USING TRAFFIC IMPACT FEES TO FUND ALTERNATIVE TRANSPORTATION PROJECTS AND IMPACT MODAL CHOICE IN URBAN AREAS

by

Mark J. Magalotti P.E.

BS, University of Pittsburgh, 1976

MS, University of Pittsburgh, 1981

Submitted to the Graduate Faculty of

Swanson School of Engineering in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2013

UNIVERSITY OF PITTSBURGH

SWANSON SCHOOL OF ENGINEERING

This dissertation was presented

by

Mark J. Magalotti P.E.

It was defended on November 14, 2013

And approved by

Radisav Vidic, Ph.D., Professor and Chair
Department of Civil and Environmental Engineering

Vikas Khanna, Ph.D., Assistant Professor
Department of Civil and Environmental Engineering

Sabina Deitrick, Ph.D.,
Associate Professor Graduate School of Public and International Affairs

Martin Pietrucha, Ph.D.,
Professor of Civil Engineering Department of Civil and Environmental Engineering
Pennsylvania State University

Dissertation Director: Leonard Casson, Ph.D., Associate Professor
Department of Civil and Environmental Engineering

USING TRAFFIC IMPACT FEES TO FUND ALTERNATIVE TRANSPORTATION PROJECTS AND IMPACT MODAL CHOICE IN URBAN AREAS

Mark J. Magalotti, Ph.D.

University of Pittsburgh, 2013

The purpose of this research was to determine if focusing traffic impact fees on alternative mode capital improvement projects would this result in the enhancement of the transit, bicycle and pedestrian systems in an urban area. Alternative mode transportation projects are defined as improvements to the transit, pedestrian and bicycle facilities in a transportation network.

Based upon a review of the literature, there have been relatively few attempts to use traffic impacts fees to fund alternative transportation mode projects. Traffic impact fees have traditionally been used to fund capacity adding transportation projects to mitigate the impact of growth.

The research involved development of a limited contact base of government agencies that have used impact fees to fund alternative transportation projects. This contact base and interviews with experts in this field, gave a perspective of the limited use of these fees currently.

A national survey of transportation planners and engineers, who work with government agencies and administer traffic impact fees, was also conducted. One purpose of this survey was to further determine if impact fees are used to fund alternative mode projects and how they are implemented. This survey identified alternative mode enhancements, such as pedestrian and transit facilities that are funded by impact fees and the methods of project selection and measuring effectiveness.

A transportation planning model developed for the City of Pittsburgh, Pennsylvania was used to test the effectiveness of alternative mode projects enhancements in an urban transportation network. The model evaluated a significant long-range program of transportation alternative mode enhancements. Measures of effectiveness that were outputs of the model (e.g., average travel speeds, congested links and number of transit trips), were compared in the future no-build and build conditions to determine the impacts on the transportation network.

The model results revealed some positive and negative impacts on future travel conditions due to implementation of these alternative mode projects. The results included a positive impact on the roadway system performance by projecting a 7% reduction in total distance traveled in the roadway network. A negative impact, which was an increase in average travel distance, was also a result.

Potential revenues from the impact fee were estimated based upon the long-range projected growth in the City of Pittsburgh. The projected revenues were compared to the cost of the alternative mode projects to determine the financial feasibility of using impact fees for this purpose.

The results of this work revealed a limited positive impact in overall congestion measures in the City of Pittsburgh, maintenance of expected travel characteristics and a minimum revenue realization compared to transportation project costs. However, employing impact fees as a revenue source for alternative mode enhancements is worth exploring further. One consideration for further research would be concentrating their use in a specific urban neighborhood or corridor which may result in more focused results relative to convincing travelers to shift modes or generally enhancing the transportation travel characteristics of an urban area.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

I would like to acknowledge my wife Roni for her continued support of my academic career. After a pause of over 30 years in my academic career, I renewed my effort to complete my research. Without her support in both my personal, academic and professional aspects of my life, I could not have achieved the goals that I set.

1.0 INTRODUCTION

The purpose of this research was to determine if focusing traffic impact fees on alternative mode capital improvement projects would this result in the enhancement of the transit, bicycle and pedestrian systems in an urban area. The research also determined if this enhancement of travel choices would be significant enough to influence travel patterns for mode shifts. In addition, the research evaluated if these mode shifts would provide a significant benefit to travel conditions. Benefits would include reduced traffic congestion, increased transit utilization and decreased travel times.

Based upon a review of the literature there have been relatively few attempts to use traffic impacts fees to fund alternative transportation mode projects. Fees are not currently being charged to assist with transit or other mode enhancement projects in any significant manner. Although traffic impact fees are a relatively small mechanism of how transportation improvements are funded, these fees are based upon the expected direct impact of new or significantly altered land developments on a transportation system. Therefore, the use of traffic impact fees to fund transportation projects, to accommodate growth and reduce congestion is more focused in an urban area. Traffic impact fees are similar to a vehicle miles traveled (VMT) tax than the current gas tax that is used to fund transportation on both a federal and state level.

