

The Hidden Price of Refining - The Economic Benefits and Respiratory Health Costs of the Petroleum Refining Industry

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Abstract

Petroleum refiners play a very important role in the economic development of global nations, by reducing costs of imports, strengthening their energy security, generating stable employment opportunities and stimulating overall economic activities associated with the sector. However, the same refinery operations come under the radar for their toxic pollutants that increase the burden of respiratory health conditions. This review examines the economic benefits of refining, embedding them in the context of their often unaccounted for health care and social costs, the true negative externalities faced by contemporary governments.

Keywords: Petroleum Refineries; Respiratory Diseases; Air Pollution; Employment; Cost-Benefit; COPD; Particulate Matter

Introduction

The world economy relies on petroleum as the primary transportation fuel, and energy production entity, with about a 100 billion barrels of it consumed on an everyday basis [1]. It is used as gasoline and diesel in transportation, as jet fuel and marine fuel in aviation and ships. It is used as energy driving the manufacturing industries, construction and infrastructure. However, petroleum cannot be used in its crude form. Crude oil has to be transformed. The petroleum refinery is basically the set of quite extensive installations that transform crude oil into more than one petroleum product like motor gasoline, jet fuel, diesel, lubricants, liquified petroleum gas, naphtha and more. There are about 400 deposits in crude oil around the world, but these cannot be harnessed for fuel or energy without the refining process [2].

Refineries were established in an industrial manner with the first distillation unit launched in 1863 in Boston, United States [3]. In present times, refineries are divided quite disproportionately across the world, with Asia having the largest distillation capacity of around 1.7 billion tons per year, followed by North America, Western Europe, Middle East, Turkey and Central America. Refineries were built and developed in demand for the petroleum products [4]. In the history of refinery establishment, many countries invested in them in order to secure their national energy suppliers and reduce overall fuel imports. Domestic economies relying on imports could face instability and interrupted flow in transport of petroleum products during global crises, and a steady inflow of the product meant stable job creation, and saved costs in regional shipping and logistics. Furthermore, keeping the refinement process close to the consumer base was considered critical for economic benefits [5]. However, this is where the externalities of the refining industry show up, in the form of adverse health effects, which mitigate the potential economic costs.

Economic benefits of refineries

The refineries are a critical backbone for many countries that rely on imports largely to meet their domestic demand and in doing so suffer severe economic setbacks internally. Studies on the cost-benefit analysis of constructing a refinery (Figure 1) versus importing petroleum-based products have shown that there is a positive net profit value, with a minimum payback period of 3.5 years, with an estimated Return on Investment ROI of around 29% or more [6]. The estimated ROI means that for every dollar invested in a refinery product, there is a return of \$0.29 in profit. This suggests that refineries are generating significant return relative to their initial cost, covering not only their initial establishment costs, but also provide a substantial profit margin.

