

A Comprehensive Analysis of the Potential for Increased Student SEPTA Ridership and its Effect on Villanova CO₂ Emissions

By

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Abstract

Much of Villanova's emissions are a result of students' daily commute to the university. Public transportation, such as the local SEPTA transit, can displace these emissions by reducing the number of vehicles on the road each day. In this study, we assessed the benefits of decreasing the number of students commuting on a daily basis in terms of cost as well as emissions reduction. In a survey distributed to a wide base of Villanova students through social networking and email, we determined the percentage of commuter students that drive and how far these students travel to estimate the emissions generated by this group of students. A thorough analysis of SEPTA's published emissions summary for trains, buses, and trolleys gave us a detailed report of how much emissions could be reduced by promoting public transportation through a student discount. We also analyzed the cost-effectiveness of using this student discount as opposed to paying for gas and parking passes. Based on the results of our survey, we determined that 87% of commuter students would be more likely to use SEPTA if offered a discount. This increased ridership would reduce CO₂ emissions by over 400 metric tons. We also determined that the SEPTA pass, even with the discount, would cost students at least \$45 more than commuting by car, parking pass and gas included. With this information, it can be concluded that although it might be difficult to achieve higher ridership with the higher cost, it would definitely reduce regional carbon dioxide emissions by a significant margin as a result of decreased single occupancy vehicles and decreased traffic.

Introduction

The onset of global climate change recently sparked a multitude of actions across the world to combat the causes of the warming effect. Countries are working to decrease emissions from factories, homes, vehicles, and various other sources in order to lower the amount of gases in the atmosphere. Vehicle emissions are something every individual can work towards mitigating, which can make a real difference in improving the environment and worldwide air quality. One way to decrease the amount of vehicle emissions that are individually produced is to utilize public transportation. Public transportation is provided in most countries and is usually accessible and relatively cheap. However, many people, particularly in the U.S., don't use public transportation for reasons such as convenience and independence. This is a primary contributor to why the U.S. is a worldwide leader in emissions production.

Another reason some may not use public transportation is that they don't understand how beneficial it really can be. However, when public transportation emissions are compared to individual vehicles, the numbers suggest a stark contrast between the two. Shapiro (2002) conducted detailed analysis comparing individual vehicle and public transportation emissions per person, taking into account different types of vehicle as well as types of public transportation. His results are clear and produce staggering evidence that advocates for the implementation and use of public transportation across the nation. For example, for every passenger mile traveled by Americans, public transportation produces only five percent as much carbon monoxide and little more than half as much carbon dioxide. (Shapiro 2002)

Shapiro goes on to describe how using public transportation reduces emissions in terms of various industry use. He calculates how much emissions are saved by current use of public transportation, instead of individual vehicles, and compares it to major industrial emissions. For

example, he compares emission savings of public transportation to emissions produced by chemical manufacturing, gas and oil production, and other major industries. A notable comparison is that the carbon monoxide emissions saved by public transportation are equal to 60% greater than CO emissions of all electric utilities, more than 75% of all chemical manufacturing CO emissions, and 30 times oil and gas production CO emissions (Shapiro 2002). Further, Shapiro states that in 1999, the cut in NO_x emissions due to use of public transportation equaled one-third of the NO_x created by metals processing industry or all of the gas and oil production (Shapiro 2002).

Clearly, there are environmental benefits to utilizing public transportation and decreasing the amount of individual vehicles on the road, but the issue that remains is whether the masses will make the change. Shapiro investigates this as well, and comes to more convincing conclusions. Shapiro compares American use of public transportation to Canada's and Europe's, which have substantially higher usage than the United States. Canada uses public transportation seven times as much as Americans, and for the Europeans it's 10 times (Shapiro 2002). There are definitely demographic and geographic factors that contribute to those numbers, however this comparison is useful in order to display how much the U.S. can change. In fact, if we used public transportation as much as the Canadian citizens, we would reduce VOC pollution at an equivalent amount to 60% of all four major industries combined (chemical manufacturing, oil and gas production, metals processing, and industrial use of coal)(Shapiro 2002). We would decrease NO_x pollution one-fourth the combined industry total and CO emissions nearly double the combined industry total (Shapiro 2002). If we matched Europe the numbers would increase to 84%, one-third, and three times as much as the combined industry total, respectively. To put those numbers in perspective of global warming, if we utilized public transportation as much as

Europeans, it would equal 20% the reductions the Kyoto agreement implemented (Shapiro 2002).

It is proven that public transportation is better for the environment than individual vehicles, and that widespread use of trains and buses is possible. The next important thing to do is to facilitate the widespread change needed to make public transportation more popular.

