OIL

A LIFE CYCLE ANALYSIS OF ITS HEALTH AND ENVIRONMENTAL IMPACTS

Lee Stoetzel, Oil, 2000, Oil on paper mounted to aluminum, 20 x 30 inches (c) of the artist and Mixed Greens (www.mixedgreens.com)

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Executive Summary

Introduction

When significant deposits of oil were discovered in the 19th Century, this fossil fuel appeared to offer a limitless source of energy to drive development. While oil and the energy it supplies provide multiple benefits to human society, every stage in the life cycle from exploration to use can have harmful effects on our health and the environment. This report examines the health and environmental impacts of oil exploration, drilling, extraction, transport, refining and combustion.

Drilling and extraction carry acute and chronic hazards, including fires and blowouts, occupational injury and disease, and can lead to long-term harm to plant and animal communities. Oil spills and leaks along coastlines pose risks for marine life and fisheries, and can threaten the livelihoods of human communities. Refining exposes workers and wildlife to petroleum, its by-products and the chemicals used in the refining process. At the pump, gasoline can be both toxic and carcinogenic.

Refining and combustion result in air pollution and acid rain. Pollutant chemicals can be toxic to humans, other animals and plants, while acid rain has impacts on terrestrial, aquatic and marine coastal systems. Finally, the aggregate of gas and particulate emissions from burning oil have begun to alter the world's climate system; with implications for human health, agricultural productivity, vulnerable ecosystems and societal infrastructure.

View of an oil rig from a helicopter

This report, while not exhaustive, is intended to provide a comprehensive framework for evaluating the true costs of our use of oil. The authors hope it will serve as a resource for further study.

Key Points

Oil Extraction

- Each year, 0.75-1.8 billion gallons of crude oil are unintentionally released into the environment.
- Occupationally-related fatalities among workers in the oil and gas extraction process are higher than deaths for workers from all other US industries combined.
- Oil well workers risk injury and chronic disease from exposure to chemicals such as cadmium, arsenic, cyanide, PAHs and lead.
- Gulf Coast offshore oil rigs contaminate sediments, fish and fish consumers with mercury at levels far exceeding EPA standards.
- Spills, explosions, fires and blowouts have multiple environmental and public health impacts.
- Operational discharges of water, drill cuttings and mud have chronic effects on benthic (bottom-dwelling) marine communities, mammals, birds and humans.
- Inadequately regulated drilling of oil has harmed sensitive ecosystems in several developing countries.

Oil Transport

- Spills and leaks from the transport of petroleum and petroleum by-products occur from the point of extraction to refineries and to the sites of consumption.
- According to the Oil Spill Intelligence Report, 1999, approximately 32 million gallons of oil spilled worldwide into marine and inland environments as a result of 257 transport incidents that year.
- While large tanker accidents attract the most attention, the cumulative effect of spills and chronic leaks cause the greatest environmental damage and harm to wildlife communities.
- Many leaks and spills occur in developing nations where safety regulations for pipelines and oil rigs are inadequately enforced.
- Coastal marine and human communities in developed nations also experience significant impacts from oil spills and leaks.
- Marine mammals are affected by the oiling of their fur and skin, and through consumption of oil-contaminated foods (e.g., mussels), or via inhalation of fumes that have liver, kidney and central nervous system toxicity.
- The marine mammals most commonly affected include: seals, sea otters, walruses, sea lions and whales; manatees and dugongs (in tropical waters); and polar bears in the Arctic. (Detailed in appendix of report.)
- Sea otters are particularly vulnerable as they feed near the surface, have little blubber and depend upon an intact fur coat to maintain their body temperature.

Oil Refining

• Oil, by-products and chemicals used in the refining process cause chemical, thermal, and noise pollution.

• Oil refining affects the health and safety of refinery workers through accidents and from chronic illness (e.g., leukemia) associated with exposure to petroleum and its by-products (e.g., benzene).

• Petroleum refineries present major health hazards for human communities living near refineries, and for marine and terrestrial ecosystems where they are situated.

• Regulations on labor, safety, emission standards and environmental protection are often inadequate in developing nations and in poor communities in developed nations.

Gasoline

• Gasoline and many of its additives can lead to acute and chronic toxicity, and is associated with some types of cancer.

• Groups at high risk for exposure to gasoline and its additives include: employees in the distribution, storage and pumping of gasoline; people living near refineries, transfer and storage facilities, and service stations; automobile drivers who pump their own gas; people who live in houses with attached garages; and those whose drinking water has been contaminated with gasoline.

• Despite the well-recognized health impacts of lead poisoning, and evidence that reduction in the lead content of gasoline significantly diminishes lead-related morbidity, much of the gasoline available in the developing world remains leaded.

