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RECOIL

LIFE10 ENV/IT/000341 RECOIL

RECovered waste cooking OIL for combined
heat and power production

Layman's Report



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Background

Every year 1.4 million tons of vegetable oil are put on the Italian market for food consumption (either as edible oil or as an ingredient in other food), accounting for an average consumption per person of 25 kg per year (source: Italian Ministry of Health). Out of this amount, **the unused residue is estimated at 20%, which corresponds to more than 280,000 tons of used vegetable oil**, mostly present as frying waste residues. More specifically, CONOE estimates that approximately 65,000 tons of used oil come from catering; 45,000 tons are from commercial and manufacturing activities and the remaining **170,000 tons are from domestic use**.

Although the **waste edible oil and fat** (EWC 200125) is not considered a dangerous waste, its **incorrect disposal can be very harmful to the environment**.

Industrial producers of **WCO (Waste Cooking Oil)** must comply with the obligation of collection, retrieval and recycling of used vegetable and animal oils and fats (Legislative Decree no. 152 dated April 3rd, 2006), but only a small part of domestic WCO is properly collected and disposed of **because citizens are rarely aware that WCO should be treated as waste and can cause environmental and economic problems**.

Incorrect disposal of WCO can cause:

- malfunction of water treatment plant;
- soil and water pollution, with effects on the life of plants and animals;
- groundwater pollution, with effects on drinking water wells;
- increasing of global costs for water treatment plant.

When collected, WCO is used to produce biodiesel or other products: according to Ministerial Decree dated February 5th, 1998 and subsequent amendments, WCO can be used for recovery activities and products such as the soap industry and surfactants (with the use of glycerin produced by the chemical reaction that leads also to biodiesel), fat materials and building products.



Aim and objectives

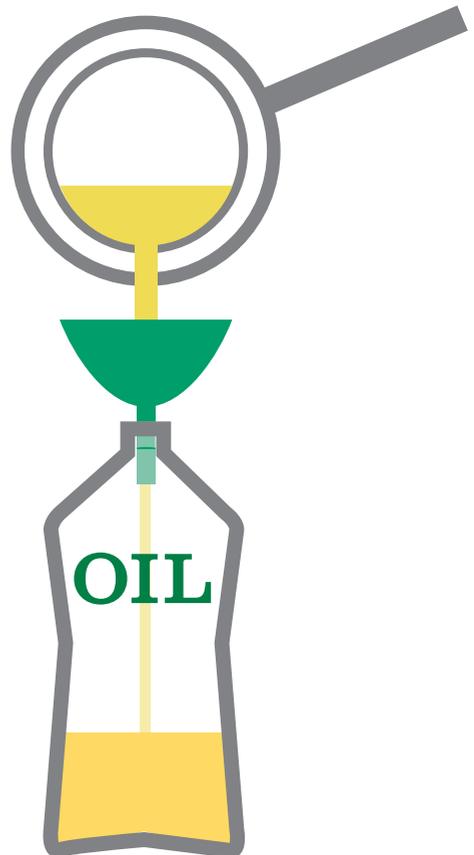
Aim of the Project

The RECOIL project was conceived within the EU Directive 91/156/EEC on waste and 2009/28/EC on the promotion of the use of energy from renewable sources.

The RECOIL project aims to manage the domestic WCO in order to solve the problem of its disposal, creating a network for a door-to-door collection and to exploit its energy potential.

Objectives of the Project

1. Creation of an optimised door-to-door chain to collect waste cooking oil;
2. Development of a software for the traceability and monitoring of the WCO collection and storage chain;
3. Rehabilitation of a waste into a tested fuel through a low emission process, eliminating chemical conversion processes;
4. Public awareness raising on waste cooking oil recycling and environmental impact caused by its dispersion;
5. New jobs creation from WCO collection and treatment;
6. Municipal technicians' training on how to create a successful WCO collection and storage system to replicate the RECOIL project;
7. Production of clean energy (electricity and heat), reducing CO₂ emissions, in the CHP power plant.



Main results and lessons learnt

Two municipalities have agreed to test the RECOIL methodology: **Ariano Irpino**, in the province of Avellino (Campania Region), and **Castell’Azzara**, in the province of Grosseto (Tuscany Region).

The collection was organised in a door-to-door procedure on monthly basis, and advertised on posters put up in the streets, on websites of the concerned partners and by means of brochures and funnels (useful to facilitate the collection) distributed during events.

