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Agenda Item 5: A technical and economic feasibility study for waste lube oil ESM (Pilot project Algeria)

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A TECHNICAL AND ECONOMIC FEASIBILITY ANALYSIS OF A WASTE LUBE OIL PILOT PROJECT FOR THE STATE OF ALGERIA

CHAPTER 1. INTRODUCTION

1.1. INTRODUCTION

The Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem (MedPartnership) is a collective effort of leading organizations (regional, international, nongovernmental, etc.) and countries sharing the Mediterranean Sea towards the protection of the marine and coastal environment of the Mediterranean. The MedPartnership is being led by United Nations Environment Programme (UNEP) Mediterranean Action Plan (MAP) and the World Bank and is financially supported by the Global Environment Facility (GEF), and other donors, including the European Union (EU) and all participating countries.

The main purpose of this study is to provide an economic feasibility analysis with particular applications to an Algerian Waste Lube Oils (WLOs) pilot project. The study seek to cover both technical and economic dimensions involving the collection, transportation and processing of used oils in accordance with sound environmental standards the international laws. The study is written with a genuine concern towards environmental protection and promises to the readers that this will not be a reason to compromise the scientific integrity of the findings. The indented audiences are mainly the Algerian used oil stakeholders who are eager to learn and do something about their country's pollution problem. The study will attempt to assist them to take the first step and respond to domestic and international social and political pressures that call for the development of a national strategic plan for recycling WLOs and prevent further environmental pollution.

1.2. AN ECONOMIC FEASIBILITY STUDY FOR WLOs PILOT PROJECT

An important component of this first step is to create an actual physical facility to test the systems performance in all of its operational dimensions designed for managing the collection and transportation of used oil activities within and without the WLOs processing facility. The projects in question will cover industrial, urban and rural

areas in order to identify issues that may occur. In essence, and at the initial stage, the pilot projects will be a “learning and intelligence gathering institution” dealing with information surrounding the flow of waste lube oils (WLOs) in the country and to discover the best way of collecting and recycling it in accordance with sound environmental standards and international laws. The system will be very useful to see if there is adequate documentation or not, if there is a census of producers and collectors or not, whether the appropriate procedures of collection and transportation are followed to collect, whether temporary storage places are adequate or not, and if the producers and collectors are all known and aware of the problem around (WLOs), if they have containers and adequate documentation.

1.3 WHAT IS WASTE LUBE OIL?

The term Waste Lube Oil (WLO) is a broad category that includes lubricating oils generated by all kinds of engines and industrial machineries during regular maintenance and oil changes. All kinds of Automobile lubricants are considered potential waste lube oils once their lubricating quality is no longer pure and uncontaminated. Other types of oils included in this category of waste lube oils are industrial hydraulic, transmission & heat transfer fluids and insulants that have gone through their intended use cycle and must be either disposed of or treated and re-used. “EPA defines used oil as any oil refined from crude or synthetic that has been used and thereby contaminated by physical or chemical impurities.”1

1.4 THE ENVIRONMENTAL PROBLEM WITH THE USED OIL

It is well known by now that “lubricating oils becomes waste oil after most of their useful properties have been altered due to use in the machines or equipment they supposed to lubricate. The useful properties consist mainly of various additives that are chemically blended with base oils that originate from the fractionation of a certain portion of crude oil.”

Worldwide, waste oils represent the greatest sources of pollution because of their multipurpose applications. Used oils contain toxic elements but they are still largely taken to landfills, dumped down sewers, used for dust control or wood

[1] http://www.americanrecycler.com/0110/used002.shtml

protection or burned in an unregulated fashion in various small industrial boilers. The result is that the waste ends up in everyone's soil, water and air. These liquid materials are entering the waste streams and the environment in alarming quantities because there is no controlled or regulated economic incentive to properly manage the various streams. In Algeria WLO activity is a self-managed market overseen by no one. A gallon of used oil contains 140,000 BTUs of energy, approximately the same heating value of a new gallon of oil."[2] And, here is where the pilot project's mission fits in with the overall national effort of resource renewal and environmental protection.

1.5. THE SCOPE OF THE STUDY

The solicitation of this study by the UNEP/MAP MED POL will provide Algerian stakeholders the information they need to begin the WLOs pilot project in the most effective and expeditious manner. The specifications of the study call for four main tasks to be completed:

1. Develop technical options for the collection and recycling of lubricating oils in accordance with sound environmental standards and international law.
2. Undertake an economic evaluation of the recommended technical options.
3. Calculate the costs including the direct cost, indirect cost, and general expense.
4. Submit the profitability analysis, and the payback period.

1.6. STUDY AREAS AND RESEARCH QUESTIONS

In line with the above specifications this study sets to produce results in four main areas of concern that usually are subsumed under a system analysis in organizational theory. These areas are the following:

1) Domestic environment within which the system is embedded and is been influenced by many positive and negative forces;
2) The international environment with which the system interacts by barrowing ideas and selling WLOs products;

[2] http://www.americanrecycler.com/0110/used002.shtml

3) The technical dimensions - material and procedural- that are necessary for to carry out its mission effectively;
4) The economic and financial feasibility of the system's survival.

The above system areas in conjunction with the tasks of the study inevitably give rise to five key research questions that frame the study. These questions are listed below. There is also a sixth question but this is rather a general question intended to bring a closure to the study and provide a future orientation for the stakeholder and general audience.

Q1. Question 1: Is the market context (internal & external) within which the proposed WLOs system intends to operate conducive to its long term viability that could justify the country's investment in the pilot project?

Q2. Question 2: Where, by whom, and how much of waste lube oil is annually generated in Algeria?

Q3. Question 3: What possible experiential options are internationally available for Algeria to draw upon and develop its own innovative WLOs Stakeholders and recycling policy model for its Pilot Project system?

Q4. Question 4: what technical installation and equipment are necessary for a WLOs Pilot Project?

Q5. Question 5: Is an Algerian WLOs Pilot Project economically feasible?
Q6. What Steps Must Be Taken To Implement A Pilot Project?

With the above intentions in mind, the five chapters which are devoted to this undertaking are briefly reviewed immediately below. After presenting the scope and the main contents of the study and other introductory remarks in Chapter 1, Chapter 2 follows with a conceptual overview of the study, covering the historical background, the system framework analysis, the main four study areas (the environmental scanning and the techno-economic dimensions) along with research questions, whose answers are given in chapter 4 under the heading of results. Chapter 2 is brief, but useful; in particular to the stakeholders who have been having hard time understanding the difference between a pilot project and a final national plant, or the difference between

the piloting system and the storage facility itself. The exposition is modern but not overly technical.

Chapter 3 focuses on the methodological aspects of the study, linking each of the research questions to the data collection and measurements. In so doing, it explains what kinds of data are needed to answer the research questions and from what possible sources these data will be retrieved. The discussion here is purposely condensed in order to avoid stakeholder's confusion. The more complex and purely academic issues were left out of the study. An understanding of the methodological complexities will not necessarily improve stakeholders understanding of the sustentative dimensions of the issues. If anything, it might unnecessarily add to their confusion.

Chapter 4 is the longest of all the chapters in this work, since it deals with the results of the study and supplies the answers to all the research questions raised early in the introductory chapter. It covers the study areas related to environmental scanning of domestic and international environments and provides answers to the first three research questions. In answering the first research question a brief SWOT analysis is utilized and the pilot project's strengths, the weaknesses, opportunities and threats are identified. The strengths are related to the availability of large quantities of used oils that can be collected at low cost in comparison with other countries collection cost. The opportunities are related to high market demand for used oils in the African and Europeans continents, given that new re-refined facilities are set up and are willing to pay more than $150.00 per tons for good used oil.

This in turn suggests a strategy for the stakeholders to follow whereby the threats and weaknesses are converted into strengths and opportunities. This can be accomplished by taking advantage of the pilot project's technical processing apparatus that is geared to convert the dirty used oil into readily available products to be sold at a good price to domestic and foreign market for farther consumptions. Using for heating energy only the part of waste oil that is not suitable for rerefining the facility will be able to dewater the rest of the oil at very low cost.

The second research question of the study highlights the phenomenon of WLOs generated by different types of automobiles in the 48 regions of Algeria and brings into focus those (farming) regions that are most likely to spill used oil in the

environment or to use it for fuel, and as a consequence, to waste a precious resource for any future use. Used oil burned as fuel is utilized only once. Whereas, used oil re-refined for base lube oil can be utilized many times over.

Then, as a way of suggesting a possible model for Algeria to adopt for its WLOs recycling purposes, the study proceeds with an overview of the ways in which other countries have dealt with the collection and recycling of WLOs resources. In so doing, the study looks at the various schemes of incentives used by other countries to maximize the collection and recycling and evaluates the performance of these schemes on the bases of quantitative criteria, such as collection rates, collection costs, tax rates and final disposition of used oils.

After comparing the various waste lube oil schemes used by other nations, the study moves into the pilot project technical dimensions that form the core of its daily external and internal operations. The technical aspects involve the kind of the equipment that are necessary to collect, transport, and process the waste lube oils, and the set of activities and procedures that must take place within and outside the systems processing facility. Here the emphasis is placed on the quality of the product starting with a well-designed system to encourage the segregation of used oils right at the source. Additionally, a mobile test unit must be in place to test collection sites suspected of tampering with quality used oils.

Following the segment on the technical aspects of the study is the economic analysis with emphasis placed on fixed and variables cost including profitability estimates, and a payback period. The results of the analysis suggest that the pilot project may be viable, if and only if, the facility is able to sale to the international and domestic markets more than seven thousands of used oil annually at a price of $120, 00. Sales below the seven thousands tonnage will not quarantine the project viability without some form of governmental subsidies. However, if the selling price of used oils is set at $150.00 which is the most likely scenario than the future of the project looks much brighter.

Of course, the above estimations are based on the assumption that the WLOs pilot project will be based on the “free-market” model without any other governmental intervention other than the initial investment

Finally, the study closes with a possible time frame of implantation scheme that covers short-term, medium-term, and long term goals of the project. The analysis suggests that the project has great chance to succeed provided that public and private sectors stakeholders will play a major supportive role in the initial stages of the project and see that the incentives are strategically placed to maximize compliance with the national objectives.

The ultimate justification for this forecast is whether it yields plausibly true beliefs about the future, not whether it is based on a particular type of method, quantitative or qualitative. In this and other respects, it is better to be approximately right than exactly wrong.

CHAPTER 2. BACKGROUND

In recent years Algeria, a country known for its oil rich resources exports, has made a conscious decision to join the "green movement" and promised to the world to cut waste and promote a "two-fold strategy: more renewable energy projects and stronger support for recycling efforts."[3] The newly established recycling industry for plastic is booming with success in the city of Constantine. This green boost is helping Algeria meet its international environmental obligations and change the perception of the country.

2.1. OPPORTUNITY FOR THE PILOT PROJECT FUNDING

In line with the above environmental objectives, Algeria plans to invest $60 million into its renewable energy projects by 2023. The goal is set to make Algeria's economy greener than ever within the next 15 years."[4] It seems likely that the country will spend some small portion of this $60 million superfund to setup a WLOs pilot project to play a leading role in the used oils recycling domain. The intended outcome of this spending is to create an intelligent, self-learning, and self-sustained waste lube oils (WLOs) recycling institution. The main mission of this organization is to generate

[3] http://www.wallstreetdaily.com/2014/05/05/oil-rich-algeria-recycling/
[4] http://www.wallstreetdaily.com/2014/05/05/oil-rich-algeria-recycling/

the knowledge Algeria needs in designing a national management plant to renew lube oil resources and prevent farther energy waste and environmental degradation.

According to the latest reports, Algeria generates more than 120.000 MT of waste lube oil (WLO) per year. However, other reports put the mount up to 180 MT of waste lube oil per year. Regardless of what the exact amount is, nothing can be for sure without a primary research on this topic. Anecdotal evidence states that most of this oil, about 86% of it, is produced along the 1,000 km coastal zone that stretches from Morocco in the West, to Tunisia in the East. This region accounts for 17% of the country's territory where 90% of the population lives. This suggests that the area is under increased (WLOs) pollution, even though the dominant national company NAFTAL - that commands nearly 50% of domestic sales of the lubricants market - has services available for the collection of waste oil, often its service is interrupted due to break-downs and lack of spare parts for its collection vehicles. This logically implies that many of pollution problems persist; among others is the problem of not having available temporary storage facility with sufficient guarantees.

2.2. IN SEARCH FOR WLOs RECYCLING MODEL

Rising environmental concerns are causing Algerians people to question the environmental harm from mismanagement of used oil, including air pollution, water pollution and dump sites requiring cleanup. Independent voices on the web are challenging authorities to stop consider this issue as a luxury concern and do something about it.

Although Algerians are aware of the WLOs pollution, the Algerian legislation of waste oil related definitions are incomplete or confused; this is understandable. Given the technical complexity of the issue and the wide range of economic and cultural ramification regulation might have, no one is willing to legislate on something that is not clear in terms of what the legislation should entail and by what means to get there. This shows that legislators are very careful and take their time to figure out all the parameters and the various interests that are at stake. Nevertheless, no one can insist that there has not been a national response to the WLOs problem and no steps have been taken to avoid risks of environmental damage due to uncollected oil being inappropriately discarded.

There is an ongoing Algerian policy and legislative reform initiated to set up a National Plan for the Stakeholders of (WLOs) and to monitor its implementation by means of statistical and other empirical indicators. Algeria has signed the Basel Convention and is fully aware of the environmental compliance of waste oil recycling technologies. Algerian government demonstrated much interest and good will in relation to the development and the application of new environmental regulations. This is illustrated by the fact that Algerian authorities are interested in feasibility studies like this one and welcome the opportunity to learn about cost and benefits resulting from a WLOs Pilot project.

2.3. THE WLOs PILOT PROJECT OVERVIEW

In February of 2015, the Algerian Pilot Project Steering Committee made a decision to limit its undertakings and begin only with one pilot project in the region of Algiers. For this reason, the study will no longer be preoccupied with issues related to other potential location sites. Instead, the study from now on will focus only on the technical and economic aspects of the proposed project that falls within the purview of feasibility analysis discussed in the next chapter. Recently another decision was made by the steering committee regarding the lot size of 3000 square meters.

With these two elements in mind settled, the study proceeds now with the discussion of an overall conceptual framework designed to address technical and economic study areas including issues related to the viability of the pilot project's. The conceptual framework describes the logical development of the study and the relation between phenomena that need to be examined and evaluated. These are study areas, research question and concepts, methodology, and data sources.

2.4. THE WLOs PILOT PROJECT AND THE NATIONAL PLAN

A pilot project such as the one intended here for the Algerian WLOs collection and recycling project is nothing more or less than a social economic experiment conducted as a strategy for change.

The word experiment might cause some readers to think of laboratory experiment where, air pressure, heat, volumes, doses of chemicals, temperatures and other variables are under the scientist's control. The system is closed and nothing comes out or goes in other than what the scientists want. In the social experiment the

system is open and the scientists have little control of what goes in and comes out of it. Nevertheless, social experiments are conducted regularly and decisions are made on the bases of the results. This type of experiment is defined as an action undertaken by one or more public and/or private stakeholders in order to test novel practices or technologies, i.e. innovations in the sense of Olivier de Sardan (1995): “every graft of novel technology, knowledge or form of organization (generally as local adaptation of borrowed or imported innovations) on existing technologies, knowledge or forms of organization”….. The main characteristic of a pilot experiment is to be implemented on a smaller scale than that of the ultimate objective: local or regional scale for national objectives, pilot farms for watershed-wide objectives, individual work unit for objectives at the whole administration or company scale. [5]

2.5. THE ALBERTA WLOs PILOT PROJECT EXAMPLE

Perhaps an example of a pilot project may help alleviate the frustration and agony that some of the stakeholders that have been experiencing trying to understand how it differs from the national plant. The AUOMA model of Alberta province in Canada began after the existing system that placed the responsibility on the retailer receiving used oil from their customers turned out very costly and ineffective. Not all the retailer invested in the equipment required and the ugly head of the free–rider beast rose to kill the effort. As Hollins puts it, “penalizing those retailers diligent enough to accept the returned oil (Hollins, 2009 p. 14). The Alberta provincial government initiated a series of meetings and brain storming sessions with stakeholder that resulted in the formation of new ideas and in an improved used oil management collection and recycling model. The model became a success story and soon was adopted by four other Canadian provinces.

