

Environmental and Economic Impacts of Reducing Diesel Emissions

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Abstract

Increasing diesel emissions and fuel costs negatively impact the environment and economy. The quality of air deteriorates, but goods must still be transported while the maintaining costs grow. Diesel emissions pose a threat to the quality of life of humans, but technological advances in improving fuel efficiency in the trucking industry will ensure a reduced impact on the environment, as well as benefiting the consumer by keeping the air clean and balancing the cost of goods and the cost of cross-country transportation. Using the General Problem Solving Process (GPSP) facilitates the examination of technological advances in the trucking industry, and the ongoing efforts to solve the problem of diesel emissions and reducing the negative impacts on the environment and consumer.

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**Table 1 - Peak Price for One Gallon of Diesel**

Year	Peak Price
1995	\$1.10
1999	\$1.29
2003	\$1.50
2004	\$2.16
2005	\$3.15
2006	\$3.06
2007	\$3.44
2008	\$4.76

**Note:** The prices from the table represent peak diesel prices during the specified year.

**Table 2 - Average Cost of Basic Necessities (per pound)**

October	1999	2003	2008
Bread (White)	\$0.89	\$0.97	\$1.40
Beef (Ground)	\$1.87	\$2.35	\$2.96
Eggs (Grade A)	\$0.88	\$1.33	\$1.85
Lettuce	\$0.67	\$0.86	\$1.00
Orange Juice (16oz)	\$1.66	\$1.98	\$2.50

**Note:** The CPI data was obtained from the Bureau of Labor Statistics website. To obtain the data, navigate to <http://data.bls.gov/cgi-bin/surveymost?ap> and select the appropriate items and click Retrieve data.

## Environmental and Economic Impacts of Reducing Diesel Emissions

Diesel emissions cause significant damage to the environment and human population. Pollution from diesel emissions deteriorates the quality of air that people breathe and may cause potential health epidemics, such as asthma or even lung cancer. A majority of diesel emissions come from the nationwide transportation of goods from large, semi-trailer vehicles, such as Class 6, 7 and 8 trucks. The flow of transportation must continue in order to maintain the quality of life that Americans are accustomed, but the environmental risks cause concern for the future of the planet. The rising cost of diesel prices also negatively impacts the average consumer because the prices of goods are often increased to offset the increased fuel costs.

Actively increasing technological advances in the trucking industry may ensure a minimized environmental impact of diesel emissions, as well as lower transportation costs. In order to understand the problems caused by diesel emissions and the potential solutions to reducing their impact on the environment and consumer, analysis follows using the General Problem Solving Process (GPSP), particularly discussing the environmental and health risks associated with increasing diesel emissions, the negative impact on consumers due to rising fuel costs, the solutions being developed to combat the negative impacts of diesel emissions, and the potential effects of technological advancements on other sectors of the economy.

### *Define the Problem*

#### *Environmental Impact*

As stated in Chapter 4 of FUEL, when analyzing a problem, it is necessary to display awareness before defining the problem (Lipuma, 2008). Most people should

recognize that semi-trailer trucks run on diesel fuel, but they may not be aware of the fuel efficiency of these trucks. It is also valid to assume that trucks use a large amount of fuel, due to the size of their fuel tanks. The average semi-trailer truck receives five to seven miles per gallon (mpg) fuel efficiency. This number is quite low compared to the efficiency of the average commuter vehicle in America, which is around 25 mpg (Energy Efficiency). The engines in semi-trailer trucks require high torque and power, in order to transport goods across the country, and one of the largest commercial trucks (Class 8), may haul up to 80,000 pounds of freight. For many citizens, the convenience of timely, delivered goods becomes more important than the impacts on health and environment that result from diesel emissions.

According to the Environmental Protection Agency's (EPA) *Health Assessment Document for Diesel Engine Exhaust*, a large percentage of the American population is exposed to diesel exhaust, and this places people at the risk of developing acute health problems such as asthma, or chronic illnesses, such as lung cancer (U.S. EPA, 2002, p. 27). The report further discusses the composition of diesel exhaust. Diesel exhaust contains elemental and organic carbon, sulfate, nitrate and ammonium, and various minerals (p. 44). The amount of these particles emitted into the atmosphere increases with larger classes of trucks. The percentage in usage of diesel has also increased from 1% in 1949 to almost 20% in 1998, and diesel fuel consumption in that same time period increased from 400 million gallons a year to 26 billion gallons annually (p. 55-56). As one may imagine, the increase of those carcinogenic particles has a detrimental impact on health.

