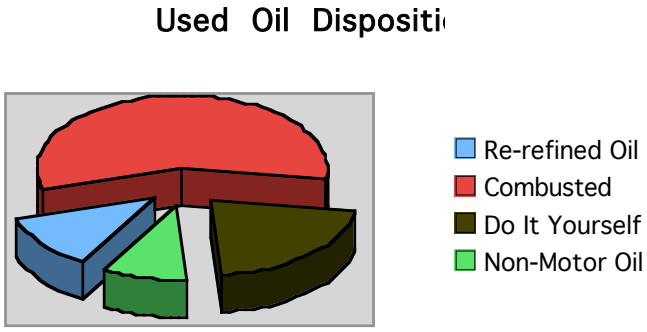
Status of Recycled Oil in the United States

230 billion gallons of crude virgin oil are processed in the United States each year.[1] In 1997, the total annual demand for oil was 263 billion gallons with 60% of the demand associated with automotive oils.[2] Of that amount, 992 million gallons was consumed in operation, which leaves 1.37 billion gallons of used oil available for recycling. However, the amount of oil actually recovered for recycling is estimated to be only about 945 million gallons. For example, California currently generates about 161 million gallons of used lubricating and industrial oil each year and only about 50% of that oil is recycled. Recycled oil in the United States is either combusted and burned as a fuel in various processes, or re-refined.[3] Re-refining used oil preserves a non-renewable source of energy, avoids related polluting uses such as burning, dumping in landfills or illegally pouring into sewers, and provides a domestic source for this commodity that is otherwise imported from foreign, and increasingly hostile, suppliers.

Even though re-refining is the preferred considered action step of resource conservation, only 17% of used oil in the United States is actually re-refined. The remaining 83% of "recycled" oil product is burned, dumped or sold as fuel to portable asphalt companies or large ships as bunker fuel.[4] The used oil that is used for combustion is called "recycled" product because it is reused, however in the re-refinery process, the oil can be used time and time again, therefore it is a true recycling process.



*Only 16% of the total DIY value is recycled. The rest is improperly disposed of or dumped.

[1] "Used Oil Recycling Markets and Best Management Practices in the United States," Presented to: the National Recycling Congress. By: Northern Virginia Planning District Commission (1992)
[2] "Used Oil Re-refining Study to Address Energy Policy Act of 2005 §1838," By: U.S. Department of Energy, Office of Fossil Energy (July 2006). Hereinafter "Used Oil Re-refining Study"
[3] Id. Combustion Types: Asphalt Plants (286 million gallons), Space Heaters (113 million gallons), Industrial Boilers (93 million gallons), Utility Boilers (80 million gallons), Steel Mills (80 million gallons), Cement Kilns (33 million gallons), Other (95 million gallons).
[4] Id. In one study, bunker fuel emissions contributed to 51% of the sulfur emissions, 5% of the oxides of nitrogen and 3% of particulate matter emissions in the San Francisco Bay Area and San Diego Air Basins. (South Coast Air Quality Management District, 2003).

The limited amount of re-refining is attributed to the high cost involved in building and maintaining a re-refining plant. The DOE estimates this ranges from $4-$17 million to produce between 5 and 24 million gallons of recycled oil where hydrogen is used, $5-$7 million to produce 7-10 million gallons where clay regeneration is used, and $17- $21 million to produce 15 million gallons where partial hydrogenation is used. In November of 2006, Totale announced construction of a re-refinery in France to produce 35 million gallons of re-refined motor oil at a cost of Euros 50 million, thus calling into question the DOE estimates.

Re-Refining Process

The first step in the re-refining process is the extraction of toxic heavy metals (zinc, cadmium, chromium and lead), additives and dirt. The resulting output is then solidified and stabilized. The processing technology employed by re-refineries produces a broad range of products from industrial fuels to regenerated base oils that are used as industrial lubricating oils. The industrial oils include hydraulic oils, metal working fluids, marine lubricants, compressor oils, heat transfer oils, process oils, and greases.

Re-Refining Environmental Impact

Negative Impact

The re-refining of oil involves releasing of emissions into the atmosphere to complete the process. However, re-refinery permit regulations require that emission to be less than 25 tons/year on average. Of the heavy metals that are released from the used oil, 100% of the Lead, Cadmium, Chromium, and Zinc are reduced to asphalt, the polynuclear hydrocarbon is removed by hydrotreatment, and the phenols are converted to a fuel byproduct or to wastewater treatment. Only the Sulfur and Chlorinated Hydrocarbons are burned but generally scrubbed with caustic to form a neutral salt. The Nitrogen is generally released into the air or pollution control equipment. The waste streams involved in re-refinery include wastewater, tank bottoms, and ash.[5]

The environmental impact of re-refining is a substantial improvement over burning with respect to human toxicity potential, heavy metals, eutrophication potential, aquatic ecotoxicity, carcinogenic substances, photochemical oxidant potential and acidification potential.[6]

Byproducts from the recycling process -- diesel fuel and asphalt-- can be sold in their own right, thereby limiting waste from the process.