Charlotte, N.C. is a great example of a place that did that. In 2007, the city began building a 9.6 mile light-rail from the south end to uptown, expecting moderate usage (Voorhees, 2010). What happened was an unexpected and huge ridership demand. In fact, the city now has to go back and make the rail bigger to accommodate more people. The interesting thing about this story is that the ridership doubled what was federally projected, and more interestingly, 70% of the riders were previously not regular users of the city's public transportation (Voorhees, 2010). This is a staggering fact and goes to show the untapped desire to utilize public transit, particularly rail, all across the nation.

When looking at Philadelphia's public transportation system specifically, it is easy to see that it is vast and highly utilized. However, like Charlotte, there could be an untapped reserve of potential riders. Perhaps some are unaware of the service, confused by it, or maybe discouraged by the price. Philadelphia's transit system is the Southeastern Pennsylvania Transportation Authority (SEPTA) and uses a large network of rail and bus that extends all the way out to the suburbs. The prices vary depending on where you are headed, and SEPTA offers various types of passes to account for different types of riders. One type of SEPTA rider is the college student. There are numerous universities and colleges within SEPTA's network, and some have worked out deals to get their students discounted passes. For example, Temple and the University of Pennsylvania offer these programs (Penn Transit Services).

Villanova University sits in the suburbs of the city, between two SEPTA rail stops and crisscrossed with SEPTA bus routes. Villanova enrolls thousands of students, of which many live off campus and commute. The amount of Villanova students that currently use public transportation to get to class is unknown, however it is easy to see that the parking lots are full by mid-day. If Villanova make an agreement with SEPTA similar to other local schools, it could change its daily commute, and perhaps more importantly, the everyday habits of its students that could persist beyond graduation. We hypothesize that student interest in a discounted SEPTA pass is high, and if Villanova University and SEPTA agree to a discounted rate for Villanova students, student ridership will drastically increase and because of this, the Universities' emission totals will decrease.

Methods

The first step of the experimental procedure involved evaluating the potential student interest in discounted rates for the SEPTA public transportation system to determine the viability of Villanova University's participation in the proposed program. A survey was created to gauge student response, and consisted of the following questions:

1. How many miles do you live from campus? (*open ended*)
2. Does the price of SEPTA discourage you from taking it? (*y/n*)
3. If SEPTA (bus or train) offered a discounted semester pass, would you be more inclined to take it? (*y/n*)
4. If buying the SEPTA (bus or train) semester pass got you a discounted student parking pass, would you buy it? (*y/n*)
5. How often do you travel with SEPTA (bus or train) per month? (*open ended*)

These surveys were electronically distributed through Facebook and paper copies were issued to Villanova students and faculty. Approximately a month after distribution, the survey responses were compiled and recorded.

The average emissions of each Villanova commuter were calculated by multiplying the average distance driven (as determined by the survey results) by the average estimated emissions of an American, single-occupancy vehicle:

$$6.92 \text{ miles} \times 0.96 \text{ lbs of carbon} = 6.64 \text{ lbs of CO}_2 \text{ emitted daily per commuting student.}$$

These data were compared to the total distance travelled by the commuting students to calculate the potential reduction of carbon emissions if students were to elect public transportation as the preferred method of commute:

$$2,175 \text{ commuting students} \times 498 \text{ lbs of CO}_2 \text{ emissions per semester} = 830.03 \text{ metric tons of CO}_2 \text{ emissions/semester.}$$

We then analyzed the economic practicality of the discount program for SEPTA. Student interest was evaluated to determine whether it would be economically beneficial for SEPTA if they were to collaborate with Villanova University to establish a discounted student rate. We compared the student rates SEPTA currently offers to other universities in the area to estimate a potential discount for Villanova students.

Student costs were then estimated and reviewed to determine if the discounted SEPTA pass would be economically beneficial from a student's perspective. The cost of vehicular transportation to campus (which included expenses from the Villanova Parking Permit, gas prices, and typical car maintenance) was compared to the cost of the discounted SEPTA pass.

Using all of the gathered information, a final analysis was conducted to evaluate the environmental impacts of the SEPTA pass for Villanova. We compared the current and potential carbon emissions contributed by commuting students to the university's primary sources of carbon emissions to determine the feasibility of this program as a method for Villanova University to reduce campus emissions and achieve the CAP goals.

Results

The distributed survey indicated that Villanova off-campus students live an average of 3.46 miles from campus, ranging from 0.24 miles to 15.64 miles. 58% of all students and 74% of commuting students surveyed believed that the price for a normal septa pass was too expensive to buy. On average, 87% of students polled wanted to participate in the SEPTA discount program, and 90% of these students desired discounted parking. On average, students travel on Septa public transportation 4.45 days out of a month, ranging from 0 to 30.