The literature review also revealed that there does not seem to be any significant body of work on implementing traffic impact fees to promote or measure multi-modal transportation

usage. Increased multi-modal use provides a transportation system that is more sustainable due to reduced fuel consumption and emissions.

To evaluate these research questions several steps were taken. The work began with development of an initial contact base of government agencies that have used impact fees on a limited basis to fund alternative transportation projects. This contact base and interviews with the appropriate contact person gave a perspective of the limited use of these fees and how a broad survey of government agency representatives, who have experience in using traffic impact fees, might answer these questions. The broader survey information was employed to help formulate an approach to evaluate using the impact fees to fund alternative mode transportation projects. The second part of the research used a predictive transportation planning model to evaluate an urban area potentially using traffic impact fees to predict the effect of the fees on local travel characteristics. The final step of the research compared these two approaches and formulated a conclusion as to the benefits and feasibility of such an approach.

This chapter provides an introduction to the topic, a description of the relationship of impact fees to land development, a list of urban travel characteristics that will be used as evaluation measures and the relationship of this method of transportation funding to future trends in federal and state funding.

1.1 LAND DEVELOPMENT IMPACTS AND TRANSPORTATION FUNDING

Transportation funding that is used to add roadway capacity in urban areas has traditionally been created through the use of fuel taxes on both a federal and state level. As land development occurs within an urban or suburban area, additional fuel taxes are generated through increased

fuel consumption. However, there is no direct relationship between the revenues collected and the land development that creates the need for additional highway capacity. As the transportation infrastructure ages, more of the current fuel tax revenues are devoted to maintenance and replacement of infrastructure rather than the expansion of the existing traffic capacity. Ultimately, if traffic capacity expansion is not addressed, congestion will increase and system performance will be diminished.

Traffic impact fees are used by many states for transportation funding because they recognize the need for additional highway capacity due to increased land development activity. This has resulted in the use of traffic impact fees applied to land developments to directly fund needed highway capacity expansion. This method of funding is well established in the United States and has been used primarily in suburban areas to increase local roadway capacity.

1.2 URBAN TRAVEL CHARACTERISTICS

Providing the necessary elements for the urban transportation system, as compared to those needed for suburban or rural travel, presents different transportation planning and funding challenges. Because suburban and rural travel is primarily via the auto mode, highway capacity needs are directly related to the growth and projected traffic demands created by land development. In urban areas, demand is created for all modes of travel by land development. This includes auto, transit, bicycle and pedestrian modes.

As urban areas in many older cities undergo redevelopment, resulting in increased travel demands, the impact on the transportation system must be examined. While many older urban

areas had substantial transit and pedestrian networks at one time, many of these have deteriorated or been eliminated. This deterioration was created through reduced funding for public transit, limited land area for highway expansion and diminished resources for transportation funding. As land development activity increases in urban areas, the need for increasing capacity for all modes must be examined to maintain or improve system performance. Older cities have little opportunity to expand highway capacity due to limited rights of ways and building developments directly adjacent to streets and highways.

To accommodate this urban growth, more emphasis must be placed on increasing the capacity of alternative mode systems, such as public transit, bicycles and pedestrians. If alternative mode travel is enhanced, then mode shifts may occur from auto to alternative modes and highway congestion could be reduced. As is the recent trend for any mode of transportation, funding of alternative modes has also become limited. This limitation, and the need to encourage modal shifts to accommodate land development without increasing roadway congestion, leads to the principal of using traffic impact fees to fund alternative mode enhancement transportation projects.

1.3 THE FUTURE OF TRANSPORTATION FUNDING

The future of transportation funding was very much in flux at the time of this research. The traditional method of funding transportation through fuel taxes will not remain a viable source into the future. Because of increased vehicle fuel efficiency, fuel consumption has decreased significantly. Also the need to dedicate additional funds for maintenance of current transportation infrastructure has led to a decrease in funding of projects that reduce traffic

congestion. This decrease in revenue has led to reduced transportation project funding on both the federal and state levels. The two most recent United States federal reauthorizations for transportation funding, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2005 and the Moving Ahead for Progress in the 21st Century Act (MAP-21) enacted in 2012 both recognized this shortfall. Limited consideration was given in the funding reauthorizations to alternative funding methods, such as the tolling of interstate highways or vehicle miles traveled tax. However, but both acts have failed to address the long-term impact of these decreasing revenues. This failure of the federal legislation to address long term needs resulted in funding levels have remained stagnant while infrastructure needs and construction costs have increased. The background review and research conducted and presented in the next two chapters examined the use of traffic impact fees to fund alternative mode transportation project and supplement current transportation funding. The use of traffic impact fees to fund alternative mode projects in urban areas as this alternative method was the subject of this research.