Positive Impact

[5] "Assessment of Opportunities to Increase the Recovery and Recycling of Waste Oil," By: D.J. Graziano and E.J. Daniels; Department of Energy Agronne National Laboratory (August 1995).
[6] National Recycling Congress. By: Northern Virginia Planning District Commission (1992)
[6] "Used Oil Re-refining Study," *This is assuming no air pollution controls.

Even though re-refining consumes energy during the refining process, the level of energy consumption required is greatly outweighed by the amount of energy saved by re-using the oil. The estimated amount of energy savings due to current re-refining of used oil is 63 million gallons annually.[7]

By increasing the number of re-refineries in the U.S., Omega will increase the amount of actual recycled oil on market. Currently there are less than 20 operators of used oil recycling refineries and most are involved in refining their own product.

The re-refining process recovers the heating value of hydrocarbons and recaptures chemical makeup suitable for use as a premium hydrocarbon product for manufacturing lube oils. Therefore, the product that this system produces may be used for a variety of products and so long as the end use isn't fuel, those products may be refined again and again.

Because the re-refining process is not involved in dumping or delivering used oil in landfills or bodies of water, the process avoids drinking water contamination.

Comparison

Energy Savings

ENERGY SAVINGS FOR RE-REFINING VS. BURNING OF USED OILS

Energy Balance Thousand Btu/Bbl of Waste Oil	Process to Fuel & Burning	Burn in Space Heaters	Re-refining	Variance Burn in Space Heater vs. Re-refining
Transportation	-144	0	-198	198
Processing Consumed	-294	0	-742	742
Processing saved	745	745	1,722	-977
Energy Recovered	5,564	5,564	5,564	0
Net Energy Recovered	5,872	6,310	5,346	-37 (<1%)

The preservation of energy as an environmental consideration favors re-refining or combustion in larger industrial applications. The energy balance favors re-refining because the energy consumption that occurs during the distillation and hydrotreating is less than that consumed in burning the used oil as fuel or in space heaters.

Emissions

Generally, emissions released during the process of re-refining occur during the transportation of the used oil and during the re-refining process itself. However, the total amount of emissions is less than the emissions released by combustion. Further, once the used

[7] "Assessment of Opportunities…" (1995). This estimate may be conservative and may be as high as 124 million gallons.

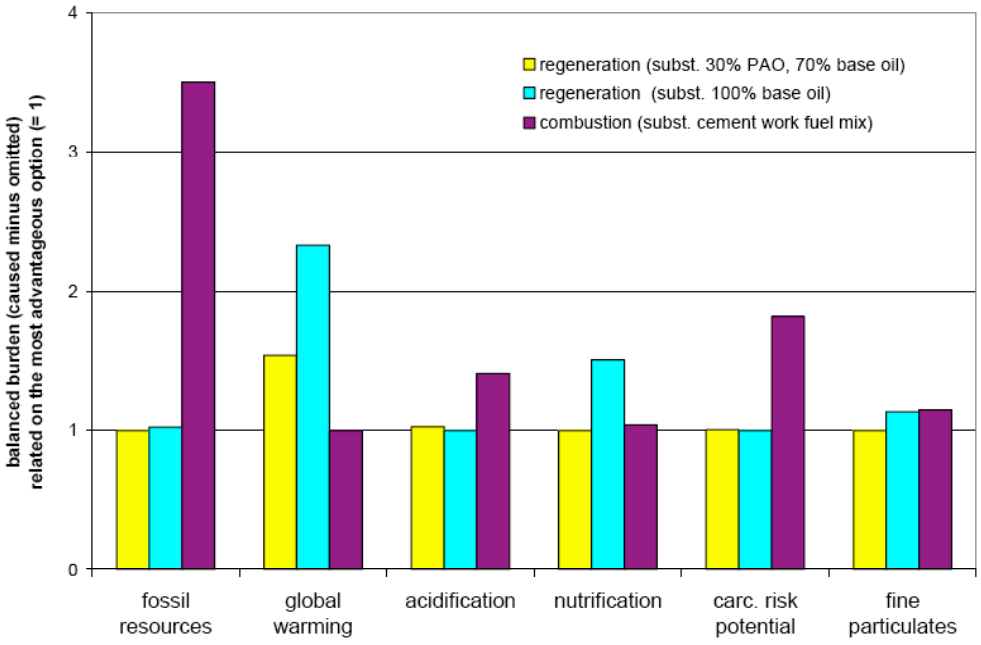
oil goes through the re-refining process, the emissions registered during heat generation is less than primary fuels.

