



Project LIFE 02/ENV/GR/360

**Innovative Collection System &
Life Cycle Assessment
for Waste Lube Oils
ICOL**

Layman's Report



September 2005

INTRODUCTION

At the proposal phase of the LIFE02 Environment Project “Innovative Collection System and Life Cycle Assessment for Waste Lube Oils” (ICOL) there was a significant social and environmental problem in Greece regarding the **Waste Lube Oils (WLO) Management in Greece**, as it was characterised by poor collection and reuse rates.

The resulting environmental impact was extremely serious as the WLO were classified as “Hazardous or problematic wastes” and their management was and still is among the top priorities within the European Union’s Environmental Policies.

Regarding that problem, **ICOL wanted to demonstrate and to monitor an integrated selective collection system of WLO**, to evaluate the efficiency



of this system under different social and economic conditions and to assess the achieved WLO recovery rates. The project was implemented, **from 1/10/2002 to 30/09/2005**, in the **Prefecture of Thessaloniki** (Northern Greece) and in the **Prefecture of Thessaloniki Achaia** (South-Western Greece), two regions of Greece with different weather conditions, urban development and financial activities.

The beneficiary, **CYCLON HELLAS S.A.**, a private company producing lube oils and trading lube and fuel oils, located on the outskirts of Athens, and the partner **EPEM S.A.**, a private environmental consulting company, undertook, in the framework of ICOL, the following activities:

- ***Registration of WLO collection points in the Prefecture of Thessaloniki and Achaia***
- ***Design and implementation of an optimum WLO collection system***
- ***WLO Collection System Monitoring***
- ***Life Cycle Assessment for WLO and Cost Benefit Analysis***
- ***Dissemination activities***

METHODOLOGY AND ACHIEVED RESULTS

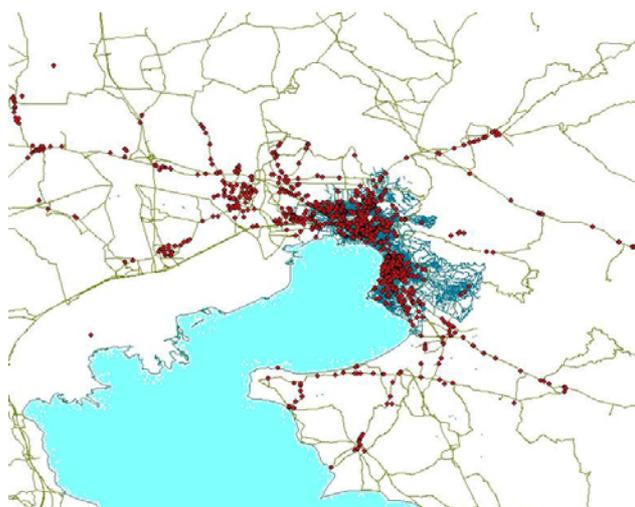
Registration of WLO collection points in the Prefecture of Thessaloniki and Achaia

The main WLO collection points are gas stations, vehicles reparation workshops, industries, harbours and airports. From the beginning of the project, until the 30th of September 2003, approximately 900 WLO sources had been identified in the Prefecture of Thessaloniki and 300 in the Prefecture of Achaia (Patras). After the establishment of the collection system, CYCLON's collectors continued the effort of registering all possible WLO collection points. The final number of WLO collection points (updated 30th September 2005) is presented in the following table.

Number of registered WLO collection points	Thessaloniki Prefecture	Achaia Prefecture	TOTAL
<i>31st August 2003</i>	899	289	1188
<i>30th September 2005</i>	1975	765	2740

WLO collection points in Thessaloniki and Patras (updated 30.09.2005)

CYCLON HELLAS S.A. estimates that all the WLO collection points, in the Prefectures of Thessaloniki and Achaia, are participating to ICOL.



WLO Collection points, Prefecture of Thessaloniki

It is also important to mention that after the initiation of ICOL and due to the expertise gained by this LIFE ENV project, CYCLON HELLAS S.A. has started an effort to register **all the WLO collection points in Greece** and the latest update of this database contains the vast majority of WLO sources in the major Greek cities, towns and islands.

Design and implementation of an optimum WLO collection system

ICOL partners had studies, designed and implemented a collection system of WLO in the Prefecture of Thessaloniki and Achaia, which is composite of the following main elements:

- **WLO Collection points**
- **Transfer Stations** for the temporal storage of the collected WLO prior to their transfer to CYCLON HELLAS S.A. Refinery in Aspropyrgos. The Transfer Stations are equipped with steel upper-ground cylindrical tanks and weighbridges.



