYCLING. There are also oil storage facilities ▪ Company does not have EMS but captures it on OSHE Management System

	Used Lubricants and Oil collection and transportation? (Your responsibilities, requirements for drivers and vehicles, and transportable containers?)	4	4	1	15	▪ Mainly small operations ▪ ULO for the company is managed by waste removal contractors
	Used Lubricants and Oil storage and processing?					
	• Used oil facilities?	5	4	1	14	▪ All waste (ULO) oils are drained into the empty drums (200 L) and stored at the waste oil storage area where company responsible for removing waste oil picks it up for disposal/ management.
	• Your responsibilities?	5	4	1	14	▪ Do not have a processing facility
	• Storage facilities?	6	4	1	13	
	• Transfer Operations? (Compliance with national and international regulatory requirements?)	4	5	1	14	
	B) Disposal of used lubricants and oil? (A sustainable and environmental friendly disposal technique that promotes or coincides with Cleaner Pacific 2025 – Pacific Regional Waste and Pollution Management Strategy 2016 – 2025?)	2	3	3	16	
	Does the organization or company have a used lubricants and oil management system in place?	4	3	1	16	▪ Waste Management Solutions – By PNG Waste Management Services ▪ The system is not sustainable nor environmentally friendly ▪ ULO for the company is managed by waste removal contractors
Record keeping and document& data control	*Is a procedure in place for controlling all data, records, and documentation of:*					▪ Lubricants and oil products are classified as a hazardous substance as such is managed under the company's hazardous substance procedure ▪ There is only data for stores involving purchase but not for EMS
	Types of Lubricants and Oil products in demand for usage?	9	3	1	11	▪ Commenced baseline reporting ▪ Lubricants & Oil Products are supplied by TOTAL
	Quantity and Types of Lubricants and Oil products being supplied or distributed to the organization/ company?	9	3	1	11	

	Countries of whom Lubricants and Oil products are being imported from?	7	4	2	11	▪ Australia
	Main importer/s of Lubricants and Oil products in PNG?	10	2	1	11	▪ Major Motors in PNG
	Main supplier/s or distributor/s of Lubricants and Oil products to the company?	8	2	2	12	
	Lubricants and Oil consumption rate?	8	2	1	13	▪ Commenced baseline reporting
	Types of Used Lubricants and Oil being generated?	8	3	1	12	
TOTAL SCORES						
% OF THE TOTAL SCORES – ENVIRONMENTAL MANAGEMENT STRUCTURE (Total Score = 144)		31.25	16.67	3.47	48.61	**100**
% OF THE TOTAL SCORES – ENVIRONMENTAL MANAGEMENT PROGRAM (Total Score = 48)		22.92	10.42	12.50	54.17	**100**
% OF THE TOTAL SCORES – EDUCATION AND TRAINING (Total Score = 120)		31.67	11.67	4.17	52.50	**100**
% OF THE TOTAL SCORES – INTERNAL AND EXTERNAL COMMUNICATION AND REPORTING (Total Score = 120)		20.83	23.33	9.17	46.67	**100**
% OF THE TOTAL SCORES – PLANNING AND RESOURCES (Total Score = 216)		16.20	14.81	5.09	63.89	**100**
% OF THE TOTAL SCORES – RECORD KEEPING, DOCUMENTATION, AND DATA CONTROL (Total Score = 168)		35.12	11.31	5.36	48.21	**100**