In April 1993 AUOMA was established and charged with trialling a user-pay incentive-based programme in six locations in Alberta. The outcome of this two year pilot resulted in the 1997 Lubricating Oil Material Recycling and Management Regulation. The Alberta Used Oil Management Programme was launched, and continues to this day. AUOMA is a multi-stakeholder not-for-profit organisation now consisting of 184 oil and filter wholesalers, oil collectors, transporters and processors.

[5] http://www.accc-africa.org/kb/documents/2012/06/26/125/action-without-change-use-and-usefulness-pilot-experiments-environmental

Its key function is to maximize used oil collection but it does not stipulate end-uses for the recovered material (Hollins, 2009 p. 14).

It is evident from the above quote that it took two years of trialing and tinkering with the various aspects of the model before it was deemed fully functional and ready for implementation throughout the entire Alberta province. The persistence and the cooperative efforts of the Alberta stakeholders produced an innovative model whose performance today draws the attention of the world as a lesson to be taught and as an example to replicate in another place and time. The Algerian stakeholders are advised to take note of this model and consider its low cost and high collection results. This remark is not without reason.

To some great extent, the Algerian stakeholders are in a similar path today with that the Alberta stakeholders were more than 10 years when the latter decided to reset the time and start all over again with a novel WLOs recycling model. After attending a brain-storming session of the Algerian steering committee in March 22 in Algiers, I walked away with a general impression that there was a bit of confusion and some member were conflating the ideas offered for the pilot project with that of the national plan. Even though the session's topic was about the pilot project, some of the members were not quite clear about the "temporariness" of it, and were reacting to the ideas offered for the pilot project, as if these were indented to be tomorrow "permanently" implemented in the national plan. This fusion of the two horizons of thought and action - in some members mind - was also observed in a previous stakeholders meeting held back in February of 2015.

Perhaps the Alberta example will help clarify the differences between the "temporariness" of the pilot project with the somewhat "permanence" of the national plan. In spite of the conflation of the two action frames, the ideas and suggestions surfaced during these two meetings are worth mentioned here for future references and inspiration. They will be worth particularly to those who refuse to follow the ominous advice of the Cheshire cat that states: 'if you don't know where you're going, any road will get you there.'

These ideas and suggestions are summarily framed in this this study as a conceptual overview that hopefully will assists Algerian WLOs stakeholders to move back and forth between the two times frames and projects' actions and have a better

grasp of the issues involved in two realms. The visualization and the streamlining of two sets of the ideas in their proper context will help clarify which of these will be tried only in the pilot project and which will pass the test and retained to be implemented in the eventual national plan.

2.6. THE ALGIERS WLOS PILOT PROJECT FACILITY

The following is an overview of the process of selecting a model for an Algerian Waste Lube Oil (WLOs) pilot processing facility (PPF) that is geared to accomplish the following objectives:

(1) To develop and maintain a data base of used oil generators and suppliers throughout Algeria aligned to the purpose of monitoring the systems inputs and outputs of WLOs and to forecast future supplies, demands and prices;

(2) To monitor and coordinate the flow of used oils into the national market collected by either private or public firms;

(3) To collect and transport WLOs into its own facility in Algiers and segregate it into various types of readily available value added products suited for (fuel or basic lube oil) recycling purposes;

(4) To promote the sale of these products into domestic and international markets for a price that helps finance the facility's costs and share its profits with its collaborators;

(5) To undertake studies linked to discovering of the best and efficient way of accomplishing the above objectives; and finally,

(6) To propose legislation, or amendments to rules, governing the WLOs recycling system.

With these Pilot Project Facility (PPF) objectives in mind, the overall conceptual purpose this study is set in the following section.

CHAPTER 3. METHODS

3.1. CONCEPTUAL FRAMEWORK

The use of systems perspective facilitates speedy communication and advances a better understanding among all stakeholder of a project. An open systems

approach recognizes the dynamic interaction of the system with its environment. The systems approach defines a system as a set of interrelated and interdependent parts arranged in a manner that produces a unified whole. Enterprises and other organizations are open systems, and so too are WLOs recycling pilot projects like the ones proposed for the Algerian environment.

Figure 1 below illustrates the sequential stages of waste lube oils flow from diverse points of origin to the Pilot Project storage facility to be processes and segregated for delivery the potential fuel burning and re-refining markets clients. The diagram illustrates the conceptual framework the waste lube oil pilot project system that is in constant interaction with domestic and international environments within which is embedded. Its likely primary inputs will be waste lube oils, capital, labor, and information. The transformation process turns these inputs into outputs of finished products and services.

The pilot project's system success will depend on successful interactions with its environment; that is, those groups or institutions upon which it is depended. These might include waste lube oil generators, haulers, truck drivers, suppliers, labor unions, financial institutions, government agencies, and customers. The sale of its outputs, used lube oils, burning fuels, generates revenue which can be used to pay wages and taxes, buy inputs, repay loans, and generate profits for stockholders. If revenues are not large enough to satisfy environmental demands, the organization shrinks or dies.

Algerian pilot project managers must understand the project's environment and the constraints that that environment imposes; they must recognize, at the outset, that this organization is not self-contained. It will rely on its environment for life-sustaining inputs and as sources to absorb its outputs. No organization can survive for long if it ignores government regulations, supplier relations, or the myriad of external constituencies upon which the organization depends. A schematic representation of the system approach to the pilot project is shown below in Figure 1. There are five interrelated parts to it: The environment, inputs, conversion mechanism, outputs, and feedback.

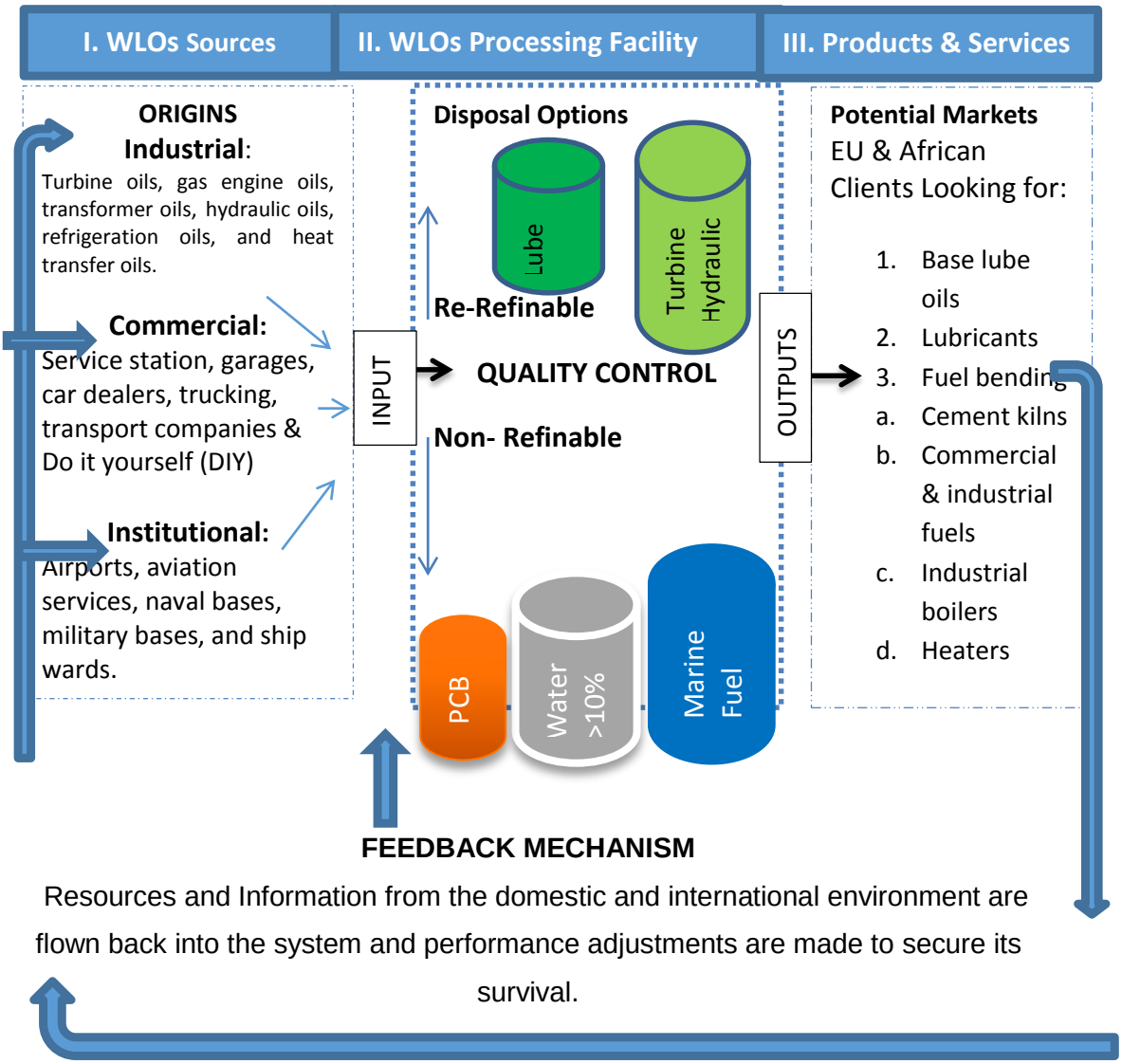


Figure 1: WLOs Pilot Project System

The job of WLOs leadership is to ensure that all parts of the organization are coordinated internally so that the organization's goals can be achieved. A systems view of Stakeholders, for instance, would recognize that, regardless of how efficient the collection, storage, and production departments might be, if the marketing department does not anticipate changes in oil prices the organization's overall performance will be hampered. Similarly, if the communication department fails to place the right quantity and quality of commercial outputs targeting “the do it yourself oil change group”, the collection and storage departments will not be able to do their job effectively. If the lab department fails to secure labeled samples in an organized manner and the analysis records for the clients to see no purchasing agreement will be signed. All these point

to the importance of maintaining a data gathering, managing and analysis culture for an effective decision making process and speedy reaction to environmental changes.

By its very nature the systems approach to WLOs pilot project suggests the study areas of this work and assist the reader to conceptualize the unity of its parts. Just as the system envision the Algerian WLOs pilot project organization as being made up of interdependent factors, this study too is made up by a number of parts that have direct correspondence with the systems parts. There are four study areas to this work. The first two areas are related to the system's domestic and international environment. The first two research questions, (RQ1) and (RQ2) are dealing with the present condition and phenomena in the domestic environment, while research 3 (RG3) draws on the experiences from international environment. Research question 3 (QR3) and research 4 (RQ4) are dealing with core aspects of the system which are the conversion mechanisms and the product outputs that have direct relevance to the financial resources flowing back into the system and help it to survive. Figure 2 portrays the various parts pf the study and their unity.

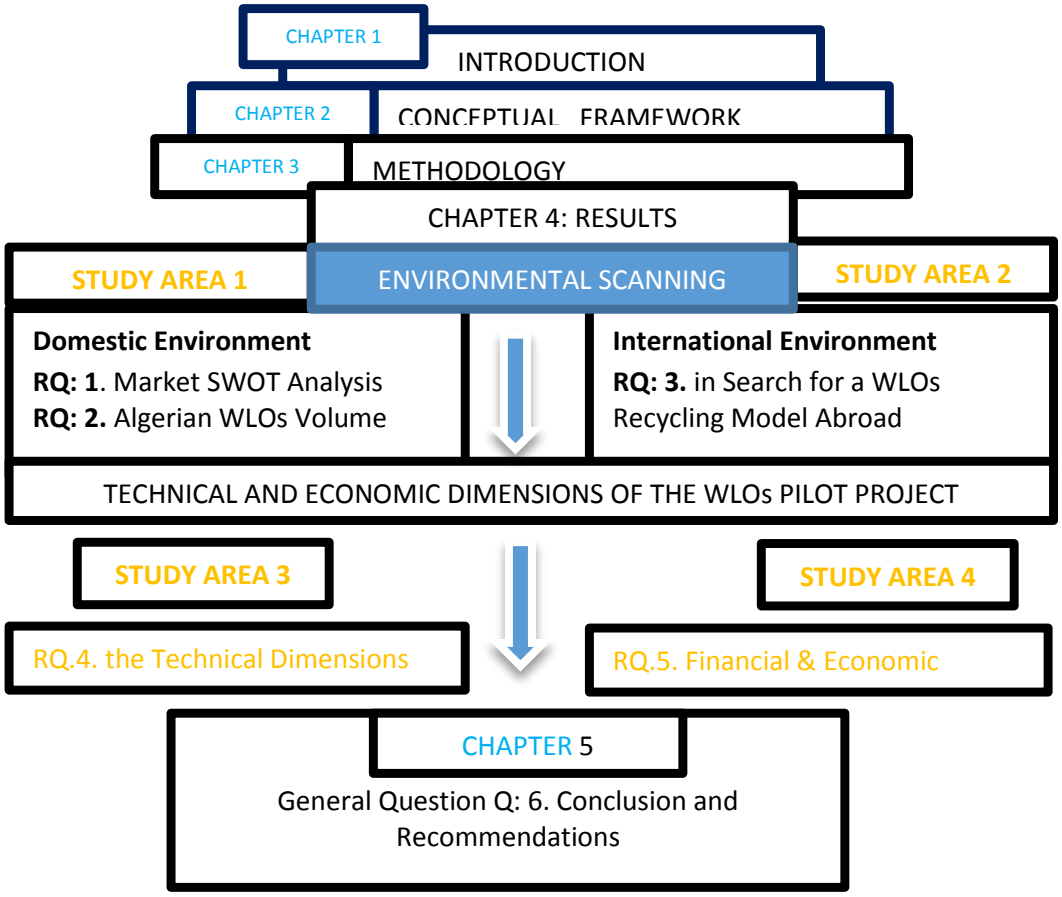


Figure 2: Conceptual Framework of the Study

3.1. PURPOSE OF THE STUDY

The aim of this study is to conduct a feasibility analysis covering economic and technical aspects of the available options related to setting up a pilot project intended to study and monitor the flow of lubricating oils in the Algerian market place, including the Stakeholders of collection and transportation of WLOs in a storage facility geared to safely process and promote the collected material for further recycling purposes in accordance with sound environmental standards and international law. The indent of the analysis is to help stimulate entrepreneurial practices in public and private stakeholder and to make a decision about whether or not to participate in the pilot project.

Another intention of this study is to fill the conceptual gap that seems to appear in some of the stakeholders understanding surrounding the nature, scope and the time frame of the pilot project. To this end, the study will attempt to clarify some key concepts and issues which up to this day have been hindering clear communication amongst stakeholders and slowed progress toward the projects implementation. For this reason, the study wants to be crystal clear with the stakeholders and to help them understand that reaching the goal of setting up the "pilot project" is one thing, and the outcome as a result of reaching that goal is another. Knowing this, they will consider the consequences of achieving the goal, rather than just the goal itself.