Patras Transfer Station

- **Chemical laboratories** for the qualitative and quantitative testing of the incoming WLO



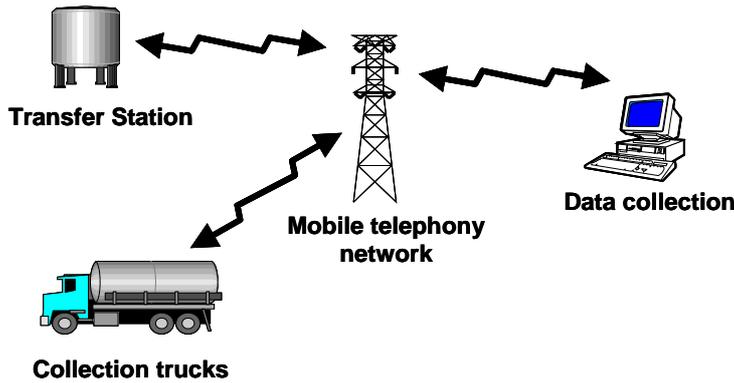
Collection truck of Patras Transfer station with a storing capacity of 5.5MT

- **Collection truck fleet.** Thessaloniki Transfer station has eight collection trucks with a storing capacity of 48MT (metric tonnes) and Patras Transfer Station has four collection trucks with a storing capacity of 22,5MT.

- **Electronic equipment** for the continual monitoring at real time of the collection process

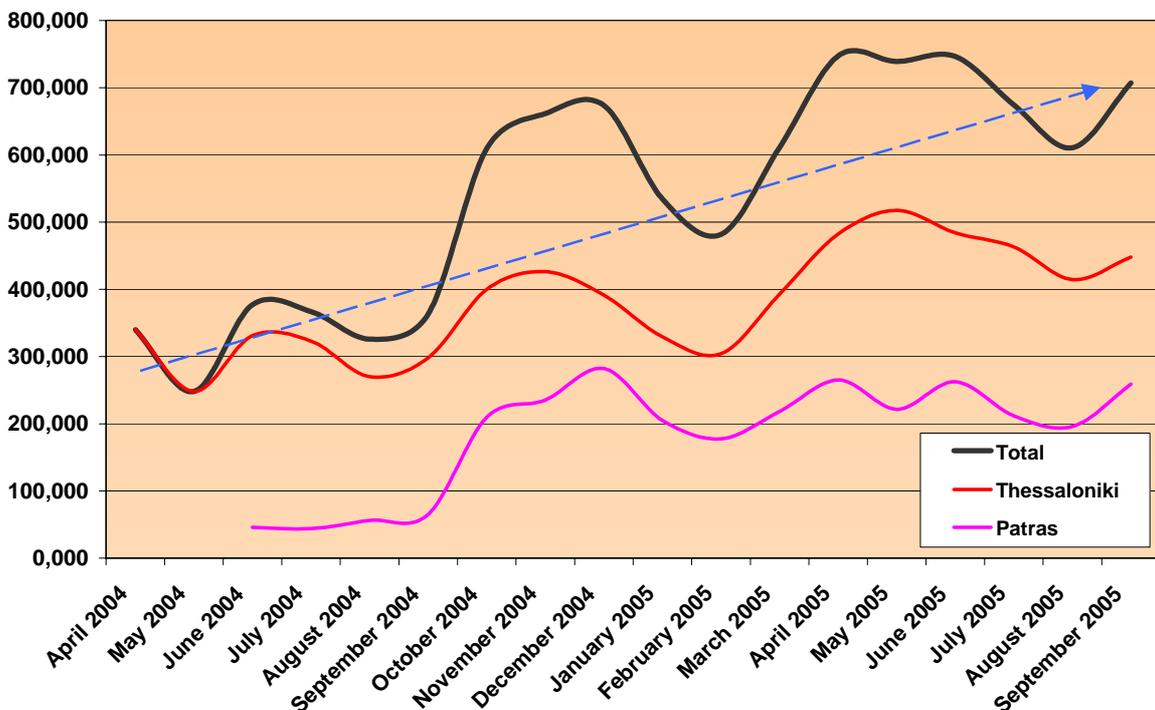
WLO Collection System Monitoring

All parameters affecting the performance of the collection process are under continuous monitoring by means of data collection at real time. All the registered data are transmitted to CYCLON HELLAS S.A. ERP (*Enterprise Resource Planning*) in order to have all the necessary provisions for the production line of the Refinery in Aspropyrgos.



By using the described system, CYCLON HELLAS S.A. can optimise the collection process and deal immediately with any kind of problem or environmental danger (leakage at the WLO storing tanks).

