Transportation and the Environment: A Multidirectional Approach

Natural Science Inquiry
Winter 2000

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Introduction

The Portland metropolitan area is currently in the mist of a transportation dilemma. The city must decide how to effectively improve its current transportation system. While convenience is important the over goal is to reduce carbon monoxide (CO) emissions. We, The Student Transportation Team (STT), have been assembled to assess this issue and have the duty of recommending how the Portland metropolitan area should invest $1 billion in transit solutions.

After considerable research and consideration STT's findings indicate that a multidirectional approach to the problem of transportation and the environment would best fit as working toward an adequate solution. This paper is divided into sections that investigate: 1) current CO emissions; 2) the role of the light rail system; 3) automobile enhancements; 4) electric car parking and bus improvements.

Carbon Monoxide Emissions (Patrick Leonard)

What is carbon monoxide?

Carbon monoxide (CO) is a gas composed of one carbon atom and one oxygen atom. It is colorless, odorless, and tasteless. It is also poisonous.

When you breathe carbon monoxide (which, by the way is also in cigarette smoke), it enters your bloodstream through

the lungs and forms carboxyhemoglobin.[1] This substance makes it more difficult for your blood to carry oxygen to your organs and tissue.

In terms of pollution, it is a more significant problem for people who already have cardiovascular problems.

This is not that it is harmless to individuals who do not suffer from these types of health problems; it can lead to problems such as visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty performing complex tasks in healthy people. Now around here, I doubt the pollution gets bad enough to significantly reduce manual dexterity, but children and elderly people do tend to be more sensitive to environmental pollution factors.

Where does carbon monoxide come from?

Carbon monoxide, for the most part comes from automobile exhaust. Nation wide, automobile emissions account for roughly 60 percent of the carbon monoxide released into the atmosphere.[2] Within cities however, auto emissions contribute to a far larger portion of carbon monoxide emissions, as much as 95 percent.

The reason auto exhaust contains carbon monoxide is that it is created when fossil fuels are not completely burned. When this happens, carbon molecules are not completely oxidized. When the carbon gets completely

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1 http://www.epa.gov/orcdizux/03-co.htm

2 http://www.epa.gov.oar/aqtrnd97/brochure/co.html

oxidized, the result is carbon dioxide. When it is not, the result is carbon monoxide.

This is most likely to occur when the car is cold (referred to as a “cold start”), because when the car is cold the air-fuel mixture has to be “richer”. This means there has to be more fuel and less air than when the car is warm. Because there is less air, there is less oxygen to oxidize the carbon, hence more carbon monoxide. This is why in what are called “non-attainment areas” by the EPA, gasoline has to be oxygenated during the winter. This is done by adding an oxygen-containing compound to the gas, to help completely burn the fuel. Why during the winter months? This is due to the fact that cars take longer to warm up when it is colder outside; hence emit more pollution for a longer period of time.

Though CO emissions are still a significant problem, the problem was much worse in the early 1970’s. The air in downtown Portland was so dirty in 1972, that it violated health standards set by the EPA concerning carbon monoxide one out of every three days![3]

As a result of several changes and improvements made to the city (many thanks to Mayor Neil Goldshmidt and other visionaries), the air quality in Portland improved greatly. Some of these improvements included the construction of the downtown bus mall, and removing a six-lane expressway in

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[3] http://www.tri-met.org/envfacts.htm

order to build Tom McCall Waterfront Park.[4]

Catalytic Converters. An extremely significant factor in reducing carbon monoxide emissions was the invention and improvement of the catalytic converter. The first catalytic converters entered the American market in 1975, as did unleaded gasoline.[5] Catalytic converters are devices that convert pollutants such as carbon monoxide and hydrocarbons into carbon dioxide and water.[6] These new devices went a long way toward decreasing emissions. Another benefit was that they needed unleaded gas to operate, which meant a decrease in lead pollution from cars.