It should be clear from the outset, that it is not the aim of this study to include a refining or a distillation plant beyond the scope of a pilot project processing storage facility. Nor it is the purpose of this study to develop an exhaustive technical analysis of all the components and performance of the proposed pilot facility plant, but to develop a structural framework within which to think and act in accordance with the time bound (short term, medium-term, and long-term) objectives set for the pilot project. Additionally, this structural framework falls squarely within the entire national undertakings to "go green" policy by promoting more renewable energy projects and provide stronger support for recycling efforts.[6]

3.2. RESEARCH QUESTIONS AND DATA

Taking into consideration the purpose the study, that is, to conduct an economic analysis of the recommended technical options and to calculate the costs, including the fixed cost, variables cost, general expense, followed by a profitability analysis, and a payback period, this inevitably raises five core research questions that fall within the purview of a feasibility analysis. This in turn necessitates separate section exclusively devoted to each one of these questions. The indent therefore, from this point on, is to address each of these key research questions listed below, by keeping in line and remain faithful to the methodological scientific standards, as closely as possible. Questionable data and sources that could compromise the scientific integrity of the study are not included. The sixth question is not a research question

[6] http://www.wallstreetdaily.com/2014/05/05/oil-rich-algeria-recycling/

but a general question intended to provide cautionary thoughts and recommendation to those who might wonder: where do we go from here?

Even though data on Algerian lube oil demand and used oil supply are very limited, yet necessary to carry out a research of this kind, the study manages through a practical triangulation method and the use of proxy indicators to come up with the information and to provide answers to following research questions:

RQ1. Question 1: Is the market context (internal & external) within which the proposed WLOs system intends to operate conducive to its long term viability that could justify the country's investment in the pilot project?

RQ2. Question 2: How much of waste lube oil is annually generated in Algeria?

RQ3. Question 3: What possible experiential options are internationally available for Algeria to draw upon and develop its own innovative WLOs Stakeholders and recycling policy model for its Pilot Project system?

RQ4. Question 4: what technical installation and equipment are necessary for a WLOs Pilot Project?

RQ5. Question 5: Is an Algerian WLOs Pilot Project economically feasible?

GQ6. What Steps Must Be Taken To Implement A Pilot Project?

The answers to these questions, and to the sub question they generate, are given in the next chapter 4, under the heading of results. The methodology is divided into four different parts where each part corresponds to each study area discussed early in the introduction and depicted in Figure 2 above. With the exception of the first study area which is dealt by the first two research questions, the rest are covered by each of the remaining three research questions. Starting with the first research question, a SWOT analysis of the context within which the system is embedded is a "must" first test in this study.[7] The test will tell, among other things, if there is a demand

[7] This in effect attempts to identify a sustainable niche for this organization by understanding the strengths and weaknesses in the context within which the system will be embedded and to collect the necessary information that will help produce a strategy it needs to survive

for the Algerian waste lube oil in the national as well in the international markets. The SWOT analysis is known for its evaluative nature since it attempts to identify the system's organizational possible market strengths, weaknesses, opportunities and treats. The data for this analysis come from publications on the web and from personal interviews conducted with those who have experience with the exported used oil from Algeria and know a great deal about its quality and short comings.

The first part also deal deals with the phenomenon with which we are all concern here, that is, the Algerian waste lube oil itself. Here the study attempts to identify and describe the presence of used oil in quantitative terms. This corresponds to research question two (RQ2). How much of waste lube oil is annually generated in Algeria? To answer this question, how much lube oil is generated and what quantities can be found in each of the 48 Algerian provinces, the automobiles registration records are utilized as a proxy indicator to come up with an approximate estimate of the used oil quantities. Bearing in mind of the deficiencies of lube oil data, the use of automobiles data is the second best indicator for the purpose of the study. The various types of automobiles generate a given amount of used oil per oil change - usually this occurs twice a year. The quantity of used oil generate by each type of automobile per a single oil change can be estimated by using a simple formula of multiplication: where (Vehicle type) X (Average Number of Liters) = Quantity of Used Oil.[8]

The second part (Study Area 2) considers the various schemes and option other countries have been using to effect the managing and encourage the recycling of their WLOs oil produced in their environment. This corresponds to research question (RQ3). To answer the question that asks, what possible recycling schemes or options are available for Algeria to follow? The study explores and draws on European, North American and Australian experiences reported in case studies conducted by various researchers and consulting firms.[9] Using the data from these exploratory efforts, this

[8] Lolos Th., C. Raptis, G. Lolos, C. Tsompanidis, P. Fragkakis. The waste oil management plan of Cyprus republic: Technical and financial aspects of the proposed strategy. Enviroplan S. A.

[9] Australian Government, Dept. of the Environment. Uses for Recycled Oil. Available at http://www.evironment.gov.au/topics/environment-protection/used-oil-recycling/recycling-your-oil/uses-recycled-oil; ENVIROPLAN (2009) «Integrated waste oils management plan in Cyprus» ENVIROPLAN (2008) «Assistance in promoting solution regarding recycling and use of recycled material from ELVs»; United States Environmental Protection Agency. (Nov. 1996). *Managing Used Oil Advice for Small Businesses*. Solid Waste and Emergency Response;

study derives four WLOs "Managing and Cycling Models", for the benefit of the Algerian stakeholders who have been wondering of what options might be available for their project. Now they have an inventory to select from. Needless to say, that these WLOs models can serve academic scholarship as well. The models are the following:

1) Free-Market-System – (a non-subsidized WLOs recycling scheme);
2) State-Interventionist–System-(a subsidized WLOs recycling scheme);
3) The Mixed-System –(WLOs recycling Scheme); and
4) Non-Profit System – (Canada's Alberta province Scheme).

These models can be combined and readjusted in multiple ways to meet the standards and outcomes of the Algerian Stakeholders.

The third part deals with the four research question (RQ:4) related to the technical operations within and without the facility's environment. The data needed for answering this question are derived from diverse source: internet publication, consulting firms' publications, interviews conducted with used oil collectors and processors themselves. Moreover, the author's draws from his personal experience working with a collection teams and being a consultant and researcher for a re-refining facility for a long time.

The fourth part (Study Area 4) and final step is the capstone of the entire research because it addresses the economic dimensions of the pilot project covering both fixed and variables cost and profit analysis and costs. The data for this analysis are triangulated using three sources: international prices found on the web, personal interviews with re-refining facilities operators, and Algerian cost of living adjustment provided by the website Numbeo.[10]

http://www.wasteauthority.wa.gov.au/media/files/documents/analysis_used_oil_policy_management_options.pdf

[10] http://www.numbeo.com/cost-of-living/calculator.jsp

CHAPTER 4 RESULTS

4.1 RESEARCH QUESTION 1

Q1. Question 1: Is the market context (internal & external) within which the proposed WLOs system intends to operate conducive to its long term viability that could justify the country's investment in the pilot project? What if there is no market demand for the product and services the waste lube oil pilot project intends to offer?

Posing the questions in this way, forces the issue of market analysis right from the start of the journey into the less traveled and even unknown petroleum business world for some of the stakeholder. Before we even begin thinking about an Algerian WLOs Pilot Project, as an organizational system with a mission statement, organizational goals, and a strategy plan, a SWOT analysis of the market within which indents to operate and deliver its products and services is of a first priority. Such an analysis known as the initial environmental scanning is a necessary step to be taken in order to harness the information the system needs to consider and develop strategies for its survival and success. "Just like any planning tool, a SWOT analysis is only as good as the information that makes it up. Research and accurate data is vital to identify key issues in an organization's environment."[11]

Of course, the driving forces behind these projects are local and international environmental organizations that pressure the political system to do something about the recycling of waste lube oils. Both the domestic and international markets are signaling that Algerian used oil might be in the short supply list. Looking through the prism of SWOT analysis this study identifies external and internal factors that can be considered more of sources of strength and opportunities rather than source of weakness, or threat.

Factors that provide strength to the project should be strengthened further and be utilized toward success. Conversely, sources of weakness have to be handled so that to minimize their potential impact on success. Opportunities are the unrealized sources of strength, so planners and Stakeholders will have to optimize opportunities

[11] http://onstrategyhq.com/resources/internal-and-external-analysis/

in the best possible way to enhance the success rate of the project. Threats represent a potential source of failure and collapse, thus Stakeholders should allocate sufficient resources to minimize threats and their negative impact on the project. Action plans then will have to be developed in order to employ the outcome from the SWOT analysis towards the objectives of the project.

Table 1: SWOT Market Analysis for Algerian WLOs PFP

	WLOs Pilot Project Facility	**Competitor Type A Private & public collection WLOs enterprises currently supplying domestic & foreign clients re-refining**	**Competitor Type B Used Oil Burners Cement Kilns, Steel Mills, Utility Boilers, Industrial, Space Heaters, & Asphalt Plant**
Strengths	The quality of the new lube oils entering the market plus the quality control of the processing facility will guaranty a better used oil for exports than in the past	They have been operating in this market for a long time and have developed strong relations with the generators	Product is cheaper than A and sells well in the underground market for burning fuel to consumers.
Weaknesses	. Algerian WLO[12]s are known as being heavily contaminated creating re-refining problems and producing too less base lube oils than is expected.	Gradually they will face hard times of selling their WLOs since their clients shift to Pilot Project Facility for cleaner and less expensive supply of fuel	Poor quality fuel burners are having constant problems with the solid sentiment and water content. These clog burners, foul boilers tubes, and cause sediments build up in the customers tanks.
Opportunities	There are new re-refining facilities built in	Hunting for cash they will sale their good oil	The fuel burners tired of receiving less and less of

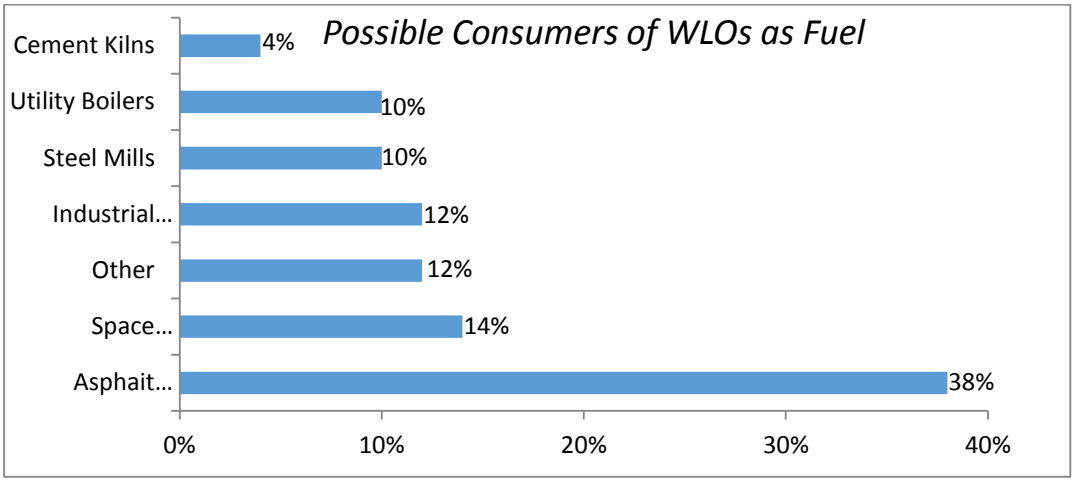
[12] Waste Lube Oils or Used Oils

	France, Algeria, & Tunisia and soon will be in need for large quantities of used oils for their operations. Paying $150.00 per ton or even $180.00 per ton, if it is free of contaminants.	supply to facility all too often until they become regular clients. In the end, they will be exchanging used lube oils for cleaner fuel which in turn they will be delivering to their own clients.- fuel burners	good quality of used oil might sift for cleaner supply to PPF[13] until they will realized that are better off in term of price and quality
Threats	The slow movement of the Algerian bureaucratic red tape & the infighting for the leadership of the facility might slow the process or even kill the idea	Private collector will offer money to generators under table for their oil supply at the cost of making less profit	The presence of a new player in the market will cause to them seek more supplies only to cause price increases which they no longer can afford.

The supply of used oil shows many strong points, but there are nevertheless significant weaknesses which include, (1) a growing private collectors force may pose a challenge to the system if rewards and punishment for noncompliance are not allocated, equitably (2) each of these operators may attempt to work outside the system and thus undermine its the effectiveness if the incentive of profit sharing is not present, (3) unreliable quality of collected used oil which could prevent its export to markets paying higher prices (4) low domestic fuel prices place severe limits on used oil prices in the Algerian markets and thus interferes with the natural incentives for its collection.

A number of Algerian web bloggers' suspect that great portion of it goes to industrial burning for energy, and only a small portion goes to re-refining into base lubricants and to on-site heating. In reality nobody knows how much is illegally dumped, but the consensus among taxi drivers is that illegal disposal has decreased substantially over the past few decades.

[13] Pilot Project Facility



Sources: http://www.americanrecycler.com/0110/used002.shtml

Figure 3: Consumer of WLOs as Fuel

When I asked them to take a look at the above figure and tell me what they thought about it, one responded by saying "this graph very much reflects what really is happening in our country. And I counter. "But clean fuel in your country is so inexpensive why anyone will pay for used oil for fuel?" His response, "yes but the used oil costs half of the price of fuel and there is not tax involved."

A number of Algerian of used oil business men attending Med/Pol work shop in April 22 complained for the lack of support they expected from governmental authorities. They like to see some kind of incentives be in place that would encourage small investor to go out and collect as much oil they could afford. "If the bank could give me a loan to purchase a small tank truck, I would go out and collect used oil tomorrow" a taxi driver said.

Another businessman boasted about the good samples of base lube he produced from used oil and that his facility was ready to start production but the authorities are taking their sweet time he complained. I checked on his facility status and found that in terms of a web site presentation seems credible. The finding of these section are summarily presented below in Table 2

Table 2: A Summary of SWOT Analysis in table 1

INTERNAL	**EXTERNAL**
Strengths Low collection costs due low fuel prices and labor salaries and wages compared to European	**Opportunities** In African and European Markets Algerian WLOs can be sold to European markets above the $150.00per ton very easily
Weaknesses 1) Poor reputation of Algerian WLOs; 2) Private sectors collection infrastructure is underdeveloped ; 3) Legal framework to enforce recycling compliance is incomplete	**Threats** Drops in crude oil prices are a threat to WLOs pilot project's revenue.

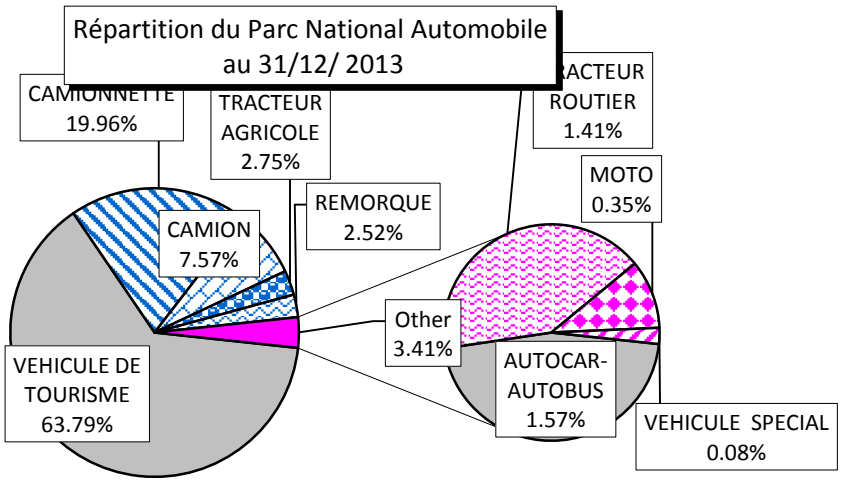
There is an international market for used oils and that can absorb much of the quantities produced in Algeria at a very good price, if and only if, drastic measures are taken to guarantee its quality at the generation sites first, and then in the processing facility where dewatering and filtration will remove coarse solids and water contents.

A growing number of European states seem interested in importing used oils from elsewhere, particularly for fuel since most of their own supply is incentivized through forms of subsidies towards regeneration. Regeneration is required by EU directives. Greece is already importing at least 15,000 tons annually from Algiers according to triangulated information, even though the quality of this oil is not that good. One Greek re-refining facility owner complained that sometimes about 40% of it is a total waste, worth nothing because its volume is artificially inflated with many other liquid contaminants..