3. Legal Standards

ORGANIZATION	ITEMS	RESPONSE			UNANSWERED	COMMENTS
		YES	*NO*	*UNCERTAIN*		
	a. Is the organization or company kept aware of its environmental liabilities? (How?)	5	4	3	12	▪ Only Aus/ NZ Standard, Not PNG Specific ▪ Through the provision of environmental advisory services by Environmental and social safeguards unit (ESSU) within the organization ▪ Depend on CEPA for information ▪ Through the legal team

	b. Are copies of all appropriate statutes, regulations and by laws readily available on the organization or company?	5	3	4	12	▪ Company Documents and Safety/ Sustainable Team ▪ AREA LICENSE ▪ Mostly through legal website: PACL
	c. Does the organization or company comply with the relevant legislation and regulations? (How?)	5	4	3	12	▪ Through the provision of environmental advisory services by Environmental and social safeguards unit (ESSU) within the organization ▪ Company has a legal compliance measure
	d. Are copies of permits, exemptions, relaxations, and other pertinent legal documents kept by the organization or company?	7	1	4	12	▪ DLIR Registrations ▪ AREA LICENSE
	e. Are these permits current/ valid? Who is responsible for monitoring the permits?	7	1	4	12	▪ Business Centre Manager ▪ CEPA and ESSU-DOW ▪ Department of Transport ▪ Quality Assurance and Compliance monitor all company permits and license
	f. Is there a list of all the legal standards with which the organization or company needs to comply?	7	1	4	12	▪ Draft Legal Obligation Exercise ▪ Legal register
	g. Does the organization or company regularly negotiate standards with the authorities and jointly review performance on a regular basis?	5	2	5	12	
	h. Does the organization or company have a list of principal contacts with regard to legal compliance in the case of:					
	Conservation and Environment Protection Authority (CEPA)	5	3	1	15	
	National Institute of Standards and Industrial Technology (NISIT)	5	3	2	14	
	Papua New Guinea Customs	5	4	1	14	
	Papua New Guinea Ports Corporation Limited (PNGPCL)	7	2	1	14	

	National Maritime Safety Authority (NMSA)	5	3	1	15	
	National Capital District Commission (NCDC)	8	0	1	15	
	Emergency Services (e.g. Fire, etc…)	8	1	1	14	
	Local Authorities	6	2	1	15	
	National Road Safety Council	4	2	1	17	
	Department of Works (DOW)	4	2	1	17	
	National Aviation Council (NAC)	4	3	1	16	
	Engineering Regulations	5	2	1	16	
	Others? (Please specify)	1	1	1	21	▪ Department of Transport
TOTAL SCORES					**504**	
% OF THE TOTAL SCORES		**21.43**	**8.73**	**8.13**	**61.71**	**100**

4. Environment Performance								
ORGANIZATION	**ITEMS**	**RESPONSE**			**UNANSWERED**	**MAGNNITUDE OF RATING**	**PERFORMANCE OF RATING**	**COMMENTS**
		YES	*NO*	*UNCERTAIN*		*H/ M/ L?*	*1 - 5?*	
4.1 Used Lubricants and Oil Management								
4.1.1 Used Lubricants and Oil Monitoring	a. Is there an approved method/s of testing mineral used oil and synthetic used oil for:							▪ CAT STANDARDS ISO ▪ No facility or instruments to perform the tests; however, the organization have a soil testing lab but most soil testing are done by UNITECH, Lae ▪ Uses certified laboratories who have certified methods to conduct these tests
	Polychlorinated biphenyls (PCBs)?	2	6	0	16	H; L	4; 1; 1	
	Heavy metal elements? (e.g. Lead, Pb)	3	7	0	14	H; L	4; 1; 1	
	Other chemicals? (Please specify: e.g. Sulfur, s)	3	6	0	15	H; L	4; 1; 1	