The reason catalytic converters need unleaded gas has to do with the way they work. Essentially, the catalytic converter sits in the exhaust line between the engine and the muffler. The exhaust comes out of the engine and passes through small beads or honeycomb shaped surfaces that are coated in precious metals such as palladium and platinum. The heat and force of the exhaust, along with the catalysts manage to convert much of the pollutants

How much carbon monoxide does a car put out? Here are some pertinent numbers:

Portland carbon monoxide emissions: 1,105,172 lbs/day[7]

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4 http://www.trimet.org/fresh.htm

5 http://www.ben2.ucla.edu/~vgulbina/page9.html

6 http://www.fwkc.com/encyclopedia/low/articles/c/c004001011f.html

7 North Corridor Interstate Max Lightrai Project: Final Environmental Impact Statement, October 1999

Carbon monoxide emission standard: 3.4 grams/mile[8]

Here are some other figures:

Automobile work trip market share (1990): %86.1

Public transportation work trip market share: %5.4

It would appear carbon monoxide or not, people around here either cannot or will not ride the bus. Here are a couple more numbers:

Daily vehicle miles per capita (1996): 21.6[9]

Daily public transportation commuters (1990): 39,259[10]9

Daily public transportation commuters (1980): 47,504[11]9

(Note the decrease from 1980 – 1990)

Annual transit rides per capita (1996): 43.4[12]9

(Note: it is claimed that this figure is artificially high due to "double counting" of light rail and bus riders)

Light Rail (Blaine Rogers)

Beginning this project I was instantly drawn to light rail as a seemingly obvious route to enhancing the environment via transportation. This bias was promptly dismissed upon an accumulation of evidence that pointed to several problems with Portland's metropolitan area express

8 http://www.ben2.ucla.edu/~vgulbina/page8.html

9 http://www.publicpurpose.com/dmseapor.htm

10 9 http://www.publicpurpose.com/dmseapor.ht

11 9 http://www.publicpurpose.com/dmseapor.ht

12 9 http://www.publicpurpose.com/dmseapor.ht

(MAX) organization. Further research did show that light rail short falls may be redirected in a more positive direction. The main points of this section detail: a) what light rail is and what it is suppose to do; b) problems that light rail is faced with in relation to cost and to lowering CO emissions; c) improvements that could be made to improve light rail problems.

Light Rail was created in 1982 as an attractive alternative to growing automobile use (1). The proposed goal was to reduce an increasing population reliance on autos that could in turn supplement the bus system. This goal encompasses traffic relief, pollution reduction, and time savings.

Light rail, commonly referred to as MAX, is an above ground train that runs exclusively on electric power. Portland currently has two main lines that to connect to each other. One line of MAX (east side) runs from Gresham to downtown Portland. The other line (west side) runs from Beaverton to downtown Portland.

Max’s fuel source (electricity) is Tri-met’s rational behind its positive impact on the environment (2). Simple physics illustrates that rail transportation demands less energy to move the same mass. Steel wheels on steel tracks require 6 to 10 times less power than rubber tires on the road (3). To add to this light rail can carry nearly 400 passengers per train, which is considerably greater than any other form of ground travel (4). Much of the aforementioned

information suggests that MAX is an effective method of transportation that is helping the environment, but there are drawbacks that oppose this.

Max is faced with multiple troubles. Problems include: inadequate ridership numbers, high cost, elimination of bus lines, not clearly reducing traffic, poor access to stations, and the harmful effects of park and rides. STT has chosen to focus on two main areas of dysfunction. One is how park and rides contribute to CO emissions, and the second is how inadequate ridership numbers make MAX fall short in how it could potentially help the environment.

The use of Park and rides are a contradiction to Tri-met's effort to help the environment. Light rail has 7,000 free parking spaces along its lines that are quickly filled daily (5). At first glance this number could be viewed as a positive figure, but it is not. Individuals are diving to these locations. Even traveling short distances in a car has an enormous role in the total amount of CO released. As mentioned in the emissions section of our report, the cold start is responsible for a large majority of CO released by automobiles. This Tri-met's park and ride system hinders CO reduction and should be changed. The apparent solution is to discourage or eliminate park and rides. This would work to remove CO emissions from cold starts of MAX users but result in a reaction of lowering ridership numbers, which is another trouble spot of the system.

The second shortfall of MAX is ridership numbers. The

interesting point here is that this aspect is related to other problems that MAX faces. In order to have a significant impact on lowering CO emissions new people must utilize the light rail service. While estimates of weekday ridership reach as high as 60,000 daily riders(6), two thirds of light rail passengers are or were bus riders (7). To compound this issues light rail faced with the problem of lacking new riders and even may even lose patrons over a of lack convenience and poor service (8).
It is the opinion of this author that these problems should be further investigated and improved upon to maintain and improve ridership.