Does the price of SEPTA discourage you from taking it?

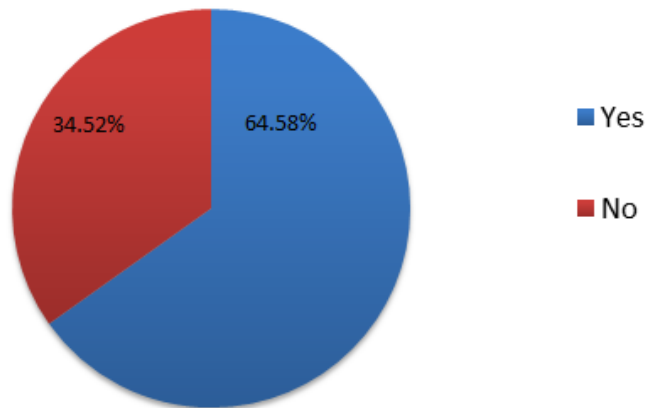


Figure 1. The division of students who are discouraged to take public transportation as a result of the price.

The average student drives a single occupancy vehicle 6.92 miles daily in commute to and from Villanova University. As the average single occupancy vehicle emits 0.96 lbs of carbon for each mile driven, according to the Department of Transportation, the average carbon dioxide emission per student was calculated with the following formula: The emission of carbon dioxide for the average student was approximately 498 lbs of carbon dioxide per semester. This information was used to calculate the potential reduction in carbon dioxide emissions with the participation of Villanova University in the SEPTA Discount. There are 8,532 students enrolled in Villanova University, 1/3 of which are considered commuters. Thus, it is determined that with 2,175 commuters emitting an average of 498 lbs of carbon per semester, the total carbon dioxide emission contributed by students commuting to school is approximately 1,083,227 lbs per semester, or 830.03 metric tons.

Discussion

Survey results indicate that approximately 87% of commuting students would be inclined to purchase a SEPTA discount pass. If 87% of students relied on septa for their daily commute to Villanova, a possible 433.6 lbs of carbon dioxide emissions could be eliminated per average student each semester. The aforementioned figures were utilized to calculate the potential reduction in carbon dioxide emissions if the maximum of 87% of the commuters all switched to public transportation provided by SEPTA or daily commute. Students using trains instead of their personal vehicles would eliminate 942,216 lbs or 427.3 metric tons of carbon emissions per semester.

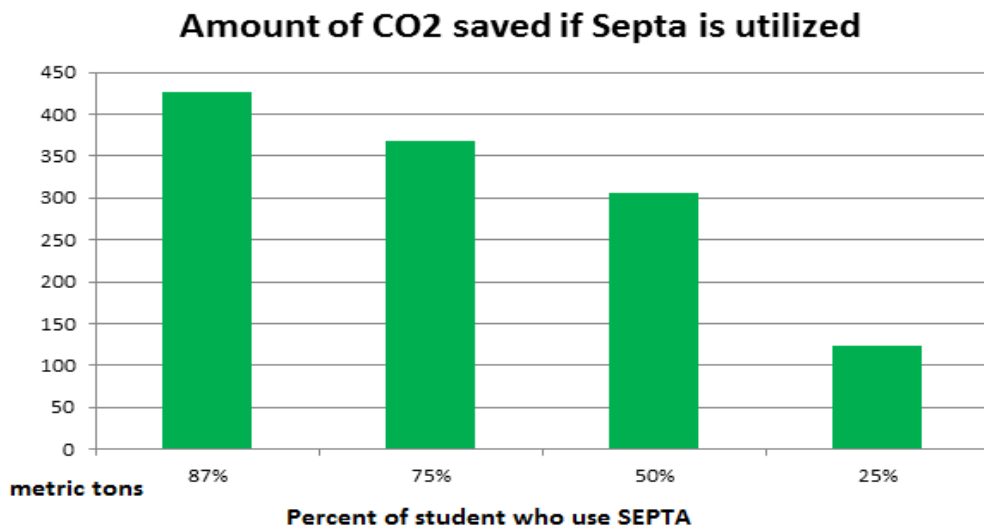


Figure 2 depicts the reduction in amount of CO₂ emissions (metric tons) over the possible percentage of commuting students to use SEPTA transportation for daily commute to Villanova per semester. If 87% commuted with Septa, 427.3mt of CO₂ would be eliminated, 75% would yield a 368.4mt reduction, 50% would yield a 306.6mt reduction, and 25% would yield 122.8mt reduction.

Cost analysis determined that with the average city MPG of an average North American Car being 21 mpg, the average cost of gas per gallon in PA amounting to \$3.69, and student parking permits costing The typical 10% discount offered to colleges off the \$75/month SEPTA pass would cost Villanova students \$270 per semester. The potentially larger discount of 25% would cost students \$225. The 25% discount would cost students \$45 dollars more per semester than driving and purchasing a parking pass.