	Physical properties? (e.g. acidity, pH, etc…)	3	6	0	15	H; L	4; 1; 1	
	b. Is sampling and testing done by the organization or company? (Who does it? Using what certified method?)	4	5	0	15	H; NA; L	4; NA; 1; 1	▪ CAT STANDARDS ISO ▪ Sampling is done by the company while testing is done by Intertek, ALS, & SGS ▪ Samples are send to independent labs in Australia & China
	c. Is sampling and testing done by other certified laboratory? (Who? Using what certified method/s?)	4	5	0	15	L; H	1; 1; 3	▪ Sampling is done by the company while testing is done by Intertek, ALS, & SGS ▪ Australian laboratory Services & Mobil Segmen Laboratory (China)
	d. Does the organization or company handle its monitoring data? (If not, who does?)	4	4	1	15	H; L; H	3; 1; 1; 4	▪ CAT STANDARDS ISO
	e. Does organization/ company provide periodical and waste reports on used lubricants and oil?	5	5	0	14	M; L; H	3; 1; 1; 3	▪ BASELINE REPORTING ▪ Monthly within the company and Annually to CEPA
	f. How effective are the communicative measures?	4	3	0	17	L; H; H	1; 5; 3; 3	▪ INTERNAL AUDIT ▪ Communication is effective
	g. Is there any records of previous audit attempted to:							
	Provide corrective actions?	5	6	0	13	H; L; L	4; 1; 1; 3	
	Provide status of prior audit items?	5	6	0	13	H; L; L	4; 1; 1;3	
	h. Is there an inventory for used lubricants and oil?	5	4	0	15	H; L	4; 1; 3	▪ CONTAMINATION CONTROL DEVISION ▪ Assume from what is being purchased
4.1.2 Used Lubricants and Oil Handling and Collection	a. Is there a specific handling requirements for used lubricants and oil during:							▪ NEEDS IMPROVEMENT ▪ No specific requirements and no manuals on this regard ▪ Company uses material safety data sheets for handling of chemicals responding to emergencies ▪ Handling Requirements are outlined in Hazardous Substance Management (HS) and Waste Management Procedures (WMP)

	Collection?	6	3	0	15	H; L; M; H	3; 5; 3; 1	
	Accidents and Emergencies?	6	3	0	15	H; L; M; H	3; 5; 3; 1	
	Transportation?	7	2	0	15	H; L; M; H	3; 5; 3; 1	
	Storage?	1	3	0	20	H; L; M; H	3; 5; 3; 1	
	Disposal?	7	3	0	14	H; L; M; H	3; 5; 3; 1	
	b. How effective is/are the method/s or procedure/s for collecting used lubricants and oil? (Is safety measures reliable?)	6	4	0	14	H; L; M; H	2; 5; 3; 1	▪ NEEDS IMPROVEMENT ▪ Uncertain, do not have a system in place ▪ HSM and WMP ensures company have effective program ▪ Clients provide samples while company provides procedures
	c. How efficient/ reliable is/are the collection, storage, transportation, and disposal equipment and resources? (E.g. staffs, trucks, storage containers, etc…)	5	1	0	18	H; M; L; M; H	3; 5; 3; 1	▪ PNG WASTE MANAGEMENT SERVICES ▪ Uncertain, do not have a system in place ▪ Current practice not effective
	d. How effective is the segregation method/s of your organization/ company on used lubricants and oil?	4	5	0	15	M; L; H	5; 1	
	e. How reliable are the funds allocated for used lubricants and oil collection?	5	3	0	16	H; L; H	2; 5; 2; 1	▪ NEEDS IMPROVEMENT ▪ No specific funding allocated
4.1.3 Used Lubricants and Oil Storage	a. Is there a specific storage requirements for used lubricants and oil considering:							▪ No specific storage requirements; contractors are advised to store them away in secured enclosures. ▪ Whole/ Retail sellers & produces minimum ULO – however, method is storage and unsure of disposal method ▪ Company have storage facilities and handling is per the MSDS and instructions from manufacturers. However, there is no documented procedures in place neither the processes.
	Storage bills? (How efficient?)	8	3	0	13	M; L; L; M; H	3; 5; 4; 5; 4; 1;	▪ Wastes and ULO are stored at Waste Management Areas
	Storage site/s approval? (How efficient?)	7	4	0	13	M; L; L; M; L	3; 5; 4; 5; 4; 5	