The aim was to inform people of both environmental damage caused by WCO and its correct disposal. The project mainly targeted the local **school** and in general the school children. An educational campaign and several local and national actions were organised to involve citizens, government, family and media too. RECOIL has been presented during several national and international conferences.

The pilot collection has been monitored through **a software** that is able to track and record loading and unloading operations, as well as to evaluate the collection paths and compare collected data.

In order to have accurate data on the performance of the door-to-door collected WCO, the Aerospace and Mechanical Engineering Department at Sapienza University of Rome agreed to use a part of this WCO in their diesel engine test. The experimental campaign confirmed WCO good qualitative behaviour regarding emissions and curves of power and torque. The measurements of the exhaust opacity showed that WCO fuel produces lower emissions of particulate matter and exhaust opacity than fossil diesel. There are practically zero CO concentration values (below the detection threshold of the instrument) and the CO₂ and NO_x concentrations are slightly lower than those observed by using traditional fuels.

Main Results

- The implementation of the door-to-door pilot project resulted in around **2 tons of used cooking oil collected in 12 months**.
- Quantification (based on field and literature data) of the **technical and environmental use of WCO for CHP was performed**. (D)

- The **training was performed** by using an e-learning platform. Training materials are available on the project's website (slide presentation – English and Italian version, technical reports and videos). The total number of trainees was 162 and the feedback collected with questionnaires showed the appreciation of the webinars. (D)
- A detailed state-of-the-art study of the Italian WCO legal framework, collecting systems and results has been produced. The report includes a **definition of the environmental and economic impact** of the non-collected WCO. (D)
- The final **monitoring software** is available upon request. The license of use is free and without an expiration date; only maintenance cost can possibly be charged.
- A proposal addressed to EU and Italian policy makers on how improve the **regulatory system has been defined**. (D)
- **Guidelines** were produced in order to give recommendation on the design and management of the WCO collection and use. These guidelines should be useful for future implementations of the RECOIL concept in other municipalities. (D)

Lessons Learnt

The overall results of the pilot project document **the validity of the planned collecting chain model, even if the model can be further implemented:**

- Domestic door-to-door collection is more effective from a qualitative viewpoint with respect to the use of road bins, and it eliminates or reduces the risk of theft, vandalism and dangerous spills, but at the same time it is more expensive.
- The costs of the door-to-door collection can be reduced if WCO is collected with other waste fractions.
- Monthly collection perfectly fitted the requirement.
- Collected WCO assessed with visual inspection and chemical analysis proved to have good properties; that was possible thanks to the collection in bottles instead of bigger communal tanks.

(D) = deliverable available on the project website

- The amount of collected WCO was always above the Italian average, but it can definitively be increased, with a larger involvement of the citizens.
- Awareness campaigns and the involvement of schools lead to an increase in the amount of collected WCO;
- The waste oil collection into small bottles reduces the risk of contamination (with respect to the “free fluid” collected into a large container) and it allows collectors to use trucks for solid waste instead of liquid one (greater simplicity and therefore less cost); it reduces or eliminates the need for cleaning of the bins placed on public places (if some), but increases the collection of oil-contaminated plastic that requires special treatment.

Dissemination Events

1. *Ecomondo*, Rimini November 11th, 2011: a general presentation of the project was given to a large public;
2. *University of Brescia*, May 25th, 2012: on the occasion of the LIFE program 20th anniversary celebration, the project was discussed at the conference *Ambiente, Energia e Sostenibilità nei Progetti LIFE Italiani* (environment, energy and sustainability in LIFE Italian projects, <http://www.ing.unibs.it/life20/>);
3. Conference in Brussels on recycling (*Il riciclo ecoefficiente: L'industria italiana del riciclo tra globalizzazione e sfide della crisi*; promoted by Cial, Comieco, CONAI, Corepla, Kyoto Club, Ricrea, Rilegno; www.ricicloefficiente.it/Programma2012.pdf; www.ricicloefficiente.it);
4. *Green Week Conference* in Brussels in June 2014;
5. *Comuni Ricicloni* (event on recycling in municipalities), July 9th, 2014;
6. *Festambiente Legalità Pollica* (event on environment and legality) Salerno, July 10th-13th, 2014;
7. *Festambiente Nazionale*, Rispeccia (Grosseto), August 10th-18th, 2014;
8. *Ecomondo*, November 7th, 2014: the final event aimed to present the data of pilot project, as well as to reward the City of Castell’Azzara;