Many solutions to maintain riders appear simple and do not seem expensive. They are just matters of convenience. One example would be improving bicycle connections to MAX terminals. Another way to keep riders would be to reduce the numbers of delays that Light rail experiences. This could be accomplished with more research or by larger maintenance staff. A final noteworthy aspect of convenience are bus connections to the MAX. Several bus lines have been eliminated or reduced in service (9) STT suggests that these lines be reinvestigated in that they might be essential to ridership morale.

STT views gaining new riders is possibly the most crucial aspect to light rail reaching is full potential. This is difficult because the automobile is so convenient. A portion of the $1 billion should be devoted to light rail

public relations through advertisement and new innovative incentives to encourage drivers to switch over. One source to obtain new riders would be to target the youth market. Tri-met could direct funds to have representatives lecture at high schools around the metro area. Another interesting idea that might draw increased attention could be to pay local celebrities to ride and endorse light rail.

If promotion of MAX does not succeed it is extremely likely that ridership will still increase ridership. In the next decade the Portland-Vancouver area is expected to gain 300,000 new residents (10). This will increase traffic and will increase the inconvenience and time of driving. Max riders will increase and therefore lower CO emissions.

References

(2,4) www.teleport.com/~samc/max/

(7) http:www.oregonlive.com/news/99/07/st071304.html

(6,9) http:www.oregonlive.com/news/99/09/st09206.html

(10)www.heranet.com/oti/

(5,6)http;//www.cascadepolicy.org/transit/literail.htm

(8) "It Could be Park and Ride…and Pay" The Oregonian. 02/10/00

(1,3) Living in the Environment. Chapter 7, 1998

Electric Cars (Dan Goronski)

As we as a society have moved toward the future, the car has developed to the point being a major source of

transportation, not only in the United States but all around the world. The car in our culture and society has become a necessary form of travel. However, with this incredible contribution has come the price of considerable damage to our environment.

One of the major sources of air pollution has been the internal-combustion engine. This engine is the source of power to millions of cars. What has the SST chosen to do with its funding of one billion dollars? Since time inevitably moves toward the future, we have chosen to take one fourth of the funding and invest it in the future: electric cars.

Electric cars are automobiles with an electric motor powered by a system of rechargeable batteries. The way an electric motor works is through reverse electrolysis. The best explanation of this process was found at www.baaction.org. Reverse electrolysis is the process by which water can be split into its original elements of water and hydrogen by an electric current. Electricity is conducted through the passage of electrically charged ions and atoms. During the process of this electricity producing reaction, hydrogen atoms give up electrons at the anode and become hydrogen ions in the electrolyle. Electrons that are released at the anode travel through an external circuit to the cathode. This is the electricity used to power the electric vehicle. The products water and heat are formed when the electrons and hydrogen ions at the cathode combine

with oxygen molecules.

With such a futuristic approach one might think that the idea of an electric car is something new. Actually, the origin of the electric automobile can be traced all the way back to the late 1800's. Inventors such as J.K. Starley of England and Fred M. Kimball of Boston, Massachusetts get the credit for developing the first practical electric car in 1888. By 1896, the first American electric car manufacturer was Woods Motor Vehicle Company of Chicago. By 1904 one–third of all the cars in New York City, Chicago, and Boston were electrically powered. The companies that produced electric cars eventually died out due to the stiff competition created by gas vehicles manufactures such as Henry Ford. Electric car manufactures were not able to keep their vehicles affordable, due to the mass production of gas-powered models. By the 1940s the only people to drive electric cars were upper class, wealthy individuals. As the years passed, gas powered models looked more appealing, resulting in the extinction of the electric car. It would not be until the environmental concerns and oil shortage in the 1970s that society would look toward alternatives to gas powered automotives. This decade would see the rebirth of the electric car.

The disadvantages of gas-powered vehicles can be seen in the 15 million Americans alone that own a motor vehicle. Motor vehicles generate more air-pollution then any other human made machine. It is believed by many scientists that

toxic gases released by motor vehicles are the major cause of global warming. According to the American Lung Association the air pollution kills between 50 thousand to 110 thousand people in the United States each year with costs of medical bills in the billions. Such gases as (CFC) chlorofluorocarbon, (CO2) carbon dioxide, (N2O) nitrous oxide, (CH4) methane and (NOx) nitrogen oxides are all air polluting greenhouse gases that are traced to gas powered vehicles. (CO) carbon monoxide is also a contributing gas toward the greenhouse effect.