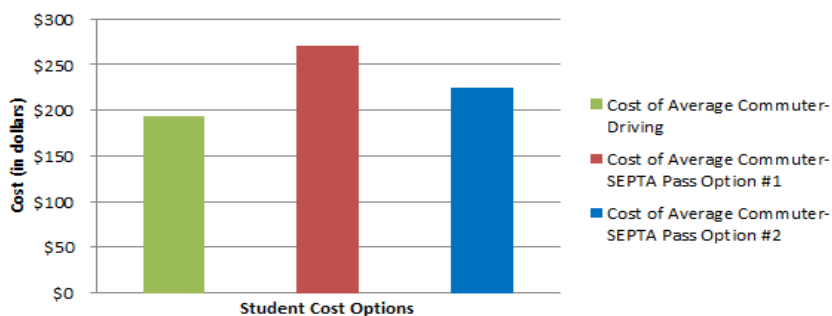


Figure 3 compares the cost (in dollars) per semester of commuting by personal vehicle (\$180), commuting with SEPTA using the 10% discount (\$270), and commuting with SEPTA using the desired 25% discount (\$225).

Although commuters are not calculated into Villanova University’s CAP, they still contribute to overall CO₂ emissions and should be taken into account when determining ways to reduce Villanova’s carbon footprint. One-third of the students that attend Villanova University commute daily. This does not take into account all of the faculty and staff that also commute daily. By offering a way for students and faculty to travel to and from Villanova at a discounted price could significantly reduce overall emissions.

Emission Source	Current Emissions (MTCDE and Percentage)	Potential Emissions (MTCDE and Percentage)
Purchased Electricity	40778 (48%)	40778 (49%)
On-Campus Stationary	17300 (20%)	17300 (21%)
Campus Fleet	761 (1%)	761 (1%)
Fugitive Emissions	83 (0%)	83 (0%)
Agriculture Sources	8 (0%)	8 (0%)
Inst. Sponsored Air Travel	8903 (11%)	8903 (11%)
Commuting	17082 (20%)	16227 (18%)

Table 1. Annual Villanova Emissions Compared to Potential Emissions With SEPTA Discount

Table 1 describes the current division of emission sources that contribute to Villanova University’s total annual carbon emissions of 84,915 Metric Tons Carbon Dioxide Equivalents. Because Villanova’s CAP currently does not include student commute in calculated commuting emission totals, the previously calculated student commute emissions were added to faculty/staff commute, yielding 17,082 mtcde which contributes 20% of Villanova University’s total carbon dioxide emissions. The emissions to be eliminated with the use of public transportation with 87%

of commuting students were subtracted from the aforementioned figure, reducing total university commuting emissions to 16,227 mtcd and about 18% of the total emission contribution.

The possible emissions saving options represented in the survey presented a more environmentally sustainable solution to commuting. By offering students and faculty a discounted SEPTA pass, it will encourage them to commute daily by train or bus rather than individual cars. Since the train and bus is making the commute regardless, it will utilize the unavoidable emissions being released instead of adding to them.

However, the ideas presented may not be as cost efficient to the student as originally thought. Because a parking pass is so inexpensive, students would be paying only \$180 by driving which includes the \$100 dollar parking pass, and the cost of gas. By purchasing a SEPTA pass at a 10% discounted rate, which is the rate that inner-city Philadelphia schools are given, students would be paying \$270 per semester. However, because Villanova is not an inner city school, and travelers would be using SEPTA's services much less than student's at an inner-city school, a larger discount is may be possible. With a 25% discount on the monthly pass, students would pay \$225 per semester, which is only \$45 extra per semester.

A possible alternative to semester pass is a discount for possessing a student ID. This would encourage students to ride SEPTA more often because it would not require them to purchase a pass at all, and would encourage them to ride the train or bus to more destinations because they know they will be discounted.

In addition to the discounted SEPTA pass, it would also make sense to offer a discounted parking pass. Although it seems counterintuitive to offer a discounted parking pass to encourage students to reduce their driving, it mostly likely will work. The only way that students would be

eligible for this discounted parking pass is if they already have purchased the SEPTA pass. Most students bring a car to Villanova regardless if they commute or not. If students and faculty had to pay for a SEPTA pass as well as a full priced parking pass, they will be less inclined to purchase the SEPTA pass. This way, students are not forced to forsake their cars in order to have the SEPTA pass. With the possibility of the current parking pass increasing in price, this is a very convenient option to be able to have. It may end up saving students and faculty a significant amount of money.

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