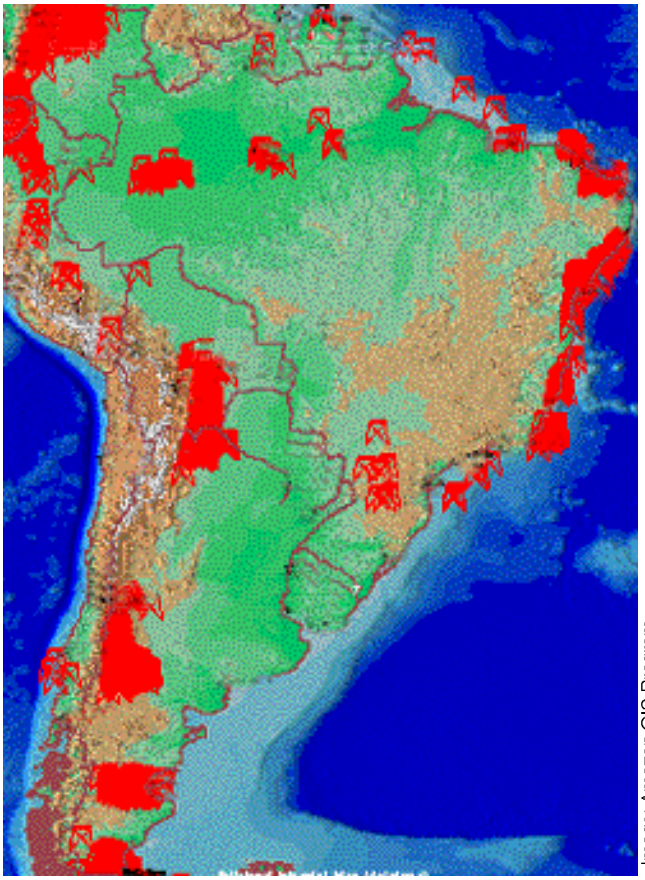

Image: Amazon GIS Program
Smithonian National Zoological Park

A GIS map illustrating oil fields in South America (in red)

Combustion: Air Pollution

• Gas flaring at the point of extraction is a source of air pollution.

• The additives and products of oil combustion, VOCs, NOxs, SOxs, CO, CO_2, PM-10s, PM-2.5s and Pb (definitions below), have numerous environmental and human health impacts.

• Chemical and particulate air pollution are related to heart and lung disease (chronic obstructive lung disease and asthma) and premature death.

• NOxs and VOCs combine to form ground level ozone (O_3) or photochemical smog.

• This reaction is temperature-dependent; thus warming increases the formation of photochemical smog and may reverse gains made in attaining ground level ozone standards.

• Subsequent to the 1970 Clean Air Act, the US has made substantial efforts towards controlling air pollution. However, studies demonstrate that even allowable levels of many of the pollutants result in significant negative health effects.

Combustion: Acid Rain

• Acids formed from oxides of nitrogen (NOxs) and sulfur (SOxs) acidify all forms of precipitation.

• The anticipated recovery of acidified soils appears to be a longer, more protracted process than originally projected, as the depletion of minerals (calcium and magnesium) persists even after correction of soil acidity.

• Calcium and magnesium deficiencies in soils harm plants and animals.

• Acidification leaches lead, copper and aluminum into drinking water.

• NOxs from oil combustion (along with sewage and fertilizer runoff) cause eutrophication of lakes, estuaries and marine coasts.

• Eutrophication (excessive nitrogen and phosphorus) contributes to harmful algal blooms in inland waters and coastal "red tides" that contaminate seafood, and leads to biologically unproductive "dead zones".

Combustion: Climate Change

• Over the past 150 years, human activities - including the combustion of fossil fuels and land clearing - have altered the levels of atmospheric greenhouse gases; the most important being carbon dioxide.

• CO_2 levels are now greater than they have been for 420,000 years and they are rising.

• Land surfaces and the deep ocean are warming, altering Earth's ice cover, accelerating the hydrological (water) cycle and changing global weather patterns.

• Droughts are becoming more severe and persistent, adding to the depletion of fresh water supplies in water-stressed areas, and increasing the vulnerability of agricultural resources.

• Melting of permafrost threatens the integrity of northern latitude pipelines.

• Warming and the accompanying extreme weather events threaten health, forests and marine coastal ecosystems.

Conclusion

Oil has many benefits and energy is necessary for all our activities. But each stage in its life cycle carries hazards for humans, wildlife and the environmental systems on which we and other species depend. Dependence on oil has also skewed incomes within nations and altered power relations among them. Efficiency gains, and more diffuse and distributed generation, could transform the current system into one that is healthier, less costly and more resilient.

The transition to clean and efficient energy technologies will depend on nationally and internationally coordinated policies and incentives. Understanding the health and environmental consequences of oil use may help decision makers assess the true costs of our dependence on this non-renewable resource.

Image: International Fund For Animal Welfare

An oiled penguin walks the beach after a South African oil spill

Definitions

VOCs: Volatile Organic Compounds
NOxs - Oxides of Nitrogen
SOxs - Oxides of Sulfur
H_2S - Hydrogen Sulfide
CO - Carbon Monoxide
CO_2 – Carbon Dioxide
PM-10s - Particulate matter with a diameter of 10 microns or less
PM-2.5s - Particulate matter with a diameter of 2.5 microns or less
Pb – Lead
PAHs - Polycyclic Aromatic Hydrocarbons

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