(1)

- Carbon Monoxide- Carbon monoxide tends to react with other compounds such as hydroxyl radicals (OH). The loss of hydroxyl radicals causes damage to the ozone layer. The greater amounts of OH, the less chance of greenhouse gases existing in the air for long periods of time.
- Methane is formed when high levels of Carbon Monoxide exist. Methane is able to stay in the atmosphere for longer periods of time eating away at the ozone layer.
- Chlorofluorocarbons are the most potent of the green house gases on a per unit mass basis. They make up 24 percent of the total global warming effect.
- Carbon Dioxide is another green house gas that is created when fossil fuels are used.

Motor vehicles consume approximately half of the words oil

and account for a quarter of the greenhouse gas emissions. The average motorist increases the miles they drive, in turn worsening the air. For a society that lives in a fast paced world, eliminating automobiles may not be an option. This is why the electric car is the answer.

Why are electric cars better? Simple. Studies all across the world have shown that electric cars are up to 98 percent cleaner then gasoline powered vehicles. The only emission from an electric car is water. Fossil fuel would be nonexistent. Data has been collected at the University of California to show that 100 electric cars equal one typical gas car, 5 to equal its nitrogen oxide production, and 100 to match is carbon monoxide output. Since electricity is collected for utility owned power plants that burn oil or coal to generate power, it is fair to say that the trade off is better than what we have going for us now. It would be much simpler to control pollution from one central location such as an energy plant then it would be to chase billions of cars around the world that spew greenhouse gasses.

In a demonstration project run by the Massachusetts Energy Office, solar cells provide the electricity to recharge electric vehicles powered at a two-commuter rail train station in Boston. Solar panels on the roofs of houses could collect solar energy by day and use it to charge spare electric batteries.

Now that I have sold you on electric cars and now you have some questions. The most frequently asked questions at

www.earthlink.net are How fast? How far? How much? Speed is not an issue. One can find electric cars that can go from 0 to 125 miles per hour in 10.5 seconds, but that can cost your battery a significant amount of power. The most up to date and popular electric cars that are on the market today are the Honda EV that is able to reach a maximum speed of 80 miles per hour and the Saturn EV1 that has exhibited a maximum speed of 85 miles per hour. Both vehicles have acceleration rates of 0-30 in 4.9 seconds and 0-60 in 17 seconds. The range of an electric car is much shorter then a gasoline-powered car. On average you would see a range of approximately 50 to 90 miles on a 3-hour charge. One initially may be concerned with this, but how many people actually drive more then 40 miles a day on a regular basis?

So now the question is: how much do one off these vehicles cost? You can purchase the GM Saturn EV1 for a retail price of $33,995. The Honda EV has a retail price of $53,999. Both these prices are steep; however, hopefully sufficient incentives can be offered as to overcome the initial sticker shock.

As I stated earlier, 15 million Americans own a motor vehicle. Not only has the car become a necessity, but also a symbol of who we are. Some of us use the symbol to represent the type of personality we posses. We look at the car as our way of keeping up with high paced demands put on us by today’s society. Is it not the American dream to own a car? Certainly for many it is. Maybe that is one of the many

reasons why eliminating the car could never be an option. Instead the SST has chosen to invest in the future research of electric cars. With the help of engineers and people with imagination, perhaps we will be able to live in an environment that can forever sustain our existence: a planet that is free from pollution.

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Electric Car Parking and Bus Improvements (John Mosser)

Some of the problems that are included in “big city” living are overcrowding and noxious air pollution. Though overcrowding is a big problem in today’s society there is very little that we can do about it. Even though this is one of the more significant problems, it is still not the biggest problem. Of all the problems that occur in a big city, there is one that effects all of us, but no one ever thinks about: the problem of pollution. Wherever you turn, you cannot avoid breathing harmful air, which damages out lungs and makes it harder for us to breathe. The contaminated air that we breathe in contributes to numerous respiratory ailments,

such as asthma and emphysema. Over the past several years the Portland area has been taking steps toward cleaning the air in our area of the country to make it more livable, and a better place for the next generation. Tri-Met, the greater Portland area public transportation system, has been operating since 1969. In the last fifteen years the metropolitan area express (MAX), has been built and extended to adapt to the greater number of residents who move to the area each year. There is one problem though: MAX is unable to travel back and forth across the city. This makes it difficult for many people to access MAX, which in turn leads to reduced ridership. The obvious solution is an increase in bus service to deliver people to the MAX stations. However, an increase in bus service would lead to more pollution, unless we can find alternate ways to power them. This is why when we look to the future we must not focus on one target area of transportation, but we must look at all the areas of transportation; only then can we maximize the efficiency of the entire system.