	Storage facilities? (How efficient?)	7	3	0	14	M; L; L; M; H	3; 5; 4; 5; 4; 1	
	Storage duration? (How efficient?)	6	4	0	14	M; L; L; M; L	3; 5; 4; 5; 4; 5	▪ Monitored monthly
	Storage capacity? (How efficient?)	7	4	0	13	M; L; L; M; L	3; 5; 4; 5; 4; 5	▪
	b. How efficient is/are the storage handling procedures?	7	1	0	16	H; L; H	4; 4; 5; 4; 1	▪ Inefficient
	c. How reliable is/are the storage condition/s?	5	1	0	18	H; L	4; 4; 5; 4	▪ Unreliable
	d. How reliable is/are the design of storage arrangement/s?	7	1	0	16	H; L; H	3; 4; 5; 4; 1	▪ Unreliable ▪ Stored in concrete bunds
	e. Is/Are there any storage documented procedures? (How efficient is/are the storage safety requirements?)	3	6	0	15	H; L; L	3; 2; 5; 4; 5	▪ None ▪ Uncertain
	f. How reliable is/are the storage labels and containers?	5	4	0	15	H; L; L	3; 5; 4; 4; 5	▪ Included in the monthly report ▪ Unreliable
	g. Are there availability of appropriate storage handling equipment? (E.g. Personal Protection Equipment)?	8	1	0	15	H; L; H	4; 4; 4; 1	
	h. Is there a budget allocated for used lubricants and oil storage? (How reliable is/are the budget/s on storage cost/s?)	6	4	0	14	H; H	4; 5; 4; 1	▪ Unsure ▪ Covered under the annual budget for workshop operations ▪ Waste Management budget is allocated every year
4.1.4 Used Lubricants and Oil Transportation	a. Is/Are there any transport requirement/s/ rule/s?	6	1	0	17	H; H; H	3; 1;	▪ BASED ON WASTE MANAGEMENT SERVICES REQUIREMENT ▪ Transportation is mainly the waste contractors' responsibility. Company ensures contractors meet transport requirements

	b. Is the company complying to updated standard/s of operation?	4	2	0	18	H; H	1	▪ Uncertain ▪ Part 92 of the Dangerous Goods Transport which is a requirement by CAA
	c. How efficient/ effective is/are the organization/ company complying to:							
	National Transport Requirement/s or Rule/s?	4	2	0	18	H; H; L	3; 4; 5; 5	▪ BASED ON WASTE MANAGEMENT SERVICES REQUIREMENT ▪ Uncertain
	International Transport Requirement/s or Rule/s?	3	3	0	18	H; L	4; 5; 5	
	d. Is/Are there any transportation regulatory procedures established in the organization/ company with:							
	National regulatory body/ies? (How effective?)	5	1	0	18	H; H; H	4; 5; 1	▪ CAT STANDARDS ▪ Uncertain
	International regulatory body/ies? (How effective?)	4	2	0	18	H; H	5; 1	
	e. Is/Are there any transport cost/s? (How efficient is the budget?)	6	1	0	17	M; H	3; 5; 5	
	f. How efficient is/are the transport equipment or facilities?	5	3	0	16	M; H; L	3; 5; 5; 5	
	G. What reliable means of transport/s does the organization or company use for transporting used lubricants and oil:							
	- R = Road? (Efficiency of transport conditions?)	8	0	0	16	H; M; H	4; 4; 4; 1	▪ Mainly by road and sea
	Sea? (Efficiency of Transport conditions?)	2	3	0	19	M; L	4; 5	▪ Mainly by road and sea