4.2 RESEARCH QUESTION 2

Q2. How much of waste lube oil is annually generated in Algeria?

A few years ago, this question could have been answered by looking at the demand for lube oil for automobiles which was estimated to be 150,000 tons per year, and that accounted for 8 percent of the African market. The Algerian car population then was 1.3 million.[14]



Source: Source: Tab.01 Departition Du Parc National Automobile Par Genre De Vehicules Au31/12/2013

Figure 4: Algerian Automobile Population by Type

Today this number has increased by threefold. According with the latest figures reported by the Algerian department of transportation the automobile population in circulation by 2013 was 5,123,705, and according to some press reports another half of million cars were sold since then generating more than 41 thousand tons of used oil per a single oil change annually. If the hydraulic lubricant oils are taken into consideration, that are present in every automobile, but less frequently changed, such as gear oil and automatic transmission fluids then, another 30,000 of use oil can added to bring the figures up to 70,000 per year.

[14] http://www.imakenews.com/lng/e_article001930124.cfm?0,w

Table 2: Used Oil Generated from Algerian Vehicle Fleet

GENRE DU VEHICULE	NOMBRE	AV. LITERS[15]	USED OIL IN TONS
Vehicles de tourisme	3.268.220	4	13.073
Camion	387.750	24	9.306
Camionnette	1.022.859	7	7.160
Autocar-autobus	80.212	24	1.925
Tracteur routier	72.240	27	1.950
Tracteur agricole	141.018	29	4.089
Vehicule special	4.196	17	71
Remorque	129.260	29	3.748
Motos	1.7950	1.5	2.692
TOTAL	5.123.705		41.342

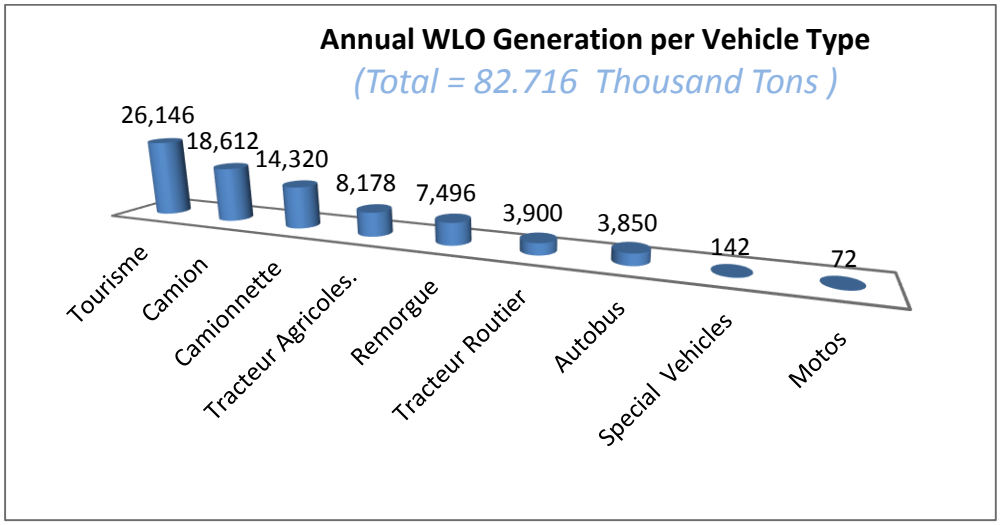
Source: For the number of Vehicles see Tab.01 Departition Du Parc National Automobile Par Genre De Vehicules Au31/12/2013. The quantity WLO generated by each type of automobile is based on the author's calculations on a single oil per annum.

The quantity of used oil this automobile fleet generates per a single oil change can be estimated by using a simple formula of multiplication: (Vehicle type) X (Average Number of Liters) = Quantity of Used Oil. Auto mechanics, car drivers, and manufacturer's technical data sheets were consulted to determine the average number of liters of new oil required to replace the old during oil change per vehicle type. See the results of this calculation in the Table 1 above. The Table shows that Algeria generates 41.342 thousand tons of waste lube oil in a single oil change from its auto mobile fleet. The largest categories are the passage vehicles with 64% and vans with 20%, followed by trucks 7.5%.

However, more than fifty percent of the automobiles change oil twice a year and as a consequence this doubles the quantity of used oil that is generated. The new figures are shown in Figure 5 below. Of course, a half of a million of newly

[15] Lolos Th., C. Raptis, G. Lolos, C. Tsompanidis, P. Fragkakis. The waste oil management plan of Cyprus republic: Technical and financial aspects of the proposed strategy. Enviroplan S. A

registered automobiles, that entered circulation since the 2013 data where published, are not counted in this estimation.



Data Source: Algerian Department of transportation

Figure 5: Annual WLOs by Vehicle Type

The present situation is that used lube oil generated from the automobiles is on the rise given the number of new registered automobiles has risen by half a million since the last figures were reported back 2013. Most of these automobiles were sold in the Algiers -where the pilot project will be located- and in its neighboring provinces.

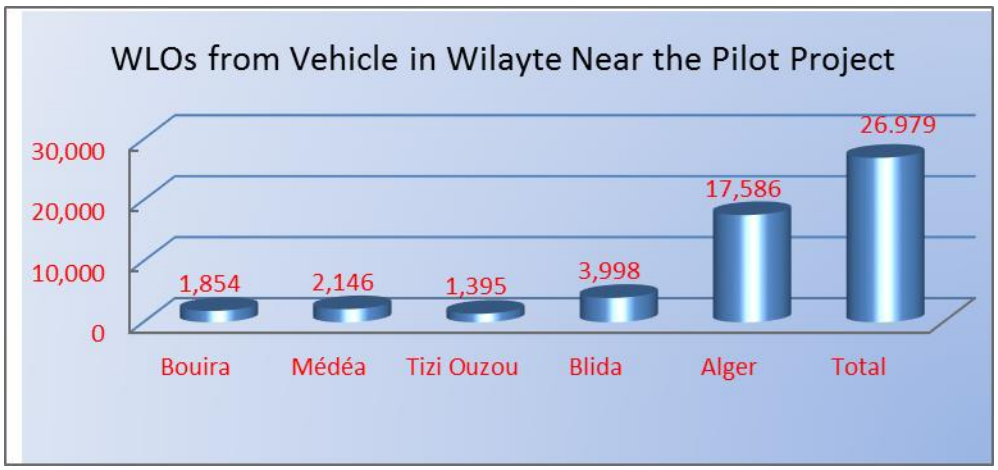


Figure 6: WLOs from Vehicle in Provinces near the Facility

The estimated total amount of WLOs generated in these five provinces from automobiles alone is close to 27,000 tons per annum. Of course this figure does not included WLOs generated from industrial site, shipyards, airports and electrical power station that make up the diversified whole of the territory that is currently heavily polluted. In addition to these, there is another element in this region that provides an

added importance to the location of the pilot facility. It is important note here, that Algiers is the champion of passenger's car registration and one of its neighboring provinces – Medea - is the champion of agricultural tractors registration generating more than two thousand tons of used oil per year. See Table 2 below. The farmers are notorious of using WLOs for burning fuel. Being so close to a pilot facility invested with the authority to study and monitor the proper used of used oils, they will be prevented from burning oil which can be re-refined many times over.

Table 3: WLOs Generated in Farming Communities

RANK	Wilayate	WLO Tons	Rank	Wilayate	WLO tons
1	Médéa	206,741	25	Alger	89,233
2	Tlemcen	193,662	26	Annaba	86,217
3	Mascara	162,748	27	Ain Temouchent	82,07
4	Chlef	161,675	28	Oran	73,225
5	Mostaganem	153,874	29	Mila	61,77
6	Skikda	149,64	30	Biskra	59,334
7	Sidi Bel Abbes	147,32	31	Tissemesilt	59,073
8	Bouira	143,057	32	Khenchela	55,68
9	Batna	134,85	33	Tebessa	53,882
10	Tiaret	130,007	34	Oum El Bouaghi	47,908
11	Contantine	128,151	35	Tipaza	46,487
12	Saida	121,539	36	Jijel	46,371
13	Setif	119,016	37	Souk Ahras	41,209
14	Boumerdes	110,142	38	El Bayadh	40,658
15	M'sila	109,011	39	Laghouat	35,003
16	Bejaia	106,691	40	Adrar	30,189
17	Relizane	105,56	41	El Oued	25,491
18	Ain Defla	104,632	42	Ouargla	24,099
19	Bordj Bou Arrerridj	104,458	43	Ghardaia	17,545
20	Guelma	100,195	44	Bechar	14,123
21	Djelfa	98,716	45	Naama	9,077
22	Tizi Ouzou	98,368	46	Tamanrasset	8,207
23	Blida	96,599	47	Illizi	3,335

24	El Tarf	90,828	48	Tindouf	1,856

Additionally, the pilot project administration will have the opportunity to invite farmers to various meetings participate in brain storming activities linked to WLOs recycling and pollution prevention strategies. These activities will in the end sensitize farmers about the dangers of polluting their land. Using this method extensively, the pilot project people will find ways to subvert farmers to becoming the best used oils recycling agent in Algeria and this will be an Algerian WLOs management innovation – assuming that farmers are also incentivized to do so. The best incentives are those set up by farmers themselves and with regional variation: farmer needs in one region may be different from those in another region. By their nature and profession, farmers know the land better than anyone in government. They know where used oils are produced and by whom. If they have the right incentive they will be able to collect the very last drop of used oil and bring it to the nearest storage facility in their region run and monitored either by the local government or registered private collector.

This is what makes the location of the pilot facility much more important since it will have all the diversity it needs to experiment upon, practice and learn; and generate the knowledge the country needs to reach its ultimate objectives, which is no other than, of renewing scarce resources and protect the environment from WLOs pollution. That is why it is necessary to focus on the creation of the pilot projects, not only to oversee the collection of waste lube oil for its reuse value, but more importantly to produce that special kind of knowledge, which will in end, serve to protect the environment and the quality of life for generations of the Algerian people that will be raised in the same soil.

4.3. RESEARCH QUESTION 3

Q3. Given that Algeria has no previous experience with recycling WLOs, what possible international recycling policy option are available from which it can to draw inspiration and design its own legal framework and administrative policy guidelines to be implemented and carried out by the Pilot Project?

In order to provide an answer to this question and help Algerian WLOs stakeholders to make an informed decision on a policy model, this section will attempt to bring summarily together the experience from other culture that may, or may not, perfectly fit with the Algerian mind set and culture. Nevertheless, logic tells us to study countries that have longer experience in the area of social life than the Algerians do, and evaluate the performance of their WLOs collection and recycling models.

Europeans, North Americans, and Australians have acquired a great deal of experience through the years and now are considered the experts in the area of WLOs recycling operations. We can learn a great deal from their efforts and use this knowledge to recycle Algerian used lube oils in an innovating and successful way. Bearing in mind the deficiencies of theoretical qualitative and quantitative policy models in this policy area, we are extremely lucky to have found a few exploratory studies, conducted by consulting firms, on most European countries, Canada and Australia. These studies harnessed enough quantitative information on which we can now draw upon and piece together the first prototypes of WLOs policy models.

In the developing these models, the countries were first segregated into two separate camps. Countries that use no subsidies to support the collection and recycling of used oil were placed in one camp. This camp reflects what we might closely call a “free market model” where governmental interference or control is kept at a very minimum. The market alone determines most of the rules of the game. Countries that do use subsidies to encourage used oil collection and recycling resources were placed in another camp which we might call “state interventionist model.” In this model, the state does play a role in determining the rules of the game and the setting of some standards. Then proceeded to calculate their average scores in these two models on three dimensions that matter the most to taxpayers: the annual percentage of the consumed lube oil collection; the cost of collection and recycling,

and the taxes paid by those operators who do business with this material. The results of the tabulation are shown below in Table 4.

Table 4: Waste Lube Oils Policy Primordial Models

Non-Subsidized			Tax		Subsidized			Tax	
	% Collected	Ccollectio n Cost	Fuel Tax	Lube Tax		%	Collection Cost	Fuel Tax	Lube Tax
Austria	74	75	38	378	**Denmark**	75	49.1	0	433
Belgium	79	50	6	0	**Finland**	80	53	58	42
Germany	85	76.5	28	16	**France**	56	72	9	38
Greece	37	47.2	39	0	**Italy**	74	100	38	623
Ireland	86	38	18	0	**Spain**	47	31.5	13	0
Luxemburg	39	n.a.	6	0					
Netherland	72	61	31	0					
Sweden	80	32.3	238	0					
UK	86	38.2	38	0					
Average	70.89	28	55.11	43.77	Average	66	45.00	23.6	167.2

Source: The table is put together by the author. The data are drawn from the following website:http://ec.europa.eu/environment/waste/studies/oil/waste_oil.pdf

To our surprise countries using subsidies on the right collect less on average of used oils than countries that do not used subsidies on the left. An average 66 percent on the right versus an average of 70 plus percent on the left is not a great difference. Additionally, the countries on the left have lower collection costs than do countries on the right. However, this difference is not of any significance in comparing the two camps. Nor there seems to be any noticeable difference on the tax rates imposed by both camps. If the outlier Italy is include in the calculation of the average tax lube on the right, then that will balance out the seemingly higher tax rates shown on the left.

There is, however, another hidden difference that needs to be brought out comparison purposes. This difference is revealed when each country, on both camps, is ranked according to a set of three criteria and their scores are summarized to declare their relative position in the sum of the ranking scores. See Table 5 below. The criteria are no other than high collection, cost of collection and tax rate on WLOs products. Thus, a country that score (1) on high collection; (1) on low cost, and (1) on low tax, and receives a total of three points gets high performance marks in this model. Low sum of score means high performance marks whereas, high sum of scores reflect low performance marks. The criteria are collection rates, collection costs, and tax rates on WLOs as shown in Table 4 on the previous page.

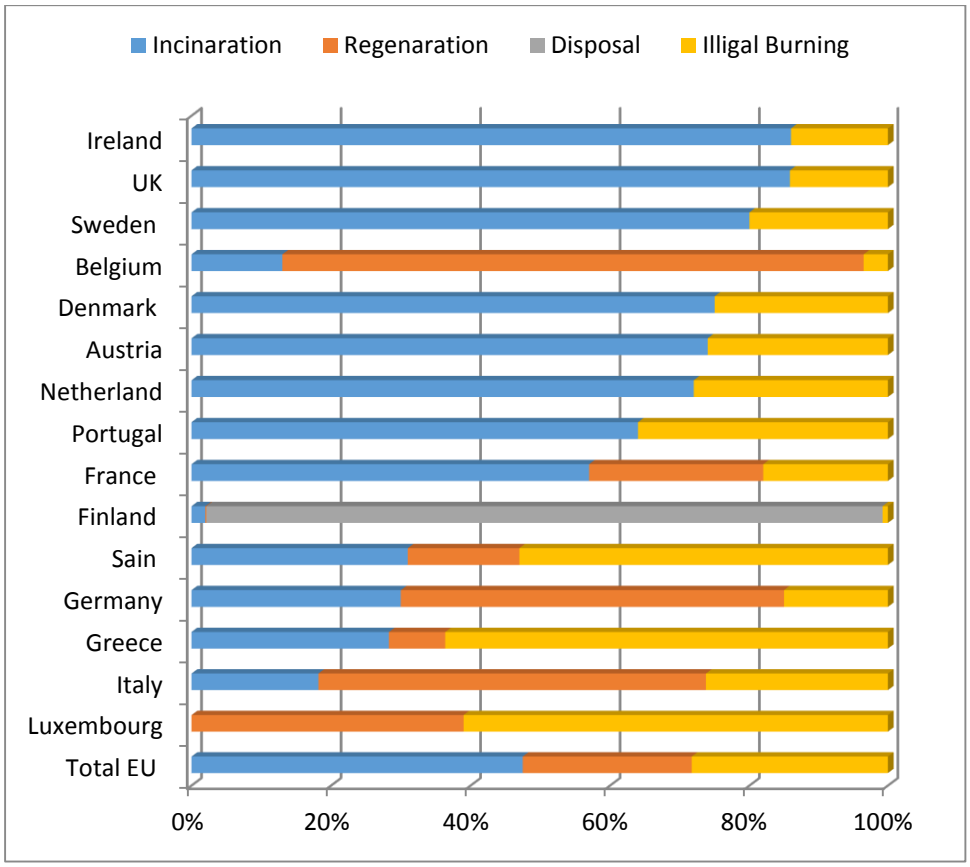
Table 5: Rankings on High Collection & Low Cost Criteria

SUMM OF RANKINGS SCORE ON	COLLECTION	COST & TAX	
Non - Subsidized	Total Ranks	Subsidized	Total Ranks
Ireland	6	Denmark	7
UK	11	Spain	7
Belgium	11	Finland	8
Sweden	14	France	10
Luxemburg	14	Italy	13
Germany	15		
Netherlands	19		
Greece	20		
Austria	21		

Each country in both camps is ranked along the three dimensions and its scores are summed up to produce single performance indicator shown in Table 5 above. This ranking order- performance - indicator is based on the tree criteria, that reflect more or less, citizens rational preferences: high collection rate is always the primary policy objective for protecting the environment; and, if that can be accomplished at low cost and low tax, who is going to complain for a successful policy strategy that helps renew resources and prevents pollution?