On-line monitoring system of the collection trucks and collection points



Quantities in metric tonnes of Collected WLO in Thessaloniki and Patras

A close examination of the previous Figure shows that during the coldest months of the year (November, December, January and February) the collected WLO quantities are decreasing as a result probably of the illegal and extremely dangerous use of WLO as heating fuel.

A smaller decrease is also observed during the summer months due to summer vacations of users (drivers, small industries etc.) and collectors (workshops etc.)

The final quantities of collected and regenerated WLO, as a result of ICOL's implementations, are (quantities in metric tonnes):

Collected and regenerated WLO	
Thessaloniki	6.863 MT
Patras	2.955 MT
TOTAL	9.818 MT

Total regenerated WLO due to ICOL's implementation

Life Cycle Assessment for WLO and Cost Benefit Analysis

A Life Cycle Assessment (LCA) of Lube Oils and a Cost Benefit Analysis (CBA) for the proposed collection system was realised close to the end of ICOL's implementation. Those studies were carried out from EPEM S.A., who used the **Eco-Indicator 95 methodology** of the **SimaPro software**, which is considered as one of the most complete and integrated tools for analysing Life Cycles, following the ISO14040 series recommendations.

In the framework of the **Life Cycle Assessment**, a comparison between regeneration and combustion (incineration) of WLO was realised by taking into account alternative Life Cycles, i.e. from virgin lube oil production (as the alternative system to regeneration) to heavy fuel oil combustion in cement kilns (as the alternative system to WLO combustion).

The different studied scenarios made clear that **regeneration is by far better than virgin oil production and the uncontrolled final disposal** (dumping, illegal burning or discharge) of the WLO.

The combustion in cement kilns is also a merit solution but it must be strictly controlled, in order to avoid the undesired heavy metal and carcinogens diffusion in the environment. **Heavy metal and carcinogens emissions**

resulting from the incineration are the main reasons that makes regeneration the most environmental friendly solution.

In the light of the results of the LCA, a **Cost Benefit Analysis** of WLO management was carried out in order to examine the system from a financial and business perspective and to determine the costs associated to the setting up and operation of the integrated collection system by taking into account all the relevant parameters.

The final outcome of this CBA is that the WLO collection scheme, as it is actually operated by CYCLON HELLAS S.A in Thessaloniki and Patras, has positive socio-economic and environmental effects:

– *Financial perspective*

ICOL as a business plan idea is efficient but it should be noted that the viability of the proposed scheme depends on the financial contribution (subsidy) of the lube oil producers, who must support financially the recycling following the EU Policy Principle “**the polluter pays**”.

– *Environmental Benefit*

The collection, storage and regeneration via catalytic hydrogenation of WLO, the **method actually applied by CYCLON HELLAS S.A,** **decreases the environmental deterioration**, since it reduces the effects of WLO incineration (air emissions) and uncontrolled dumping (water, groundwater and soil contamination).

Dissemination activities

The dissemination programme of ICOL targeted mainly the WLO stakeholders, the managers of the collection points (gas station, industries etc.) and the broad public.

Firstly, a **website** was created (www.epem.gr/icol/index.html) including a detailed presentation of ICOL, the WLO management in Greece, the involved partners and the main deliverables of ICOL. The layout ICOL's website was designed to be friendly and easy to use by the visitors.

Additionally, **two sets of leaflets** were produced, the first at the beginning of ICOL's implementation and the other at the end of the project aiming to sensitise the involved parties and to support the efforts of ICOL partners at a rational and environmental friendly WLO management.

An extensive presentation of ICOL was presented at the **3rd issue of the corporate Newsletter of EPEM S.A.** That newsletter was distributed at

companies, organisations, Local authorities and Ministries involved in Waste Management in Greece. It is estimated that more than 300 organisations received the Newsletter.

The **Final Conference** of ICOL took place the 30th of September 2005, close to the contractual end of the project's implementation, at one of Athens most well-known and central hotels, the *ATHENS PLAZA HOTEL*.



Mr Rembakos, ICOL Project Manager and Director of CYCLON Refinery, presenting ICOL at the Final Conference

The Conference attracted the interest of the WLO involved parties and stakeholders. The list of participants was extensive and included representatives of Greek Local Authorities, the Ministry of Environment and Greek Environmental NGO's.