	Air? (Efficiency of Transport conditions?)	1	3	0	20	L	5	
	Inland waterways? (Efficiency of transport?)	0	3	0	21	L	5	
	g. Is/ Are there tracking procedures? (How effective?)	3	4	0	17	H; H; L	3; 5	▪ Chain of custody form
	h. Is/ Are the physical characteristics of used lubricants and oil being transported:							
	Powdery/ powder? (Type of impact it can cause?)	3	2	0	19	L	3	
	Solid? (Type of impact it can cause?)	4	2	0	18	H; H; L	3; 4; 3	
	Viscous/ Paste? (Type of impact it can cause?)	4	2	0	18	H; H; L	4; 3	
	Sludgy? (Type of impact it can cause?)	4	2	0	18	H; H; L	4; 3	
	Liquid? (Type of impact it can cause?)	6	0	0	18	H; H; L	3; 4; 3	▪ Mainly liquid, at times solid when mixed with soil, etc…
	Gaseous? (Type of impact it can cause?)	2	2	0	20	H; L	4; 3	
	Other? (Please specify) (Type of impact it can cause?)	1	1	0	22	H	4	
4.1.5 Used Lubricants and Oil Disposal	a. Does the organization or company have a used lubricants and oil disposal strategy/ies? (How effective is the strategy/ies?)	6	4	1	13	H; H; H	3; 5; 4; 5	▪ STANDARD NEED IMPROVEMENT ▪ NIL ▪ Third Party used for disposal of wastes through NAC
	b. Does the organization or company promote environmentally sound disposal method/s? (How	5	5	0	14	H; H; H	3; 5; 4; 5	▪ The organization promotes this to the contractor, however, there are no monitoring on the effectiveness of the methodology

	effective is/are the method/s?)							
	c. Does the organization or company consider incorporation on any of the 10 Rs for sustainability into its disposal program/s? (How effective is/are the outcome/s?)	6	4	0	14	H; H;	3; 5; 4; 5	▪ Interested in 10 R's of Sustainability ▪ NIL ▪ REUSE
	d. Does the organization or company involve in conducting awareness regarding unsafe disposal practices of used lubricants and oil in the surrounding communities? (How effective is/are the outcome/s?)	5	6	0	13	H; H; H	4; 5; 4; 5	▪ Training Inductions Reporting ▪ NIL Not specifically for ULO but all hazardous substances
	e. What current disposal method/s is/are the organization or company applying on used lubricants and oil? (Please State the type of disposal method used.)	7	2	0	15	H; H; H	4; 4	▪ 1000 L STORAGE CONTAINER & WASTE MANAGEMENT SERVICES ▪ NIL ▪ ULO are stored in containers and placed in storage areas until a time when it is assumed the waste has decomposed. It is then taken to the dump for landfill or poured into the drains ▪ CEPA approves waste removal contractors ▪ UNCERTAIN
	f. How effective do/ does the disposal method/s promote:							▪ NO DISPOSAL METHOD ▪ From Items f – h: disposal is managed by CEPA Permitted & Approved Waste Removal Contractors. There are no complaints received for the waste contractors performance
	Sustainable and environmental friendly disposal?	5	4	0	15	H; H; L	3; 1; 4; 4	▪ AS PER WASTE MANAGEMENT SERVICES PROVIDED

	Cost effective and sound economic benefit?	4	3	0	17	H; L	5; 4; 4	
	Compliance to National regulation/s?	5	3	0	16	H; H; M	3; 1; 4; 3	▪ PNG STANDARDS AND NOT TO INTERNATIONAL STANDARDS
	Compliance to International regulation/s?	4	4	0	16	H; H	1; 1; 4; 5	
	g. Is/Are all used lubricants and oil sent for re-refining? h. Is/Are there any requirement/s approving regulatory document/s on disposal method/s used? (Permit or license?)	7	7	0	10	M; H; H	3; 4; 5	▪ NO OPTIONS ▪ NIL ▪ REUSED OR DISPOSED OFF
	h. Is/ Are there any requirements approving regulatory documents n disposal methods used? (Permit/ License?)	5	3	1	15	M; H; H	3; 4; 5	▪ WASTE MANAGEMENT SERVICES DO NOT REQUEST ▪ NIL
	i. Is/Are there any complaints raised on disposal practice/s from other stakeholders or communities?	5	3	1	15	H; L	4; 5	▪ NO REPORTS ▪ NIL ▪ NOT EXISTING
	j. How effective is/are the approach/es of solving complaints raised on disposal practice/s?	3	6	0	15	H; L	4; 3	▪ NO REPORTS ▪ NIL
4.1.6 Emergency Response/s	a. Is/Are there any emergency response plan on:							▪ PROCEDURES ONLY ▪ NONE EXISTING ▪ Company has ERPs to handle chemical incidents including ULO ▪ Emergency Response Kits are available but not documented in the process to be captured in the company's OSHE Manual
	Handling process? (How effective is the response?)	8	3	0	13	H; H; M	4; 4; 4; 4	
	Storage? (How effective is the response?)	9	3	0	12	H; H; H	4; 4; 4; 5	