Thus on the bases of a country's performance on these criteria the policy models can be evaluated on rational grounds. However, policy goals should not be confused with the ultimate policy outcomes and the long term citizen's expectations. In other words, there are additional performance criteria that must be observed in order to evaluate the full performance of these models. People sensitive and conscious about recycling and renewal of resources ask an additional question: what these countries do with the used oils they process? This suggests of giving countries an additional screening test. Using yet another set of three criteria such as incinerations, regeneration, and illegal burning we can observe the outcomes in Figure 7 shown below. The fate of the WLOs oil collected in European countries is plenty depicted in this figure. The test reveal a dominant and disturbing pattern of outcome comprised of

legal and illegal burning seeing in blue and yellow colors respectively in the figure below. Even though the legal burning is much cleaner that the illegal the fact remains that only few countries have placed an emphasis on regeneration.

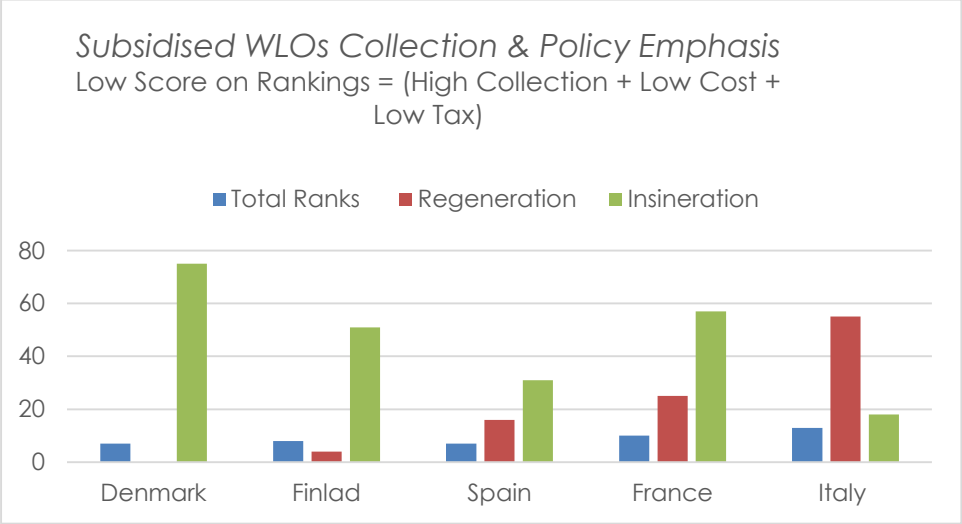


Source: http://ec.europa.eu/environment/waste/studies/oil/waste_oil.pdf

Figure 7: Management of Waste Oils in the

With the exception of Belgium, all other countries including, Germany, France, Italy, Spain, and Greece, have partially shifted towards the regeneration of used oils. The great majority of these countries are still WLOs burners. Whether the burning is legal or illegal, it does not matter. What really matters is the fact that a precious oil resource is lost forever. “This form of recycling is not as preferable as a method that reuses the material because it only enables the oil to be reused once. Nonetheless, valuable energy is provided (about the same as provided by normal heating oil).”[16] Obviously, without the motive of profit regeneration does not come naturally. A clearer picture about the phenomenon of regeneration emerges when these countries are segregated once again back into the non-subsidized and subsidized camps. The pattern that emerges is shown in Figure 8 below.

[16] http://www.epa.gov/osw/conserve/materials/usedoil/usedoil.htm



Source: Authors figure using data from Taylor Nelson Sofress, 2001.

Figure 8: Rankings in CC[17] Goals Criteria & IR[18] Outcomes

Those countries that are the champions of high collections with low costs and low taxes regenerate less than those which collect less and have high collection cost and higher taxes on WLOs products. Obviously, cost is a factor and without state subsidies there is no motive for regeneration, and this can be seen much more clearly in the case of Demark when in 2003 the Danish government decided to put a gradual end from sending used oil to fuel outlets, and sifted its priority toward fulfilling a 75% target of re-refining.

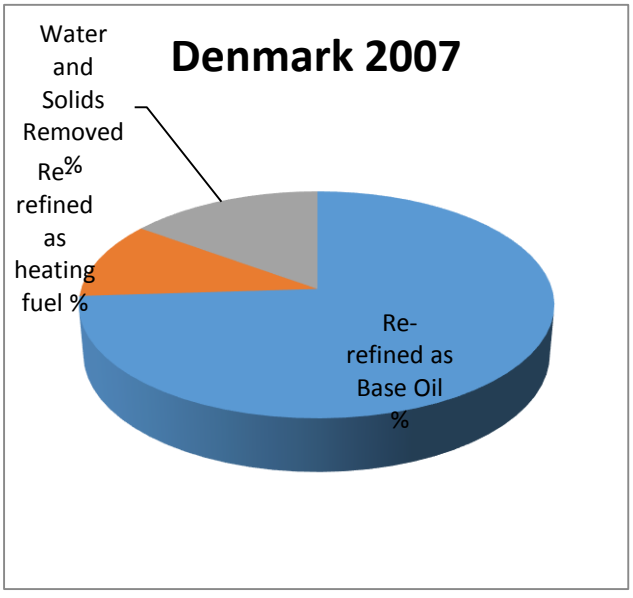


Figure 9: Denmark's WLOs Re-regeneration Priority

More on Demark, Finland and Spain will be discussed later on, under the heading of Advance Disposal Fees Models. For the time being, the discussion will focus on the French and Italian models since they represent versions of the classical subsidized WLOs collection and recycling schemes. Both the French the Italian schemes are constitute special types on their own.

[17] CC = Collection and Cost ;
[18] IR = Incineration and Regeneration

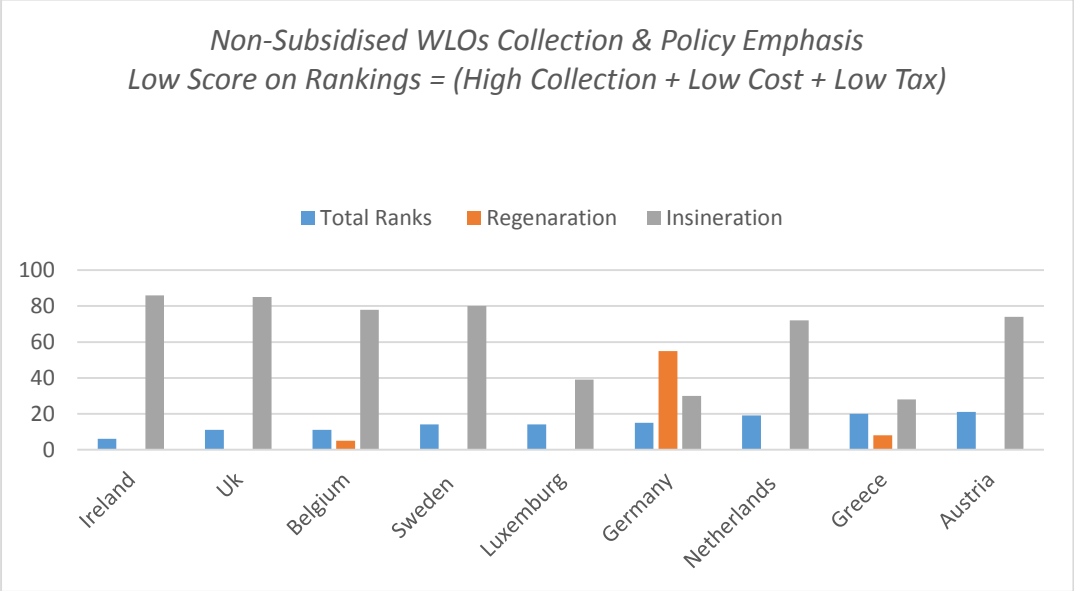
France uses a subsidized system (through tax on polluting activities (TGAP), including a product charge on fuels and virgin or re-refined oils) which benefits to collectors & cement kilns'. Local authorities (préfets de département) for a duration of 5 years. Subsidies paid by Ademe, out of the TGAP tax on polluting Activities (free of charge for individual holders & companies when WO water content is lower than 5%. Selling revenues and subsidies received by collectors are the same wherever WOs are sent (to fuel burners for energy users or sent for regeneration) so, if this measure were alone, there would be no strong incentive for regeneration. But in case of difficulty for ECOHUILE to be supplied with WO, ADEME pays a temporarily bonus to collectors to reconstitute the ECO-HUILE stocks of WO (this situation occurred in 2000). Subsidies to cover collection cost of WO to be re-refined are not applied to imported WO (only for WO collected in France). In addition to WO, most of the collectors collect also other waste interesting cement kilns[19]

Italy's subsidized system is based on a product charge on fuels and virgin or re-refined oils, managed by a private consortium (COOU) established by decree and whose priority is the regeneration of WO, which buy and sell collected WO and subsidy regeneration through tax exemption. The licensed collectors' obligation is to bring collected WO to 1 of the 6 main regional transportation co-ordination centers. The existence of a compulsory consortium (COOU) dedicated to WO recovery, whose obligation is to collect and re-refine WO in priority is an element that the Algerian stakeholders to consider. There is an obligation of all manufacturers and importers of virgin or redefined lubricants in Italy to belong to the Consortium. Monitored by all the concerned ministries[20]

4.3.1 VERSIONS OF THE SUBSIDIZED WLOs COLLECTION SCHEME

Glancing on the Figure 9 below where the non-subsidized countries are displayed, we see only two countries; Germany and Greece have taken some steps towards regeneration. But appearances are deceptive. Even in these two countries forms of subsidies have been used in the past helped to set up the expensive regenerating facilities which are now written off.

[19] Sofress 2001 p. 150
[20] P. 157



Source: Authors figure using 2001 data from Taylor Nelson Sofres.

Figure 10: Non Subsidized Ranking in CC Criteria & IR Outcomes

As Oakdene Hollins sates, "[i]n Germany, output subsidies for re-refining plants of approximately €3 million are supported, until 2004, by capital grants of between 20% and 60%, depending on location. Base oil production was 95,000 tons in 2001/02 from 600,000 tons of collected used oil.[21]

In the Greek case, things are a bit darker and even scandalous when it comes to WLOs collection scheme, and it will take an entire dissertation to cover the complexities of the case. The bottom line is that much of the recycled WLOs regenerated, is being financed by special EU grands and by fees paid directly to the regeneration facilities by lube oil importers and domestic producers regardless of the amount collected. There is only on dominant facility that has contracted with these importers and producers to collect on their behalf 60% of the oils sold in the Greek market. The contract absolves these companies from the responsibility to collect the 60% required by law. According to Sofres, Greece regenerated 25,000 tons of WOLs, but only 5,000 tons are Greek WOLs, 20,000 tons come from Algeria and Saudi Arabia[22]

Now, the question that should be asked here is the following: Does this facility collect the amount it promised? And, if it does why then it imports use oils from Algeria?

[21] www.oakdenehollins.co.uk/pdf/Waste_Oils_Report_2.pdf · PDF fil
[22] Sofres 2001. P. 29

Obviously, not much of used oil is collected in Greece to protect the environment. Glancing back to Figure 7, Greece is the champion of illegal burning- if not of a non-collection state. This is not a good WLOs model for the Algerian stakeholders to emulate.

From the cases examined in the above analysis from the analysis that follows, it will become more than evident that a WLOs recycling scheme placing emphasis on regeneration without any financial assistance from without, does not exist. The cost of regeneration is simply too expensive to attract private investors willing to take the risk. The break-even point, according to re-refiners and several authors, of a modern regeneration plant would be between 60 and 80 kt per year (Taylor Nelson Sofress 2001, p .56)

4.3.2 THE ADVANCED DISPOSAL FEES SCHEMES

As it has been previously stated, before 2002, most recovered oil in Demark was burned in local district heating plants. The Danish government initiated measures and effectively restricting competition for used oil collection to two companies - one operating the country's sole re-refinery. The same two firms dominate collection across both the MB and market systems. Demark has a twin system one that subsidizes collection for regeneration and one that does not receives subsidies for collection intended for burning fuel. Similarly, the government of Finland introduced a complex ADF (Advanced Disposal Fee) system to target only those oils suitable for re-refining. Other used oils are subject to high collection prices with the risk that this provides an incentive for inappropriate disposal-not a very good idea for protecting the environment. When challenged, the authorities in both countries did not consider this risk of environmental damage to be a real one - for cultural reasons. Perhaps cultural habits and ethical contacts are a better substitute to laws and regulations.

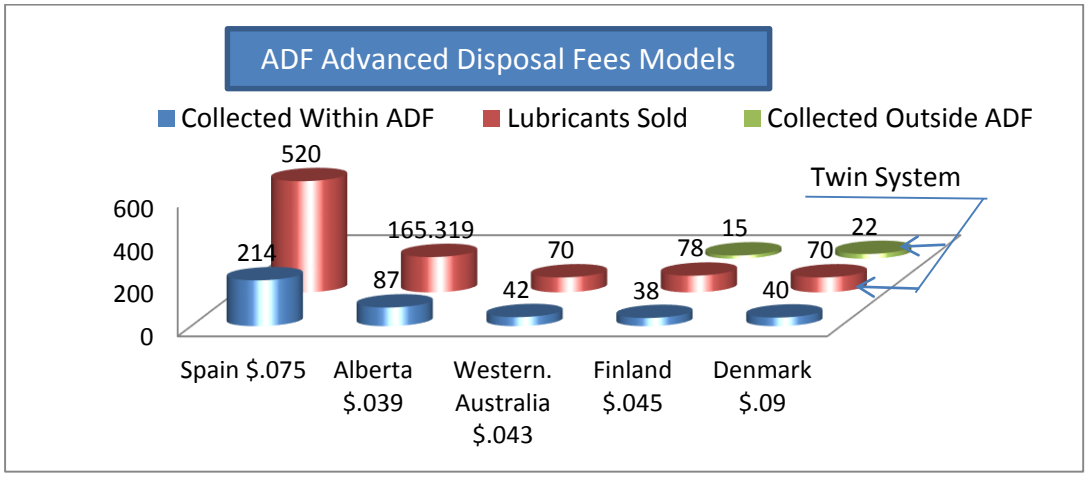


Figure 11: ADF Advanced Disposal Fees Models

The Spanish system is based on state subsidies and always has been subject to political changes. Up to June 2006, the Spanish system operated a national system of subsidies for the collection and processing of used oils. However, the frequented budget uncertainties impacted the level of subsidies, and no one was ever sure as to how much the pay from year to year will be. This e uncertainty led to the adoption of a system operating successfully in Demark and delegated the task of collection to a new private sector organization funded by a levy of $0.07 per on most new lubricant sales. The system encourages competition between collectors, and the power of the re-refining plant operators is leading to an increasing market share for integrated collection and re-refining companies.