The Clean Air Task Force (CATF) report *Diesel and Health in America* discusses the negative impact on health from diesel emissions. According to this report, diesel exhaust contains 40 dangerous air particles, as recognized by the EPA (Schneider, 2005, p. 4). The report continues to mention the increased risk of lung cancer due to exposure to the particles in diesel emissions. The risk of lung cancer increases for people living in metropolitan regions of the country, as compared to those living in rural areas (p. 5-6). This is due to the increased number of diesel vehicles operating within the same vicinity of daily human activity.

*Diesel and Health in America* also points out negative economic impacts of diesel emissions, such as increased health care costs, due to rising cases of respiratory ailments, both acute and chronic (p. 6). *Diesel and Health in America* and the *Health Assessment Document for Diesel Engine Exhaust* consistently establish that diesel emissions are harmful to the environment in the form of air pollution, as well as to humans and all living organisms exposed to the detrimental emission particles. In order to understand the economic impacts reducing diesel emissions, further analysis is necessary.

#### *Economic Impact*

Despite the environmental impacts of diesel emissions, goods still require transportation. Unfortunately, both the cost of fuel and goods increases annually due to inflation. Perhaps this will not negatively impact a middle or upper class citizen, but it causes basic necessities to become more expensive for the lower classes. Rising fuel prices also cause an increasing number of failing independent trucking companies. In a June 2008 article in the *Deseret News*, Laura Hancock reports that in the first quarter of 2008, over 935 independent trucking companies went out of business (Hancock). The

rising cost of running their businesses, primarily the rising price of diesel fuel, caused the entities to fail. Independent trucking companies cannot compete in a market where diesel prices hit almost five dollars a gallon, mainly because they must raise the transportation cost, or perhaps the cost of goods, to compensate for the fuel increase. Hancock continues the article, mentioning that 42,000 trucks were continuously idled during this same time period (Hancock). Idling a diesel engine wastes fuel and causes pollution.

Idling a diesel engine continues to contaminate the atmosphere with harmful particles. This idling also costs trucking companies money because of wasting expensive fuel. As shown in Table 1, in the period of 1995 to 2008, the price of a gallon of diesel peaked from \$1.10 to \$4.76 (US Retail). Trucking companies must increase their shipping costs and cut business expenses, in order to maintain profit margins. Quite often, cutting a business expense may involve removing an employee from the organization.

Another economic consequence of rising fuel costs harms the consumer because prices are raised on goods that require transportation. An increase in the price of an already expensive electronic product may not have a significant impact on the average consumer, but when the price of a basic necessity such as bread rises, the lower income families in America are losing their consumer purchase strength. The United State Department of Agriculture (USDA) updated the projected increases of food price indexes in the *CPI for Food Index* on November 21, 2008.

The average 2008 increase is five to six percent for all foods, but those considered basic necessities increased significantly, such as eggs (14.5%), cereals and bakery products (10%), and fruits and vegetables (7.5%) (Leibtag, 2008). Table 2 shows

increases in other basic necessities from 1999 to 2008, such as beef, lettuce and orange juice (Consumer Price Index). Recent economic activity may suggest small amounts of deflation in the transportation and fuel industries, but the environmental impact will remain detrimental. Cuts in oil production will eventually cause fuel prices to rise again, and the consumers will be negatively impacted.

### *Potential Solutions*

#### *Legislative Intervention*

Continuing the GPSP analysis, potential solutions to any problem require critical thinking, involving research and even creativity (Lipuma). Government intervention may aid significantly in decreasing diesel emissions in America. For instance, a policy such as the Kyoto Protocol may be ratified and the country would be forced to lower emissions from an international governing body. This approach is the most aggressive because it would force trucking companies to lower emissions, or pay higher taxes if they polluted over a specified amount. This would benefit the environment, but it would have a negative impact on the economy because prices on goods would rise, simply being passed to the consumer.