When I think of buses, I think of something that is outdated technology that is past its prime. It is time to move on to something more advanced, something revolutionary. The future, my friends, is in electric cars. As Dan Goronski has described in his section of the report, clearly the way to lower carbon monoxide emissions is to alter a form of transportation that the majority of the population uses to commute to and from work. Since people depend on their cars

for transportation and are not willing to give them up, we must alter the cars; specifically how they are powered. The proposed change is switching cars from the traditional gas powered to hybrid and electric powered.

The biggest problem with electric cars is: where are you going to park them when you are downtown so that you can recharge them? This is one of the vital points to our proposal. If people are willing to buy an electric or hybrid car then there will be benefits for these choices to help lower carbon monoxide emissions.

The first proposed benefit to driving an electric car is to offer free parking in your choice of two parking structures. These structures will allow you to charge your car while you are at work at no cost. This will be done by putting in the necessary equipment so that each space is provided with a socket to plug into. There will only be three or so levels of the parking garage reserved for electric and hybrid car drivers.

One problem that may be encountered is how to get the people from the garages to their place of employment if there is only one parking lot on each side of the city. The solution will be free electric bolt buses that will work as shuttles to drive people to their final destination. These buses fit right in with the ideals of the program because they run on electricity, therefore have zero emissions. They will be set up in conjunction with the already existing Tri-Met organization. These buses will run frequently during

rush hour, and less often during off peak hours, so that the extra buses in the fleet can be recharged before the next rush hour period. These buses can last up to eight hours on a single charge, and are wheelchair accessible. Another perk regarding these buses is that they cost $161,477, as compared to a diesel bus, which costs $238,000[13]. This will provide a solution for those who live where it is inconvenient to walk to a bus stop or ride a bus, due to the fact that they have to transfer repeatedly to get to there destination. It will give them all of the freedom of driving a regular car and the benefits of free parking downtown. Hopefully this will create a significant incentive for people to start buying electric and hybrid cars. Once the idea takes off, it will gather more support; as technology continues to improve, we will be able to convert more of the garages to electric car parking, due to the fact more and more people will be buying electric cars, thus putting a higher demand on electric car parking, and decreasing the demand for parking for traditionally powered (gasoline) vehicles. Then we will be able to phase out the electric bolt buses from this aspect of the idea. We can then deploy the buses onto regular routes, so that everyone can use these buses for standard public transportation. As Dan Goronski has shown, the rate at which the quality and efficiency of electric cars are improving is quite rapid, making this idea more realistic every day.

The next portion of the proposal involves bringing in

[13] http://www.southbendtribune.com/98/jul/071698/llocal_ar/89294.htm

hybrid and electric buses to replace as many diesel buses as we can. At a minimum, the idea is to switch the buses that are driving downtown for a substantial portion of their route to electric hybrid buses. This will result in a reduction of carbon monoxide levels within the downtown area to minimal.

These hybrid turbine-electric buses that already exist only put out one tenth of the emissions of the EPA standard. The city of Seattle, as well as the city of San Francisco has ideal examples of the busing system that Portland needs in its downtown area. These bus systems are powered by the same process that MAX is. A metal arm is raised up from the top of the bus and comes into contact with power cables that supply the bus with electricity. Then, once the bus route takes the vehicle away from the network of cables, the bus switches to diesel or natural gas power. This will result in lower emissions downtown, therefore cleaner air in the downtown area.

The other type of bus that could be invested in is the natural gas bus. These buses are already available in the Tri-Met fleet, and are far cleaner (in terms of emissions) than diesel buses. The key problem in terms of vehicle emissions is carbon monoxide[14], and these natural gas buses put out far less than standard diesel.

The system that the city has now is contributing to the fight air pollution that is waged every day by environmentally conscious Oregonians, but there are still

[14] http://www.tri-met.org/envtacts.htm

things that need to be done in order to improve the air quality. Team STT believes that we have found the best all around idea to help solve the problem. There is no single solution, such as building more MAX lines, or offering more bus routes that will make the situation significantly better. While those ideas will help the people that are living in the area accessible to the buses and MAX, many commuter still need to drive; if the are going to be driving, why should they not drive cars that are cleaner and run more efficiently? That is why we have decided to invest money into research on electric cars, cleaner buses, and a more efficient MAX system.