The subsidy payments are made for all used oil feedstock, thereby encouraging collection of oil regardless of its origin. The higher subsidy for re-refining seeks to make it competitive with burner fuel markets thereby encouraging collectors to keep separate those oils suitable for re-refining. In 2008, collectors were being paid up to 16 Euro cents per liter on the gate by re-refineries. With the exception of marine and some industrial oils which are heavily contaminated, most oils are being collected free of charge. The subsidy for re-refining has encouraged proposed new investment in the sector albeit during a period of exceptionally high oil prices. The levy on lubricants raises approximately €26 million.

The AUOMA model established by Albert province of Canada - partially discussed earlier under in the section of the pilot project - is a multi-stakeholder, not-for-profit organizations, whose 184 members are oil and filter wholesalers, oil collectors, transporters and processors. According Hollins, this is “a government initiated and industry driven” scheme that has nothing to do with Federal government

of Canada or with the daily collection, transportation, and processing of used oils. It does not regulate and it does not imposes any fees on its own.

There are a number of things AUOMA itself does not do: it does not transport, or at any stage take ownership of used oil materials; it does not control collection or recycling facilities; it is not government-funded; and it does not regulate. AUOMA is instead a delegated administrative organization' directed to carry out business on behalf of the Provincial government (Hollins 2009, p. 14).

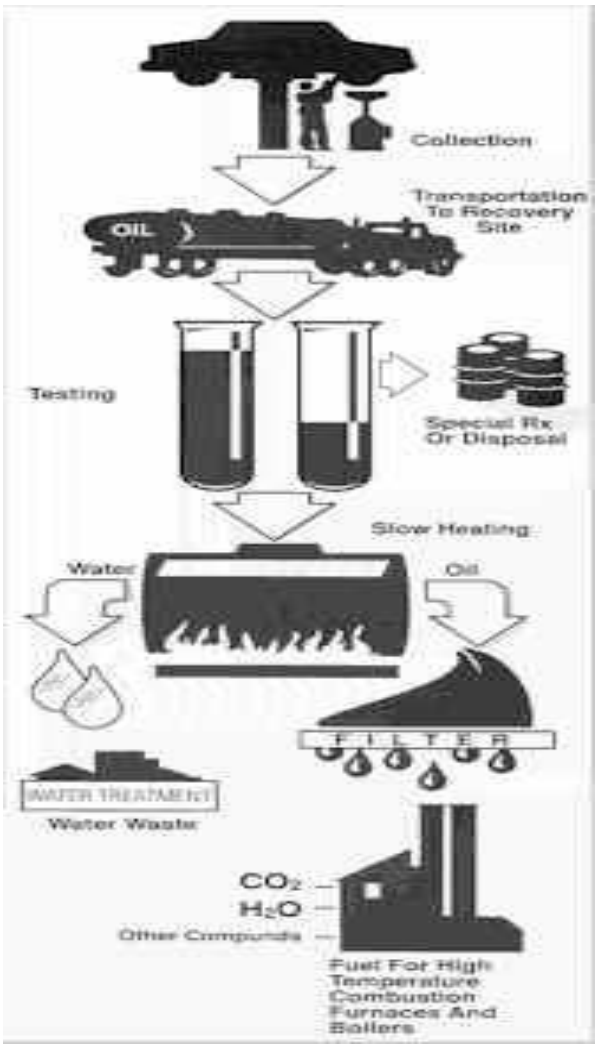
First lube oil and filter registered seller (include manufacturers, marketers, wholesalers, retail distributors or importers) operating within the province pay a five cents environmental handling charge (EHC) for every liter of lubricating oil sold to a non-registered buyer. "The levy is not paid on supply sales transactions between registered members. AUOMA collected $15.7 million through the EHC in 2007." While about 4% of the funds are kept to pay for administration and public awareness-raising activities, the other 92% is redistributed as a return incentive (RI) to private sector collectors of used oil. There are 4,000 generators throughout Alberta, of which about 400 serve as registered 'drop-off locations' accepting used oil materials from 'do-it-yourself oil changers, farmers and small businesses. These depots are run either by some local governments or by the Alberta Bottle Depot Association (Hollins, 2009 p. 14).

This section draws on the experiences from other countries and derives a number of generalizations. Using the data from the exploratory efforts, of cases studies, this study derives four WLOs "Managing and Cycling Models", for the benefit of the Algerian stakeholders who have been wondering of what options might be available for their project. Now they have an inventory to select from. The models are the following:

1) Free-Market-System – (UK, Austria, Germany, Greece, Ireland, etc a non-subsidized WLOs recycling scheme);
2) State-Interventionist–System-(Denmark, Finland, Spain a subsidized WLOs recycling scheme);
3) The Mixed-System –(France, Italy WLOs recycling Scheme); and
4) Non-Profit System – (Canada's Alberta province Scheme).

Each of these models reflects to some extent the dominant political and economic ideologies of the countries and not so much the utility or adequacies of the models. Being just generalized models, they can be modified, combined and readjusted to meet the ethical and cultural standards and outcomes of the Algerian Stakeholders.

An important conclusion to draw concerning the types of WLOs schemes for the Algerian stakeholder is to select from which environmental risks arising before collection, such as illegal dumping, are considerably greater when compared to the net increase in the risk of environmental damages from preferring any one recycling scheme over another. Consequently, if the policy objective is to minimize the risk of environmental damage, maximizing the collection of the recoverable proportion of lubricants should be a priority. In the case of waste oil, the threat presented to water resources by just a few liters should be a constant reminder in their heads.



4.4. RESEARCH QUESTION 4

Q4. What technical options are available for the collection and recycling of lubricating oils that meet the requirements of sound environmental standards and international law?

The full answer to the above question must include, not only the appropriate equipment that are necessary to collect, transport, and process the waste lube oils, but also the set of activities and procedures that must take place within and outside the systems processing facility. In order to fully address the question, it is important to have first a general overview of the main activities involved in the flow of used oils from the various sources as inputs into facility's system where are processed into various product outputs.

A pictorial representation of this process is shown on the left in the Figure 11 downloaded from SynLube web site.[23] The figure provides assistance to stakeholders who may not be familiar with such operations. Oil drained from automobiles during maintenance, is collected in storage containers; and when enough quantity of oil is accumulated, a special ADR equipped tank trucks collect it and transport to the facility for processing and storage. Once is in the facility, the oil undergoes through test analysis to ascertain its quality and water content. Depending on the type, its quality, and water content, the oil is then segregated accordingly, into labeled storage tanks to be later processed through the dewatering and filtration units. Once this process is done, test analyses are taken once again and the result are recorded in a log for future references. Potential client who wish to purchase the processed supply would like to see the results, and on this basis, they will sign the price agreement. The processed oil, it too, will be segregated into labeled storage tanks to be ready for delivery to potential consumers for a price.

4. 4.1. WASTE OIL SOURCES

Automotive service centers and commercial engine fleets: This includes service stations, garages, new car dealers, other retail establishments and automotive fleet service areas where waste oils are drained from crankcases of automobiles and some trucks. The drain oils consist primarily of crankcase drippings (greater than 90%), but also include waste transmission fluids, gear lubricants, hydraulic oils, and minor amounts solvents used in the service areas. In highly industrialized regions, a considerable amount of waste oil is available from trucking, transportation and construction company fleets. A high percentage of commercial fleets operate diesel engines. Waste oils from automotive service centers and commercial engine fleets represent the largest relatively uniform source of feedstock with good recycling capabilities.

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[23] http://www.synlube.com/usedoil.htm

Figure 11: The Used Oil Flow from Source to the Facility

4.4.2. EQUIPMENT REQUIRED FOR COLLECTION AND SERVICES

Figure 12 : Small Tank Truck

Figure 13: Truck for Intermediate Distances

Tanks trucks come in various sizes and styles depending on their use. A pilot project facility must have at least five tank trucks to collect and carry loads of oil to the storage location. Three of these trucks must be small enough to be able to get

into narrow areas where storage tanks are usually squeezed between buildings or in the back of service stations and car shops. These tank trucks have a capacity to carry two to three tons of oil and cost no more than $30,000.00 new. One of the other two tank trucks is for intermediate distances and has the capacity to carry 7 to 8 tons (See Figure 13). The cost is in the area of $40,000.00. Some of these trucks can be found in Europe for less than $25,000.00 used. There is also another type of truck that is usually used for long distance and carries up to 16 tons of used oils. See Figure 14 below. This particular type of vehicle is comprised of two separate pieces: the tractor and the trailer. The main advantage of this truck is that it can transfer trailers and dropped

and

them in strategic secure locations to receive oils from smaller facility's trucks operating in the area, or from regional collector until is fully loaded for transfer.

Figure 14: Long Distance 17 ton Tank Truck

The facility's drivers usually take advantage of market opportunities and place tanks and containers with waste lube oil generators depending on the types and quantities of oils generated in each source. Each tank should labeled for specific types of oil, such as, regular waste automotive oil draining, - light fuels such as diesel, jet fuel, kerosene and waste gasoline, - oil water emulsions, crude oil or waste which will need to be processed separately, depending upon the nature of the final usage business.

The situation in each regional location must be studied and a strategy should be developed to determine the best method of collecting the waste lube oil. Because heavily contaminated used oils create later on serious problem for re-refiners, the quality of the waste oil collected is also an important consideration. To avoid of mixing good used oils with bad used oils during the collection, the facility must supply its potential collaborating generators with market containers for its type.

Transmission and turbine oils, which are termed white oils, for example, are good for re-refining purposes and should be kept separate from engine oils or black oils. In addition to this, driver and haulers should be equipped with Instruments detecting the presence of water metals in the oil and they should manage to keep separate during the collection process. Quality assurance is a necessary aspect of the overall facilities operating procedure and should include quality control guidelines for testing all incoming oils and segregating them if they are not acceptable.

Figure17: Used Oil Drums

Figure 156: Plastic Containers

These instruments can be purchased from China for a very low price compered to North American and European producers.

Most waste oil generators need storage tanks near their shop to store the waste oil. The size is generally appropriate to the quantity of oil collected in any particular period of time. In some instance the tanks may be too small for carrying out efficient collection. In either case, it may be more practical for the facility to install its own larger tank, clean, painted, and labeled. The facility keeps the title to the tank and it may take it away when his service ends. Good arrangements should be made prior to the installation of the facility's tank, in order to describe responsibilities, liabilities and costs, of each party.

The collection system's objective is to gather sufficient quantities of waste lube oils with specific characteristics and quality for ultimate disposal for a good price that generates revenues for the facility's self-sustaining needs. Consequently, Algiers is considered prime locations for waste lube oil storage and sorting facility – save for the have traffic that creates delays and loss of time on the road. The collection of large quantities of waste lube oil must be sufficient to meet the minimum operating expenses of the organization.

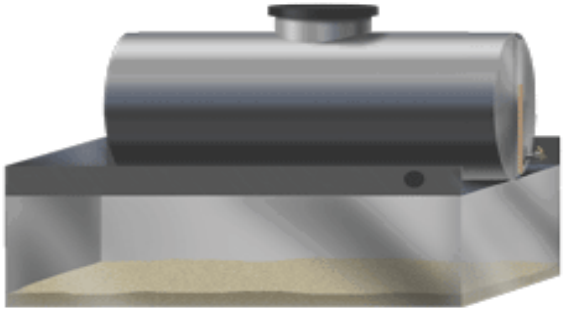


Fig 18 Storage tank on a secure base

4.4.3 SERVICES AND NETWORKING

The facility should be able provide a range of services including on-site sampling, lab analysis, and transportation and recycling services ranging from used oil marketing to processing that involves dewatering, filtering and demineralizing for use in industrial burners. There is a number of different equipment in the market of getting fluids out of vehicles used for scrap metals in Jung-yards, in in a quick and efficient manner. There are several manufacturers of self-contained fluid removal systems.

Experience in the waste oil collection business has shown that the use of computers to network and monitor waste oil collections has actually led to a significant

increase in the efficiency of the collection operation. The diversified character and the mere numbers involved are justifying the use of a computerized collection system. A network may include up to hundreds or even thousand sources of waste oil for 250 tons collected monthly.

Also these sources and the regional collectors with whom the facility collaborates differ widely in the quality of waste oils, the storage capacity, and the personnel that is under their command. A tailor made computer system can help to manage a large supply network, increase daily volume collection, reduce time and distance. This will in the end, lead to cost reductions and higher profits for the facility's continuous operations.

4.4.4 A GENERAL SCENE OF THE PROCESS FROM WITHIN

All the above suggest that the facility will be equipped to handle large quantities of waste lube oils daily. Tanks trucks of various sizes and a pippin network connected to pumps channeling fluids to various storage tanks will be general scene inside the facility. There the collected waste lube oils are daily undergoing through the usual routine of testing, segregating, filtering and dewatering mechanisms to get them ready to be sold as products to other industries, either as re-refinable lube oils or non-re-refinable for burning fuel. A general scene of the facility is shown in Figure 19 below.

Figure 19: A General Scene of the WOLs Pilot Project Facility

Once a tank truck reaches the facility it goes over the weight bridge and the load is weighted. The volume and the sources of oils are recorded in the logs. The cost of a weight bridge of this size is over $40.000.00.

Immediately samples are taken and analyzed to determine the quality and the water content of the load using the classic D-9 Method.

Then, using the latest laboratory equipment more complex and highly sophisticated test follow to determine the nature of the solid and liquid contaminants that might be present in the oils. The cost of this type of lab is over $50,000.00 worth.

Depending on the results of the analysis the load is then classified as Re-refinable or Non-Refinable (See Figure 19) and pumped into one of the storage tanks to be later processed through the filtering and dewatering apparatuses (Figure 20). Once this process is done, test analyses are taken once again and the result are recorded in a log for future references. Potential client who wish to purchase the processed supply of used oils would like to see the results, and on the bases of these, they will sign the price and the purchasing agreement.

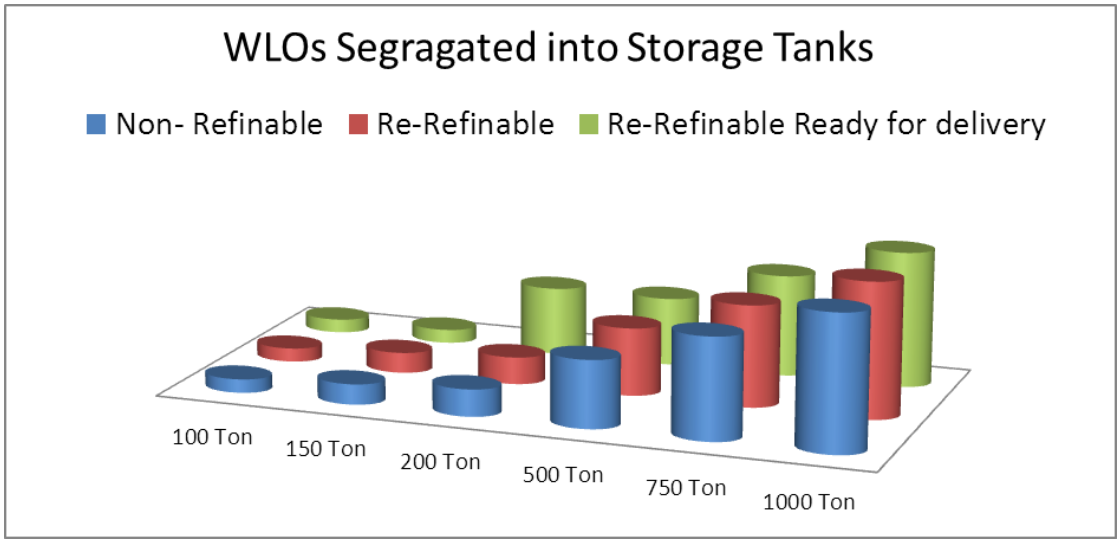


Figure 16: Storage Tanks for Used Oils

The processed oil, it too, will be segregated into labeled storage tanks to be ready for delivery to potential consumers for a price. When used oils are contaminated with metals or with high volumes of water, such as marine lubricants and spend cutting and drilling fluids, must be segregated since are unfit for re-refining purposes. Since these materials are unsuitable for re-refining, the facility may use it for slow heating energy to dewater the rest of the used oil at no cost (Figure 20).