Collaboration between the public and private sector may prove beneficial for the environmental and economic impacts of diesel emissions. A prominent example of this collaboration is the EPA SmartWay program. SmartWay partnerships recognize technological advancements and assist in encouraging the use of these innovations, such as hybrid engines and other enhancements to the mechanical components of a diesel engine (Basic Information). These associations allow freight companies to collaborate

with different parts of the private and public sectors in reducing their environmental impact. The SmartWay program also encourages the use of biofuels and ethanol.

#### *Advanced Diesel Engine Technology*

Technological advances in engine production allow trucking companies to improve their fuel efficiency. For example, the Peterbilt Model 386 Class 8 Hybrid aims to increase overall fuel efficiency by 25% in the next few years. The company announced a partnership with Eaton and Wal-Mart to transport fleet across the country in the new Class 8 model (Millikin). Due to the fact that Wal-Mart is one of the largest corporations in America and has a significant impact on the economy, this partnership will prove beneficial to the environment and consumer.

Other technological advances include the Diesel Hydrogen Injection System (DHIS), which drastically reduce emissions and provides up to 50% increased fuel efficiency (Jones, 2008). The press release mentions that the DHIS may be installed in many existing diesel vehicles. Another advantage of using this technology is lowering maintenance costs on trucks, which will ultimately reduce delays in transporting goods. Another alternative fuel that may prove beneficial is natural gas.

Natural gas already powers vehicles in public transportation, such as buses. Graham Williams presented *Future Products For Natural Gas Engines in HD vehicles* at the Alternative Fuel Vehicle Institute (AFVI) Conference in 2007. He discusses the benefits of using natural gas, as opposed to diesel. The main points are that power and torque are comparable to that of diesel engines, and that emissions are greatly reduced (Williams, 2007, slides 5, 8). The statistics throughout the presentation are significant because the information shows the benefits of natural gas over diesel fuel. In addition to

the minimized environmental impact of using natural gas, positive economic impacts may result. America already produces natural gas, and a trucking industry conversion to this fuel would provide great revenue for the country by keeping dollars in America, as opposed to oil corporations located overseas in countries such as Saudi Arabia. As discussed in the solutions section, there are various advances already being implemented in the freight and transportation industries.

#### *Expansion to Other Sectors*

There are various technological advancements in the future of the trucking industry, and all have potential. Class 8 vehicles will be able to haul the 80,000 pound loads across country, while minimizing their impact on the environment, as well as the air quality. This reduction ultimately reduces the impact on the health of American citizens. The technological advances in diesel engines may also prove beneficial to other economic sectors. Mining and construction vehicles require engine power comparable, or even larger than, those in a Class 8 semi-trailer truck. Mining and construction are two important elements of the American economy because resources are required for processing raw materials, but also in building schools, homes, and factories. By utilizing technological advances of the automotive and trucking industries, mining and construction equipment will also reduce the environmental and health impacts.

Another sector that is noticeably implementing alternatives to diesel is that of public transportation. One in particular involves city buses. Cities across America have implemented clean public transportation programs, where buses no longer run on diesel fuel, but natural gas. This technological shift includes other government vehicles, such as those used by police officers that use natural gas, hydrogen, or diesel electric power.

Using clean energy, such as natural gas, in metropolitan areas will especially benefit the health of residents and the environment because the negative aspects are reduced.

*What is the Best Solution?*

There lacks a universally optimal solution because reducing diesel emissions requires collaboration from various entities in the public and private sectors. Private corporations, primarily trucking companies and engine manufacturers, must realize the potential of their technological advancements, but also realize their limitations. Working with government agencies such as the EPA, these corporations must inform the legislatures on their capabilities, as well when they may rationally implement new technology. Essentially, this collaboration requires realistic expectancies, rather than those that would be detrimental to the economy. If the regulations are too strict, then corporations may be forced to downsize and delay their efforts at research and development of new technologies. They may also pass costs down to the consumer. If regulations are too lenient, however, the environment will continue to suffer and the quality of life for humanity progressively diminishes.

The complexity of implementing a large-scale solution also becomes an asset in reducing the environmental and health impacts. While corporations collaborate on their realistic potential and legislatures develop new emission restrictions, the consumer benefits because there is now a competitive environment in several industries, particularly automotive. Perhaps the powerful, efficient engine may be scaled down to the consumer level, providing more powerful and reliable vehicles for the daily commuter, sports car enthusiast, or light-duty pickup truck for the private contractor. The

potential of advancement exists and active measures exist in both the public and private sector to reduce the impacts of diesel emissions.

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