	Transportation? (How effective is the response?)	7	5	0	12	H; H; H; L	4; 4; 3; 4; 1	
	Spillage? (How effective is the response?)	8	3	0	13	H; H; L	4; 4; 3; 4; 4	▪ Use of Best Practice
	disposal? (How effective is the response?)	8	3	0	13	H; H; H; H	4; 4; 4; 4; 5	▪ NOT TESTED
	b. Is/Are the emergency response plan documented and available on site/s accessible to staffs?	6	3	0	15	M; H	3; 5	▪ EMERGENCY RESPONSE PLANS AVAILABLE ▪ NIL
	c. Is/Are the emergency response plan complying with national and international standards and guidelines?	6	2	1	15	H; M; H	4; 3; 5	▪ EMERGENCY RESPONSE PLANS AVAILABLE ▪ NIL ▪ Requires standards and regulations from CEPA
	d. Is/Are employer and staff fully aware and prepared for emergency response on used lubricants and oil?	6	3	0	15	M; H	3; 5	▪ NIL
	e. How effective is the communication system during emergency?	7	2	0	15	H; M; M	4; 5; 3; 2	▪ Effective communication system ▪ For items E & F, equipment are regularly checked and maintained using a schedule
	f. Is/Are the emergency equipment and materials available and commissioned on site?	8	1	0	15	H; M; H	3; 5; 3; 1	▪ SPILL KITS & FIRE EXTINGUISHERS ▪ NIL
4.1.7 Pollution Prevention	a. Does the organization or company meet regularly to discuss pollution control? (If so, how often?)	4	5	0	15	M; M; L	3; 4; 1	▪ BASELINE REPORTING ONLY ▪ NO. Rarely meet to discuss this issue ▪ Very often – Monthly HSE Meetings & Daily toolbox Talks ▪ Noise Management is managed through Safety Management Systems adopted in OSHE
	b. Have pollution control measures been implemented to minimize the potential effect/s of used lubricants and							▪ HAZARDS INCEDENT REPORTING, INSPECTIONS, SPILL KITS, BUNDING ▪ Not as yet. Development of Measures underway ▪ NOT AWARE OF MEASURES

	oil contamination on:							
	Land surfaces?	5	5	0	14	H; M; L	4; 1	
	Surface water?	5	5	0	14	H; M; L	4; 1	
	Ground water?	5	5	0	14	H; M; L	4; 1	
	Sea surface?	5	5	0	14	H; M; L	4; 1	
	c. Is/Are there contingency plan/s available? (What contingency plan/s have been implemented?)	5	5	0	14	M; L	4; 1	▪ None ▪ USE OF BEST PRACTICE ▪ ERP not specific for Spills, etc...
	d. Have pollution control facility/ies and area/s been designed and constructed so as to minimize used lubricants and oil contamination on the surroundings?	5	4	0	15	H; M; L	3; 4; L	▪ CONTAMINATION CONTROL DEVISION ▪ None ▪ There is a waste management area that has a concrete bund for all liquid hydrocarbon wastes
4.1.8 Used Lubricants and Oil Reduction, Reuse, and Recycle	a. Is the inventory kept of all types of used lubricants and oil generated, treated or disposed of?	5	3	0	16	H	5	▪ NONE ▪ ONLY ASSUME FROM WHAT IS PURCHASED
	b. Does the organization or company buy, where possible, lubricants and oil products that promote cleaner production?	5	4	0	15	H	5	▪ None
	c. Is/Are all used lubricants and oil packaging sorted into disposable and recyclable piles?	4	4	0	16	H	4; 5	▪ None – However, Proposal to develop a manual is currently underway
	d. Is/Are all used lubricants and oil sent for recycling:							
	- Internally? (What technique? & How efficient?)	4	5	0	15	L; H	1; 5	▪ None ▪ REUSE