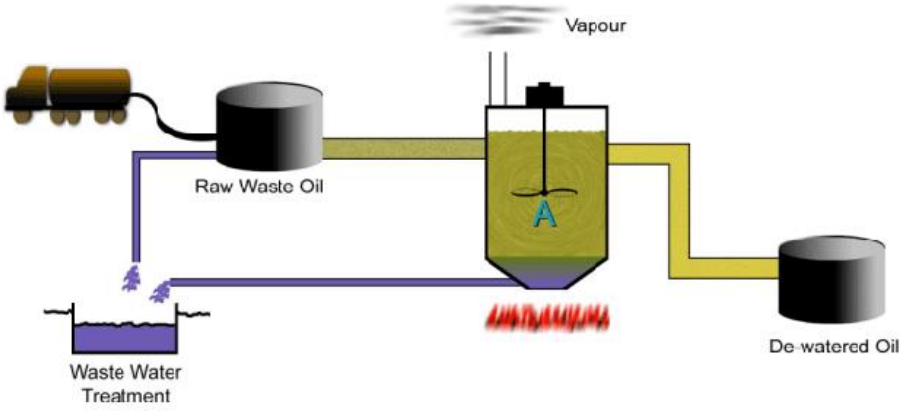
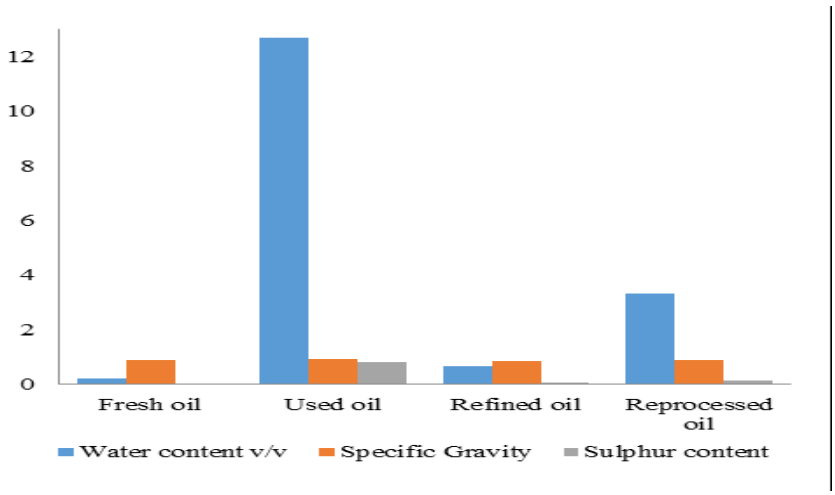


Figure 17: The Main Idea of Added Value by De Watering WLOs

With the installation of scrubbers on top of the heated mixing tank shown in the above figure, all vapors and odors will be eliminated. These scrubbers are specially designed to capture all vapors through a series of special filtration systems. The price of this type of scrubbers is over the $30,000.00 range.



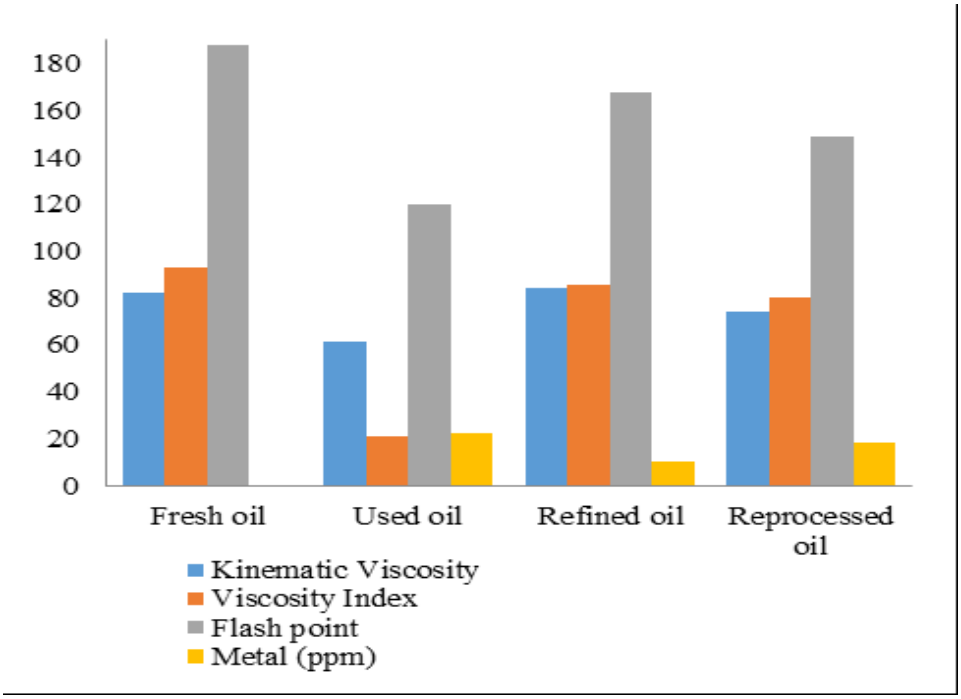
Source: Motshumi J. Diphare, Edison Muzenda, Tsietsi J. Pilusa and Mansoor Mollagee A Comparison of Waste Lubricating Oil Treatment Techniques 2nd International Conference on Environment, Agriculture and Food Sciences (ICEAFS'2013) August 25-26, 2013 Kuala Lumpur (Malaysia).

Figure 18: Comparison of Lubricant Oil Properties before and After Treatment

The above shown the values of sulphur content for the treated oils The sulphur was caused by moving parts. Sulphur reacts with the metal to form

compounds of low melting point that are readily sheared. Corrosion in engines is caused by mineral acids formed by the oxidation of sulphur compounds in engines with lubricating oils. Sulphur content was found to be 0.042wt % and 0.13 wt % through re-refining and reprocessing respectively.

Figure 21, also shows that the specific gravity of the virgin oil is higher than the treated oils and lower than the used oil. The results for the used and re-refined and reprocessed oils are 0.91, 0.86 and 0.89, respectively. The specific gravity of contaminated oil could be lower or higher than that of its virgin base oil depending on the type of contamination. If the used oil was contaminated due to fuel dilution and/or water originating from fuel combustion in the engine, its specific gravity will be lower than that of fresh oil or re-refined one.



Source: Motshumi J. Diphare, Edison Muzenda, Tsietsi J. Pilusa and Mansoor Mollagee A Comparison of Waste Lubricating Oil Treatment Techniques 2nd International Conference on Environment, Agriculture and Food Sciences (ICEAFS'2013) August 25-26, 2013 Kuala Lumpur (Malaysia).*Figure 19: Comparison of Lubricating Oil Properties after Treatment*

Let‘s now see how a fresh lube oil supposed to look like by comparison to used oil before and after the latter has undergone through a reprocessing treatment procedure. As we can see on the above figure, in the left side category labeled fresh oil, the oil is totally free from any metal content, while its flash point, kinematic viscosity, and viscosity index are at the normal state showing 180, 80, and 90 points respectively.

Looking now at the used oil itself, we can clearly see the dramatic change that has taken place in the composition of its properties after been used for lubrication purposes in the various mechanism or engines: Not only there is a noticeable reduction in the flash point, kinematic viscosity¸ and viscosity properties, but there is also a marked presence of metal property amidst its composition.

This new property content cannot be easily eliminated completely even if the used oil undergoes through reprocessing or even refining treatment. On the other hand, however, the flash point, kinematic viscosity¸ and viscosity index are showing great improvement after reprocessing treatment and even greater improvement after refining treatment.

4.5 RESEARCH QUESTION 5

Q5. Question 5: Is an Algerian WLOs Pilot Project economically feasible?

Having completed the section on the technical aspects of the pilot project, the study attempts in this section, albeit with very limited reliable information, to answer questions of the costs that are likely to be involved in the facility's operations. In everyone's mind involved in this project, a number of puzzling questions have risen: How much of a start-up capital investment is needed to set in motion a modern WLOs pilot project with a processing and filtering facility, and with the capacity to coordinates and manage the flow of lube oil in the Algerian lube oil market? How much money the WLO pilot project is expected earn annually from its operations? And, how long will it take to pay back for the entire investment?

4.5.1 ASSUMPTION

The speedy answers to these questions in feasibility or cost benefit analyses always involve some set of assumptions to be taken as true givens. Otherwise, no calculation can be done - a priory without all the variables involved in the project been included. In this study, and for this feasibility analysis, three sets of principal assumptions are involved:

1) That the Algerian stakeholder will select the option of free–market model without any further governmental interference or support other than the initial grand of investment – just as government have done so in similar cases. The project must be able to survive the market pressures like any other business organization on its own. Besides, some private investors are interested in this particular model for their business contemplation.
2) That the stakeholder would like to know. What if, for example, they ask, a decision is made to morrow to take the next step and expand the facility into re-refining unit? Will the present investment be of any value then and work well with the new investment or will it be totally discarded? The answer to this question is that it will not be discarded at all. All the equipment and machinery will be necessary appendages to the new facility.This final set of assumptions is of a general nature and all the variables involved are listed in the next Table 6.

Table 6: Assumptions of Cost and Prices Involved in the PPF[24]

DESCRIPTION	UNIT	VALUE
Annual Working Hours	Hours/Year	1920
Facility Estimate Stoppage Time	Hours/Year	50
Facility Available time	Hours/Year	1870
Annual Facility Capacity	Lit/Year	5,000,000.000
Exchange Rate	DZD/US$	0.01009
Project Period	Year	
Depreciation Period	Years	
Capital Financing Period	Years	
Margin on Investment	% per annum	
Debt	% Capital	
Bank Estimate Fees	% on debt	
Actual Annual WLO Processing	L/Year	
Available Facility Capacity	l/Year	
Actual Quantity Processed	L/Year	
INPUT COST		
Electricity Cost	$/kWh	0.060
Water Cost	$/L	0.0051
Chemical Cost	$/L	
Electrical Power Requirements	kWh/hr	70.48
Water Consumption	L/h	10
Salt for Water Filtration	Kilos/Year	200
Detergents for Cleaning Equipment	L/Year	300
OUTPUT COSTS		
Sales of Fuel Derived From WLO	$/L	.12
Sales of Dewatered WLO for Rerefining	$/L	.20

[24] Pilot Project Facility

Bitumen	S/ton	.05

Notice that the calculation of some variables is missing due to the nature of the project and the unknown sources of the initial investment.

With the above assumptions in place, the answer to the question posed at the beginning of this section is determined by what is called “a breakeven point of analysis” that shows when the facility is likely to operates in the region of “loss” and when in the region of “profit. The “loss” and “profit” regions are organizational economic performance indicators used by economist to access the financial health of any organization operating for profit.

In order to calculate the project’s breakeven point, we will need to identify its fixed and variable costs. Fixed costs are expenses that do not vary with sales volume, such as rent and administrative salaries. These expenses must be paid regardless of sales, and are often referred to as overhead costs. Variable costs fluctuate directly with sales volume, such as purchasing inventory, shipping, and processing WLOs products. All the major costs involved in our project are shown in the Table 7 below.

Table 7: Costs of the WLOs Facility

Description	**Amount**
CAPITAL INVESTMENT	
Total Physical plant cost (land 3000m^2, 1200m^2 building, parking with water drainage & filtering system to keep clean, fences, lights posts, etc.	$600,000
Fixed capital cost (12 tanks 500tons, 5 trucks, 2 weighting scales, 2 tractors, 6 trailers, 6 pumps, 2 fork-lifts, 2 dewatering machines, 1 lire truck, 1 power generator, 1 power washer, 1 mobile crane truck, etc.)	$800,000
Storage containers distributed to WLO generators to keep black & white oils segregated	$150,000
Total investment	$1,550.000
VARIABLE COSTS	
Raw materials usually WLOs from collectors to test their quality & record their source for future references	$150,000
Miscellaneous material	$4,000

Utilities will vary since the facility will take advantage of its own fuel supply to produce its own energy for its operations.		$6,000
Sub total		$160,000
FIXED COSTS		
Maintenance		$15,000
Operating labor is about nine person		$45,000
Laboratory cost		$2,000
Supervision usually consulting fees		$6,000
Plant overheads		$124,000
RND & ongoing storage expansion capital to 7,500 tons capacity		$5,000
Insurance for all truck on the road		$3,500
Promotion Campaign, tv, radio, press, & web hosting,		$61,200
Sub total		$261,200
Total start up investment	**$1,971.200**	

4.5.2 PROFITABILITY AND PAYBACK PERIOD

By using the method of “breakeven point analysis” a determination can be made as to when the proposed pilot project will be able to cover all its expenses and begin to make a profit. Having already identified the WLOs facility startup costs, fixed cost, and variables cost, we ready now to see how much processed waste lube oils the facility must sale, at a set price of $120.00 to earn the revenue needed to pay for the ongoing project expenses. The breakeven point is reached when revenue equals all operational business costs. And, that point is shown in the figure below.

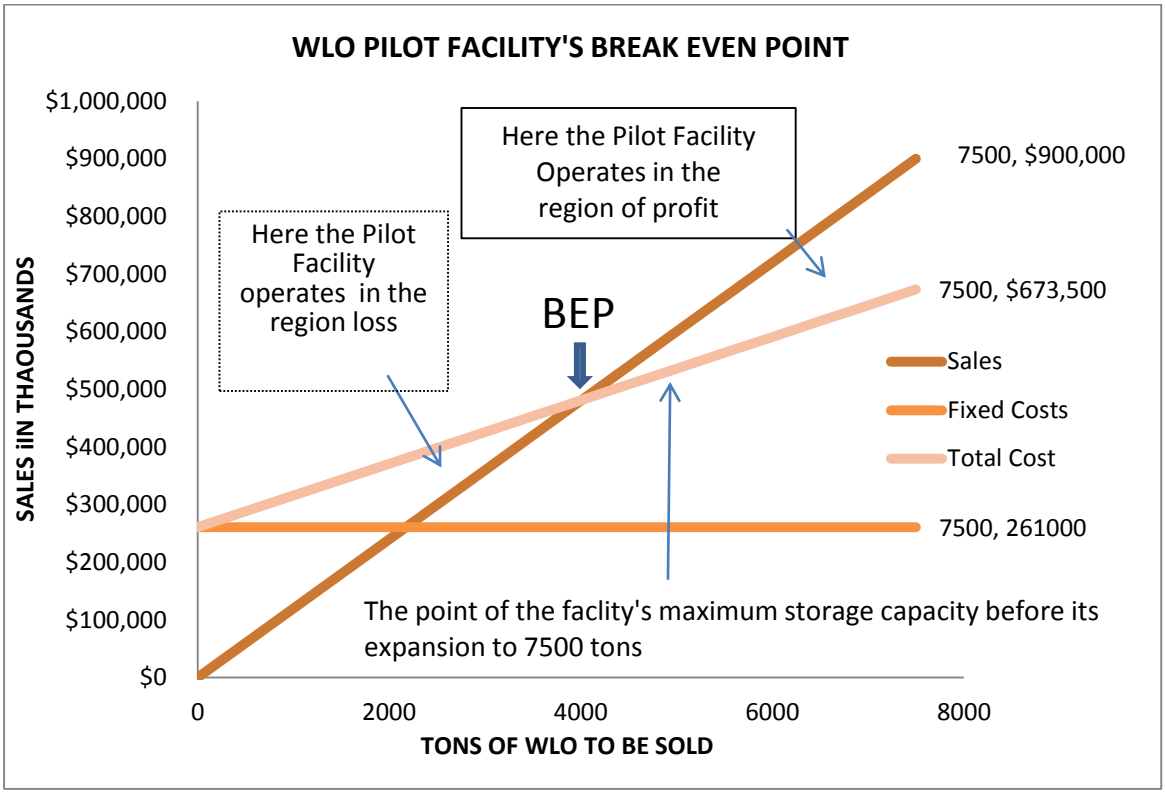


Figure 20: Breakeven Pont - Loss & Profit Regions

In other words, at the initial stage of its development the pilot facility must be able sale more than 4,000 tons per year in order to make a profit, and this mean that it must operate in its full capacity which is 5,000 tons per year. Clearly the break-even point figure is too high and that makes it more difficult for the facility to be profitable without any subsidies coming from the Algerian government. A sale of 5,000 tons per year - at a unit price of $120.00 - brings in total revenue of 600,000. Subtracting from this figure 536,000.00 which is the total cost of running the facility at this WLO tonnage level, this leaves a gross profit of $64,000 per year. Now, if we calculated a 17 percent state tax on this amount, this generates a 10,880 reduction ($64,000-$10,880) which leaves the facility with a net profit of 53,120 per annum available to pay the bank - if it had to borrow the money for its construction without any interest – or to reinvest for expansion to increase its carrying capacity. Now the question is how long will it take for the facility to get back the amount it invested in the project?