9. Workshop organised during the 5th *International Symposium on Energy from Biomass and Waste* (www.venicesymposium.it) in Venice, mid-November 2014;
10. *EDUCO* conference organised by Universitat Politècnica de Catalunya in December 2014 (*The use of recycled domestic cooking oils in the production of biodiesel*);
11. *EXPO 06*, June 2015: the final conference aimed to present the results of project;
12. *Treno verde 2015*: From February to April the Life RECOIL project went on board Legambiente's national campaign. There were several workshops and educational meetings with both schools and citizens. The RECOIL project had a dedicated corner on a coach of this train for about 50 days and it passed through 15 towns.
13. *Brussels*, June 17th, 2015. Conference organised by EcoLife project during the Sustainable Week;
14. *15th International Waste Management and Landfill Symposium* (<http://www.sardiniasymposium.it/>) in S. Margherita di Pula (Cagliari), October 5th -9th, 2015. A paper on the methodologies aimed to recover and treat WCO, as well as to exploit its energy, was submitted and accepted;



Long term impact

As far as **the environmental impact** is concerned, all the phases in the WCO recovering were analysed, including collection, purification and use in CHP, by using **Life Cycle Assessment (LCA) methodology**.

The impact due to the WCO collection and use for CHP was compared with the impact due to the use of biodiesel for transport.

The results showed that the use of WCO for cogeneration (heat and electricity production) is around 4,5 times less environmental impacting than the transformation in fuel for vehicles.

According to CONOE, the bad management of WCO causes the following economic and environmental damages:

- **for water and water bodies** as the grease forms a film on the surface that reduces oxygen exchange between water and air, thus causing damages to the ecosystem, fauna and aquatic flora.
- **for the sewage system** since the presence of grease together with other material causes clogs over time, with the risk of flooding as well during the rainy period (spring/autumn), that require further works on the entire sewage system.
- **for water purification;** the presence of fat increases the operating costs of the purifying plant due to the greater electricity consumption.
- the estimation of the **economic** loss due to the not recovered WCO, as a **valued material** for market standards was estimated at around € 150 mln.

In addition, the increase in the WCO collection could boost the employment in the waste section, both for the collection and for the purification, with **important socioeconomic effects**.

The municipalities are going on with the WCO collection because both the citizens and the administration were satisfied and changed their behaviour.

This is one of the most important results.

AzzeroCO2

AzzeroCO2 is an ESCo (Energy Service Company) founded in 2004 and supports private companies and public authorities in quantifying, reducing and offsetting CO2 emissions caused by their activities. It provides scientific and technical advice for defining energy efficiency strategies, promotes renewable energy sources, sustainable mobility solutions, efficient waste management practices, and offers support in the choice and use of materials so that the targets set by the Kyoto Protocol can be met.

www.azzeroco2.com

Legambiente

Legambiente (League for the Environment) is the most widespread environmental organisation in Italy, that for over thirty years has struck for improving the environmental quality, ensuring community's health and safeguarding the Italian artistic heritage. It counts over 115,000 members and supporters, 1,000 local groups, 30,000 classes participating in environmental training programmes, paving the way for a solid environmental volunteering. Legambiente is one of the leading member both of EEB (European Environmental Bureau) and IUCN (International Union for Conservation of Nature) and it is acknowledged as "Development NGO" by the Italian Ministry of Foreign Affairs.

www.legambiente.it

Kyoto Club

The Kyoto Club is an Italian non-profit organisation founded in 1999. Its members are business companies, local authorities, universities and environmental associations committed to meeting the greenhouse gas emission reduction. It promotes awareness-raising and information activities, training on energy efficiency, renewable energy sources, agriculture and forestry, as well as efficient waste management and sustainable mobility. It sits on the board of both ECEEE (European Council for an Energy Efficient Economy) and the European Alliance to Save Energy.

www.kyotoclub.org

CID Software Studio

CID Software Studio is an Italian IT consulting company founded in 1984. In order to meet the increasing market needs, it has developed its expertise and services so that now it has a network of competences in Environment and Healthcare thanks to its skilled experts. Its activities are focused on technical and specialised services such as planning, hardware and software development, integration and management of systems with high-level operating performance.

www.cidsoftware.it

CONOE

The National Consortium for mandatory collection and procession of waste vegetable and animal oils and fats (CONOE) is a non-profit organisation that ensures the whole national territory the collection, transport, storage, treatment and reuse of exhausted vegetable and animal oils and fats; the disposal, in compliance with current national law against environmental pollution, of waste vegetable and animal oils and fats, when they cannot be regenerated. It carries out marketing surveys and field studies and also organises awareness campaigns for an efficient collection and recycling of waste vegetable and animal oils and fats.

www.conoe.it

www.recoveringoil.eu