								▪ Company uses WEATHERING PROCESS/ BIOREMEDIATION
	- Externally? (By Who? Where? & How?)	2	7	0	15	L; H	1; 5	▪ None ▪ TWM & XLT Enterprise
	e. If NOT, what other possible measures are taken to recycle used lubricants and oil?	0	4	0	20			▪ None
	f. Is/Are the used lubricants and oil recycling plan/s cater for disposing of:							
	Used lubricants and oil generated by-products?	3	5	0	16	H	5	▪ None
	Used lubricants and oil empty containers?	3	5	0	16	H	5	▪ None
	Contaminated substance/s?	3	5	0	16	H	5	▪ None
4.2 Air Quality	a. Is the organization or company involved in open burning or other high combustion methods of used lubricants and oil?	2	6	1	15	H; L	5; 4	
	b. Does the organization or company holds appropriate concerns regarding the applicable thermal disposal approach/es or practice/s? (Permit/s or licenses/s?)	3	6	0	15	H; H	3; 4	▪ NOT RECOMMENDED
	c. Do any facilities on the organization or company produce noxious fumes? (If so, identify these.)	6	6	1	11	H	4	

	d. Have proper filtering system/s been installed to control fumes where these occur? (Buildings, trucks, etc…)	3	3	1	17	H	4	
	e. Is air quality regularly monitored on organization or company area/s? (Who does this and how often?)	3	6	1	14	H; L	3; 4	▪ REVIEWING OPTIONS ▪ Standards available but no monitoring is practiced
	f. Is/Are report/s generated of the results? (By whom?)	2	5	1	16	L	4	
	g. Does air quality meet the required standards?	2	5	1	16	L	4	
% OF TOTAL SCORES – 4.1.1 Used Lubricants and Oil Monitoring (Total Score = 312)		15.06	20.19	0.32	64.42			100
% OF TOTAL SCORES – 4.1.2 Used Lubricants and Oil Handling and Collection (Total Score = 216)		21.76	12.50	0.00	65.74			100
% OF TOTAL SCORES – 4.1.3 Used Lubricants and Oil Storage (Total Score = 288)		26.39	12.50	0.00	61.11			100
% OF TOTAL SCORES – 4.1.4 Used Lubricants and Oil Transportation (Total Score = 600)		12.50	6.50	0.00	81.00			100
% OF TOTAL SCORES – 4.1.5 Used Lubricants and Oil Disposal (Total Score = 312)		21.47	17.31	0.96	60.26			100
% OF TOTAL SCORES – 4.1.6 Emergency Response/s (Total Score = 240)		30.42	11.67	0.42	57.50			100
% OF TOTAL SCORES – 4.1.7 Pollution Prevention (Total Score = 192)		17.71	17.71	0.00	64.58			100
% OF TOTAL SCORES – 4.1.8 Used Lubricants and Oil Reduction, Reuse, and Recycle (Total Score = 216)		13.43	19.44	0.00	67.13			100
% OF TOTAL SCORES – 4.2 Air Quality (Total Score = 168)		12.50	22.02	3.57	61.90			100