4.5.3. THE ANSWER TO THE QUESTION OF PAYBACK PERIOD

It does not take an economist to figure out that with such a small amount of earnings it will take more than thirty year for the facility to payback for its initial investment. However, if the facility increases its storage capacity, either on its own, or

through collaboration with private collectors who are in possession of approved storage facilities, and is able to leverage a sale of 750,000 tons of used oil per year, then its earnings jump to $226,500 per year and the payback period is reduced to less than nine years.

This feasibility study shows that the scale of production required to meet the expected market share is very close to the break-even point, and the stakeholders should carefully examine the options of increasing the facility's capacity to process and sale of more used oil to domestic and foreign markets. There is no need to see if production costs can be reduced since with the same knowledge, labor, and machinery the facility can leverage double and even triple the quantities of used oils it could have under its own command. If the stakeholders don't see this, there is a question over the wisdom of proceeding further with the proposed pilot project.

It should be noted that the stakeholders should not automatically consider the gross profit as their own income. The money belongs to the facility and they should take a fixed wage, which is recorded as another business expense. A common source of institutional failure happens when stakeholders under the various pretexts remove cash to pay for things that are not in any way related to institutional improvements and disrupt the cash flow of the facility to a point that it cannot continue purchasing oil from private collectors. Private collectors are usually pressured for quick cash and they will settle for low price if they receive cash up front right then and there.

Now, what if the price of oil was set at $150.00 mark instead which is the most likely scenario?

5,000 X 150 = 750,000.00 - 536,000.00

= 214,000.00

Doing the simple tabulation we get an additional $150,000.00 per year by selling just 5,000 tons. Now this changes everything and the picture looks a bit brighter; and even much brighter if more oil is sold at the same price.

7,500 tons X $150.00 = ($1,125,000 - $7500,000) = $375,000 gross profit before tax
With sales at this price the payback period is reduced to less than six years

4.5.4 CASH FLOW FORECAST

If the gross profit indicates that the proposed used oil processing and filtering facility is likely to be successful, it is then necessary to repeat the calculation of annual gross profit for one to three years. This will then show whether there is sufficient cash available, not only to operate the facility without the need for further help from the state treasury, but to think of taking the next step and invest in a re-refining project. This procedure is known as a *cash flow forecast*.

4.5.5. COST BENEFITS TO SOCIETY AND INDIVIDUAL COLLECTORS

The cost and benefits to the society are not in question when it comes to collection and recycling of waste lube oils. Everyone knows that the public health risk from pollution due to uncollected and mismanaged waste oil -- dumped in sewers and rivers or tipped on soil contaminating food and the fresh water supply is so high, that hardly can question the social benefits derived from this project. In addition to health risks, non-collected used oil is a waste of precious energy resource that can be utilized as fuel and save primary non-renewable resources.

As for the cost and benefits to be distributed between the various categories of stakeholders, and used oil generators, used oil processors, burner fuel and lubricant buyers, and the environmental ministry must be discovered in the process of the project unfolding. Any type of innovation that benefits society, while providing little benefit to the individuals whose cooperation is needed is likely to meet resistance. Of course, if the facility's innovative aspects have net benefits for all categories of individual stakeholders involve in the WLOs, as well as for society, it would be an easier sell, but not all innovations work that way. Even in this case, it can be difficult if the individual benefits are intangible or they will not be evident for a long time. That is why the benefits should tangible and be distributed two to four times a year.

Algeria's annual productions of waste lube oils are estimated to be at 180,000 tons, and about 130,000 tons are deemed recyclable. Presently only 20,000 tons are recycled per annum. This leaves 110,000 tons of undetermined existence. After processing these quantities and removing water contain and metals more than 90.000 tons can be sold at the international markets for $150.00 per ton. This translates into

$13,500, millions of wealth. And, if we divide this number by $10,000 per capita which is currently is $7,000 per capita, this gives us a very good annual salary for 135 people. The Pareto utility principle is fully satisfied because no one is worth off as a result of this project.

4.6 GENERAL QUESTION 6

Q6. What steps must be taken from now to speed up the implementation of the pilot project?

This final question is rather a general in nature than a research question and it is indented to provide a visionary framework within stakeholder can think as a body with common rather as individuals with separate agendas.

Setting up a WLOs recycling system is not an easy task for anyone involved in the project. Part of the problem is that not all stakeholders understand everything in the same way about the project, nor do they share the same vision. And, because those involved come from different backgrounds and represent different interests, and their efforts are directed to varied challenges, they don't quite share a common philosophy, or what we might call a "strategic vision"; a set of ideas and actions that maximizes the leverage of results over efforts directed toward well-defined targets and supported with highly focused operating strategies.

Closely related to a common vision is the time factor. The setting up of a time horizon with an emphasis on different types of goals is one of the most important aspects of thinking and acting constructively. In projects, such as this, dealing with the collection of data related the recycling of lube oils, it is imperative that stakeholders build a general framework of goals around their common vision and the core ideas of their undertaking. The end result will be made up of a number of self-reinforcing, internally consistent elements. At the outset of their efforts, they are unable to foresee and plan all elements of strategies with which to achieve their goals. Having a framework to guide such trial and error can make the process more efficient. The following Figure 24 illustrates the possible short, medium and long term goals of a WLOs recycling system in Algeria. Several and most likely options have been looked at, and a number of pilot project ideas will be proposed articulated around a time dimension axis stretching from short term goals to a long term goals that will yield the best environmental and economic benefits for the Algerian people.

In Time, Emphasis is Shifting From Left to Right as the set of Goals are Fulfilled →		
Short Terms Goals	**Medium Terms Goals**	**Long-Terms Goals**

1-2 Years	2-5 Years	5-10 Years
Campaign for the Proper Legislation for Regulation & Enforcement of WLOs Collection Programs; Learn About Accredited Transport		
Secure Real Estate Property in Location for WLOs Storage Facility	Draw Up Plans and Schedules For Storage Facility's Infrastructure: Buildings, Tanks Trucks, Weighting Scales, Fork Lifts & Equipment	Establish Regular Routs for the Same Drivers and Haulers Who Will Gain Experience in Dealings With The WLOs Generators or Suppliers
Set Up Website & Content for Sensitization Program and Invite the Public to REPORT Environmental Risks and Violations from WLOs	Elicit Costs Proposals from Local or International Building Contractors and Assign the Completion of the Project.	Increase Collection from all the Regions and Seek Contributions from NGO. Invite back the Terminator" to see what you have done
Seek Petroleum Ass. Financial Support and Gov. Financial Support via Env. Tax for the WLOs Collection and Recycling Project	Purchase the Numbers of Small and Large ADR Well Equipped Transportation Trucks Needed for the Facility's Own Collection and Transportation Uses	Maintain Sensitization Programs and Target Local Governments to Increase Cooperation and Enforcement WLOs Environmental Laws.
Set Up a Computerized Data Based Information Gathering System for New Lube Oils Demand & WLOs Supply for Each Region	Increase Emphasis on Sensitization Program Targeting All including DIY. Invite the Public and the Mass Media to see the storage facility's progress.	Control Burning particularly in farmers communities and promote Re-refining instead of burning.

Dev. Proper WLOs Stakeholders and Segregation Program inside the faciliy	Adopt Pricing Structure for Purchasing WLOs from Collectors and Haulers and Begin Operations	Promote Lubricant Consumption from Recycled WOLs in the National Market.
Seek info about Instrument for Quality Control for Water and PCBs Content.	Do the Adjustments in all Spheres of the Operation Continuously Until the system is Perfected	Take a Stock of What Has Been Accomplished thus Far, and Decide Whether You Are Ready to Apply the System in the Entire National Territory.
Other	Other	Other

Figure 21: Use Oil Pilot Project Time Orientation

Based on other countries experiences, pilot projects of recycling WLOs were the best solutions, providing some important conditions were put in place. The definition of a short-term goal need not relate to any specific length of time. Long-term goals are usually outcomes for the distant future or are less tangible. Short-term goals are usually goals for the near future or are more tangible. Medium-term goals are usually in-between or goals that are undecided. Short term objectives can be regarded as small short term goals that can be reached fairly quickly and impact their progress towards the strategic long term outcomes it has set. Long term objectives can be regarded to as outcomes; they suggest where they would like to be in the future. The main difference between the two is that the long term objectives are less tangible due to the longer time period which it will take to attain them. Thus, short term goals are easily measured and take far less time to achieve. Long term outcomes are less likely to be measured due to many unknown objectives which need to be achieved along the way.

4.7 SYSTEMS OBJECTIVES

The collection system objective is to gather sufficient quantities of waste oil with specific characteristics and quality for ultimate disposal. Consequently, Algiers is considered prime locations for waste lube oil storage and sorting facility. The collection of large quantities of waste lube oil must be sufficient to meet the minimum operating expenses of the organization. The situation in each regional location must be studied

and a strategy should be developed to determine the best method of collecting the waste lube oil. The quality of the waste oil collected is also an important consideration. Instruments and processes of quality assurance are necessary aspects of the overall facilities operating procedure and should include quality control guidelines for testing all incoming oils and segregating them if they are not acceptable.

CHAPTER 5. SUMMARY AND RECOMMENDATIONS

5.1 SUMMARY

As it was stated at the outset, it is not the aim of this study to develop an exhaustive technical analysis of the components and performance of a refining plant, but to develop a methodology of a start-up processing of WLOs material and information plant in order to assess the feasibility of developing a national plant to be implemented in some future day. Based on market SWOT analysis found that the strength is low price cost per ton, the weaknesses is the reputation for heavily contaminated used oil, the opportunity is African market for Base I lube oil, and the European markets looking for good use oils for re-refining purpose. The treat of used lube oils has always been low crude oil prices.

There is a market demand for Algerian waste lube oil. However, its reputation of being heavily contaminated causes problems of trust. If the collectors put their act together and stop mixing the heavily contaminated used oils with those types and quantities that are much cleaner and less contaminated. Algeria's annual productions of waste lube oils are estimated to be at 180,000 tons, and about 130,000 tons are deemed recyclable. Presently only 20,000 tons are recycled per annum. This leaves 110,000 tons of undetermined existence. After processing these quantities and removing water contain and metals more than 90.000 tons can be sold at the international markets for $150.00 per ton. This translates into 13,500, millions of wealth. And we divide this number 10,000 per capita which is more than the present 7, 000 per capita, this gives us a very good annual salary for 135 people. The Pareto utility principle is fully satisfied since no one is worst off as a result of this project.

Given that Algeria has no previous experience with recycling WLOs, it can now develop its own model by barrowing and combining various parts from the French, Italian, and Alberta models. There are promising elements in each of these models that can easily be reshaped and accommodated in the existing Algerian system of governance including the four regional divisions of the environmental protection agency, the existing tax collection scheme on lube oils, as well as the departments of Agriculture, industry commerce and education. The department of education should be at the fore front of this national effort. How exactly this proposed Algerian model supposed to work? This is a choice question that the Algerian stakeholders must

decide since they know better than anyone else which of these schemes best fits their mind set and culture. The various options of organizations, that have been presented here, include, private and public scheme of cooperation, private for profit, and nonprofit. Any one of this schemes, or a combination there off, will work for the better than the option of doing absolutely nothing.

The Alberta model, which contains element from the French, Italian and Danish models, is a promising one. Starting with this model may not be necessary to invest heavily in the initial stage of the organization in the construction of a public facility before the private sector has a chance to mobilize and activate its creative potential and respond to the problem. Once the basic rule of the game are known – a job of the pilot project to work in the rules area – and the private sector is certain about which rules are applied, it might come–up with its own strategy to accommodate all the used oil in Algeria with this own investment. That is why the public sector should not rush at the initial period but wait for a while and respond diligently later and when the private sector has failed do to so. A response at a later time will be more adequate and intelligent because there will be no serious knowledge gaps on the part of those running the Pilot Project Facility. All too often public sector agencies create unnecessary barriers to business development. Take for example the businessman who demonstrated the lube oil he produced from used oil in his 4 million worth facility. The government is very slow in giving him the permit for his operation, even though the facility is equipped with the latest technology.

5.2. RECOMMENDATION

5.2.1 Department of Transportation

The department of transportation should improve the quality of data on auto mobile registration and transportation equipment to reflect more accurately engines size and horsepower. This correction will help authorities to come up with better estimates about gas and oil consumption needs per category. This in will in turn will improve the methodology of measuring or estimating how much used oils are generated annually in Algeria and how much of it is really lost due to combustion. It generally assumed that the percentage of lubricants that disappear during use (about 50% in average) and that this varies from region to region from country to country. However, this is only a hypothesis which assumes the percentage of WOLs collectable per country is the difference between the quantity of lubricant consumed and the loss during its use. This percentage thus varies between 68% and 40% according to the country. That is why an in-depth analysis of these issues is apriority otherwise no estimates or reliable forecast can ever be made.

5.2.2 Local Governments

Local governments must institute regulations banning used oil and oil filters from landfills and to impose fines for illegal disposal. And, there should be an increased funding to raise public awareness regarding recycling options and to establish more collection facilities to make it convenient.

5.2.3 Incentivize the system

The system of incentives to include all in involved in the links of oil flow in the market. A credit system should be looked at and possibly a system involving a lottery draws at the end of each year. Special incentives should be given to all farmers to collect used oils in their territories. Farmers by their nature and profession will be the best agents of collection and promoters of environmental protection. The option of profit sharing among collectors and the facility, as proposed by a number of stake holder during our work shop meeting, should be taken seriously and looked upon.

5.2.4 Pilot project as a research center

The Pilot Project should include in its realm of daily managing activities a few remote regions of the country to gain the different experience and have a better grasp of what needs to be done in regions order efficiently coordinate the transportation of large quantities of use from distant places.

5.2.5 Research on interval of Oil change

A quantitative and qualitative research need be done in order to develop a data base of the Algerian automobile oil change intervals per annum. The research on oil change period and mileage per different types of automobiles from taxis to agriculture tractors is a necessary investment for forecasting used oils supplies, prices and possible delivery delays.

5.2.6 Department of Education

It is time of national emergency for new ethical conduct and virtue. The question is no longer what can be done about it? Or what kinds of additional regulation and policies are required that would affect lube oil consumers and waste lube generators behavior. Law and regulation are not good enough without an appropriate cultural ethics.

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