Table 6-10 Selection of data on emissions from process heat generation

Reference:		Primary fuels			Fuels from regeneration	
1 GJ process heat	unit	Natural gas	Light fuel oil	Heavy fuel oil	Light ends	Gas oil (low sulphur)
fuel input	Mg	24.9	26	27.4	25.8	26.8
emissions						
CO_2 (fossil)	kg	61.3	82.2	85.5	84.7	83.4
SO_2	kg	0.0005	0.0781	0.549	0.0333	0.0333
NO_X	kg	0.0065	0.0333	0.0333	0.00805	0.00794
dust	kg	0.00015	0.0011	0.0011	0.00111	0.00111
As	g	0	0.0078	0.019	0	0.0027
Cd	g	0	0.013	0.027	0	0.0027
Cr	g	0	0.052	0.027	0	0.0027
Ni	g	0	0.065	0.66	0	0.0027
Benzo(a)pyren	mg	0	0.033	0.33	0.27	0.27

Source: calculations by ifeu [8]

Carbon dioxide, Sulfur dioxide, Nitrogen dioxide, dust, Arsenic, Cadmium, Chromium, Nickel, Benzo(a)pyren



[9]

[8] "Ecological and Energetic Assessment of Re-refining Used Oils to Base Oils" by Horst Fehrenbach, GEIR-Groupement Europeen de l'Industrie de la Regeneration (February 2005).
[9] Id.

Reviewing the environmental parameters and the impact of burning the used oil, assuming no pollution controls, the alternative of re-refining used oil produces the smallest negative environmental impact. The heavy metals emissions may lead to 150 times the ecotoxicity impacts compared to re-refining if air pollution control technology is not used. The metals emissions from space heaters are approximately 50% of the input feed, thus the toxicity impact is prorated accordingly to a factor of 75. To put this in perspective, the California EPA study estimated that the zinc emissions from space heaters alone amount to approximately 7% of the total U.S. zinc air emissions.

Combustion of used oil results in air emissions. However, the magnitude of emissions depends on the quality of the air pollution control equipment utilized. Space heaters have even higher emissions than any other type of used oil combustion process because they do not feature any emissions control equipment. While many large scale industrial applications that feature air pollution control equipment are capable of emitting metals within allowable limits, the re-refining process emits the least amount of metals.[10]

Federal Involvement

Currently the United States has no central coordinating body that focuses on used oil management as is the case in Europe. However, some states have implemented a broad range of recycling programs, sales taxes to subsidize collections, and funding of collection activities.

Further, the U.S. does have a mandatory federal policy requiring the preferential purchase of re-refined oil and does promote the source reduction and recycling of materials over their treatment and disposal under the Resource Conservation Recovery Act and the Pollution Prevention Act.[11]

Twenty–five percent of the total worldwide consumption of lube oils occurs in the United States. The amount of oil consumed by the U.S. represents 21.3% of the world's Gross National Product. However, most European countries have implemented oil recycling programs that are far more advanced and regulated. A logical response to worldwide oil consumption is a more responsible recycling policy as well as more involvement and production by private oil re-refineries.

Forecasts

In 2007, more stringent diesel engine particulate emissions limitations will go into effect that will require ultra low sulfur diesel fuel to protect catalyst activity. The result is expected to

[10] GEIR (February 2005)

[11] Executive Order 13101 "Greening the Government though Waste Prevention, Recycling and Federal Acquisition," (1998). "Agencies shall implement the EPA procurement guidelines for re-refined lube oils…" Executive Order 13149 "Greening the Government through Federal Fleet and Transportation Efficiency," (2000). "No federal agency shall purchase, sell, or arrange for the purchase of virgin petroleum motor vehicle lube oils when re-refined motor vehicle lube oils are reasonably available and meet the vehicle manufacturer's recommended performance standards."

be Two Million gallons of additional used oil that will be drained and collected starting in 2007 for all new model year vehicles.[12]

[12] "Used Oil Re-refinery Study" (July 2006).