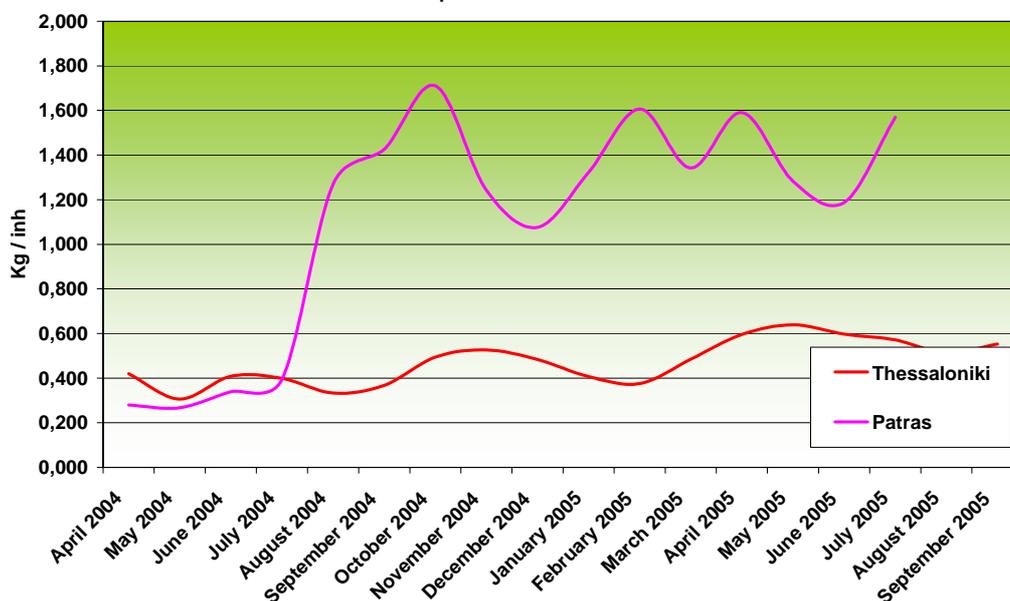
The Conference focused on the current WLO situation in Greece, the operation of the collection system, its monitoring and the findings of the LCA and CBA.

ICOL activities were also disseminated at the **2nd International Conference and Exhibition on Solid Waste Management (3-4 February 2006)**, where a paper on the "Life Cycle Assessment of Use Lube Oils" was presented by the working group of EPEM S.A. on ICOL during the session "Alternative Management / Energy Utilisation".

COMPARISONS BETWEEN THESSALONIKI AND PATRAS COLLECTION SYSTEMS

The final findings of ICOL permit to make a comparison between the operation of the collection system in the prefectures of Thessaloniki and Achaia

- Thessaloniki has a significantly bigger Industrial Zone, an airport so more collectable quantities of WLO.
- Nevertheless, at the following Figure (kg of collected WLO per inhabitant) one may see the Prefecture of Achaia has better collection rate because:
 - There are **less and more centralised collectors in the Prefecture of Achaia** with bigger WLO quantities
 - The **ground morphology is more** the Prefecture of Achaia than in the Prefecture of Thessaloniki
 - The **rooting problem of Thessaloniki** was far more complex to resolve as we had more collection points, more collection trucks but also intense traffic problems in the centre of Thessaloniki.



Kg of collected WLO per inhabitant in the Prefectures of Thessaloniki and Achaia

Finally, we may conclude that there are **no significant differences between the established collection system in Thessaloniki and Patras**. The whether conditions are more or less the same, the social characteristics of the population are also comparable and both are big and normally developed Greek cities.

TRANSFERABILITY AND QUALITATIVE ENVIRONMENTAL BENEFITS

The implementation of ICOL and the operation of the Collection Systems in the Prefecture of Thessaloniki and Achaia were very successful.

The **transferability** of ICOL has already been demonstrated as CYCLON HELLAS S.A. already constructed **five new Transfer Stations** in other major cities of Greece (Athens, Volos, Kozani, Kavala and Crete) using the findings of ICOL.

It must also be noted, that the produced **Life Cycle Assessment** is a very complete scientific documents that can now be used as reference documents for future studies on WLO. Until now, few complete LCA studies, in a European level, have been carried out regarding WLO.

In the long-term the qualitative environmental benefits of ICOL are:

- **Sustainable management** and collection of WLO,
- Continual increase of the collected WLO aiming to reach the **80% of the collectable WLO quantities in Greece**
- Respective **decrease of the quantities of illegally disposed** WLO (dumping, burning etc.)
- **Decrease of Natural Resources depletion** as all the collected WLO are re-generated in CYCLON HELLAS S.A. Refinery.
- Minimisation of the fuels used in the WLO collection trucks fleet as a result of an **optimum routing of the fleet** (minimisation of travelled km per collected WLO tonne).
- Finally, according the **Life Cycle Assessment of Lube Oils**, the collection of WLO combined with catalytic hydrogenation re-generation (**Best Available Technique in WLO regeneration**, according to the EC Directive 96/61, on Integrated Pollution Prevention and Control (IPPC)) is environmental friendlier than the combustion (incineration) in cement kilns.