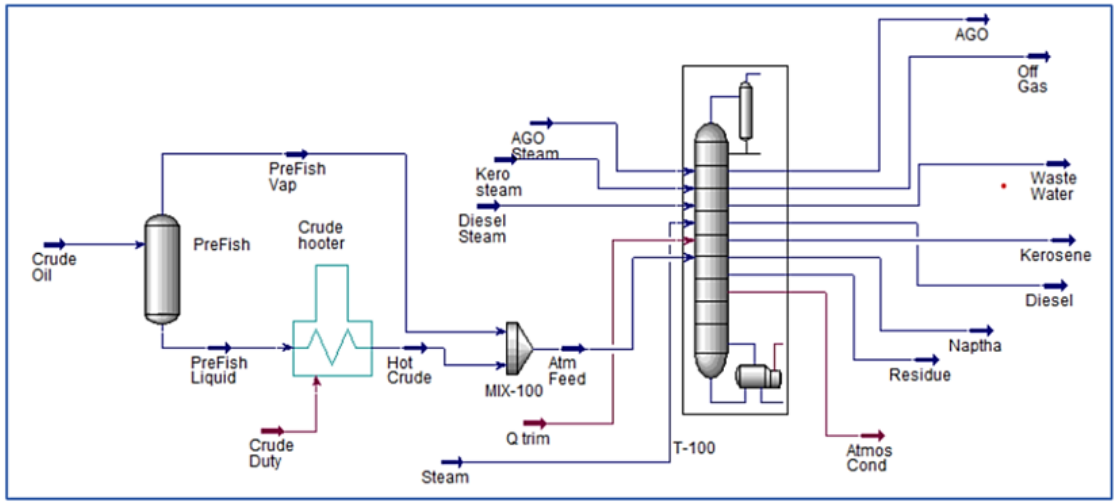


Figure 1: Simulated model of a refinery (Source: Amarin., et al).

The cost savings continue to accumulate, as studies show that refining products was better in terms of unit costs and net gains as compared to importing them [7]. In a small country like Ghana for instance, the cost savings amounted to \$1,458,335,523 per year. Refining petroleum products locally as per the study of Amarin., et al. gives \$0.53 per liter compared to import costs at \$0.82.

Parameter	Total Volume (L)	Total Cost (\$)	Unit Cost (\$/L)
Imported Products (2022)	5,112,980,706	4,192,110,000	0.82
Locally Refined Products	5,112,980,706	2,733,774,477	0.53

Table 1: Unit cost prices of locally refined and imported products (Source: Amarin., et al).

In addition to cost savings, petroleum refineries contribute to the economy in the form of jobs. A simple 30,000 barrel per calendar day refinery (the basic model option) can generate as much as 1557 full time jobs, generating more than a \$149 million in earnings. This does not include the \$239 million that such a small-scale project can generate in terms of the total economic activity it generates during the project initiation, development, construction and maintenance [8]. A refinery that is up and running, usually creates continuous full-time jobs. However, while the profits of the refining appear on corporate and national level balance sheets, there are others that might not be factored into the cost-benefit analysis, such as the externalities of refining in the form of air pollution that result in respiratory issues. This becomes an adverse healthcare budget borne by society.

The hidden healthcare costs of refinery related air pollution

The economic contribution of petroleum refineries cannot be assessed solely through the return on investment, savings because of local refining versus imports, or employment generation. Refinery operation releases much particulate matter in the form of $PM_{2.5}$ and PM_{10} , sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and hazardous air pollutants like benzene [9].

A scoping review of the impact of refineries found consistently higher prevalence of asthma, bronchitis, COPD and severe shortness of breath in people living at a certain proximity to refineries, in countries like Italy, Canada, Jordan and more [10]. The exposure to $PM_{2.5}$ and PM_{10} , sulfur dioxide (SO_2) exacerbated existing asthma conditions in children. Reduced lung function was noted in both children and adults living near refineries in India, Canada and Italy. Respiratory related hospitalizations were also high with mortality in the high range in adults and children living near petroleum refineries in Puerto Rico, Italy and the United States. In some situations, like in a refinery in Oakville, Canada, hospitalization rates due to respiratory distress were high in Oakville, but it significantly went down in the local population when the refinery was closed [11].

In other cases, the artisanal refining of crude oil, which is quite different from the petroleum refining also has shown consistent health impact. In artisanal refining, distilleries may operate on open fires with particulate matter release wholly into the environment. The contaminants are associated with human carcinogenicity. A cross-sectional study finding in three communities in Bayelsa, Nigeria shows extreme respiratory health effects associated with residents living in areas near the artisanal refineries. The study with a sample population of 615 adults, showed moderate to severe respiratory symptoms in the form of coughing, phlegm accumulation, and other chronic respiratory symptoms.

Therefore, there is evidence to show that both industrial refining attempts and artisanal attempts are harmful for people, increasing respiratory health costs.

Conclusion

Petroleum refineries are a critical backbone of global economies. However, refineries impose a substantial respiratory health cost on surrounding population, and even its workers. The negative externalities are a true social cost from the petroleum refinery company that is transferred onto the consumers, society in general and the government. Consequently, the apparent economic gains generated by refining must be considered alongside the direct costs of medical treatment and hospitalization and the indirect costs associated with absenteeism, reduced productivity, disability, and premature mortality.

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