2.0 BACKGROUND RESEARCH

This background research was conducted to determine what research had been done related to the use of traffic impact fees to fund alternative modes of transport in urban areas and to determine what the current state of the practice was. Subjects researched included policy and enabling legislation for traffic impact fees, legal precedents for the use of traffic impacts fees, current use of traffic impact fees and alternative methods for funding transportation. This information was then used to formulate a hypothesis for testing the use of impact fees in urban areas to fund alternative mode transportation projects.

2.1 INTRODUCTION

Many states impose traffic impact fees on new land developments to pay for the transportation capacity that is needed to permit the development of greenfield sites. Greenfield sites are undeveloped properties that have no current land use that generates significant volumes of traffic. Typically they may have uses such as agriculture or forest. Redeveloped properties that generate additional traffic such as greyfield or brownfield sites may also have traffic impact fees imposed upon them. This type of urban land redevelopment can result in a significant net increase in new trips added to the highway system. This may result in a smaller impact fee

charged to a redevelopment project because reduced net trip generation is expected. Impact fees are assessed only on the net increase in trips.

Developers that construct land development projects in urban areas, whether in green fields or a redevelopment, have few opportunities to add capacity to the highway system to mitigate their traffic impact. This is because widening highways is often constrained by physical features such as buildings, pubic infrastructure and topographical features.

The purpose of this research was to evaluate a potential change in the commonly used traffic impact fee structure for a different purpose. This change would involve using traffic impact fees to fund alternative mode transportation project to mitigate traffic impacts of new land development. A secondary benefit of this use of traffic impact funds is that it may create a fee structure that encourages redevelopment of existing properties, which, in turn, promotes land development sustainability. Because impact fees are paid on the basis of the net increase in trips generated by a particular greenfield or redevelopment land development, redevelopment projects would pay a lesser fee, thus encouraging more reuse of grayfield or brownfield sites because of the credits given for existing trips being generated on the site.

There are many definitions of sustainability relative to transportation. For purposes of this research, sustainability was generally defined as reducing fuel consumption, reducing emissions from vehicles by encouraging fewer miles driven by single occupancy vehicles and higher utilization of alternative modes such as transit, bicycles and walking. A review of all of the recent research in this topic area did not indicate any information on using traffic impact fees for alternative modes to promote sustainability. However, there is an obvious benefit of using impact fees in this manner. In addition, the measurement of these transportation benefits, such as

reduced traffic congestion and increased alternative mode utilization, can easily be quantified by many of the transportation planning techniques used to evaluate traffic impact fees.

The primary purpose of this new use of the traffic impact fee would be to provide funding for alternative modes such as transit, bicycles and pedestrians and to increase transportation capacity for alternative modes. The focus of research was in urban areas where opportunities for added highway capacity are limited, but transit and other alternative modes could use additional funding to improve their equipment, facilities, or operations to influence mode choice by travelers. A transportation planning predictive model was used to evaluate the potential success of the funding and constructing of alternate mode enhancements using traffic impact fees. The measure of this success was to determine if the available funding resources would have a significant impact on transportation conditions in an urban environment.

2.2 RESEARCH APPROACH

The use of traffic impact fees for the funding of transportation projects has been a tool used by state and local governments since the 1980s. Impact fee revenues in Pennsylvania and other states have focused on increasing highway capacity to meet the demand of the traffic generated because of new land development. Much of the impact fee usage has been concentrated in high growth suburban communities. Because of the increasing price of fuel and other factors, many urban areas are now seeing a shift of development and population from suburban and rural areas to urban areas. Urban areas provide more transit and other mode options for travel for new trip

generators such as housing, institutional and commercial development. Many of the new trip generators are projects that involve reuse of properties that supports sustainable development goals. The approach developed for this research was to:

- Examine the current use of impact fees and evaluate the success of limited use of traffic impact fees for such purposes;
- Identify urban areas that currently use traffic impact fees for this purpose and examine their policies, goals and evaluation criteria for funding alternative mode projects.
- Conduct a survey of transportation planning professionals to determine the attitudes and feasibility of using such fees for these purposes;
- Test the idea to fund alternative mode projects in urban area using traffic impact fees by using a travel demand model to forecast if using impact fees at traditional funding levels for alternative mode projects would have a significant impact on travel conditions in an urban environment.

The testing of the proposal to use traffic impact fees in this manner was accomplished by several methods. The most conclusive evidence searched for studies that measured the actual impacts of implementing alternative mode projects by evaluating their impact on the transportation system. However the literature review revealed that very few cities have used impact fees in this manner and the degree of implementation has not been significant when used. There were no known studies of measuring the actual modal shift in a major urban area. For this research another method was devised to test the hypothesis.

A second method developed was to test this hypothesis, was the use of a transportation planning model that predicts future travel behavior based upon a hypothetical future set of

alternative mode improvements in an urban area and predicts their impact on transportation conditions. The use of transportation planning models is a well established predictive tool accepted by transportation planners. This tool replicates travel behavior on an aggregate level, based upon numerous variables that are calibrated to simulate travel in a particular geographic area to reflect that area's demographic conditions. Because every travel demand model is designed to replicate a particular urban condition, and it is an empirical relationship type model, use of a hypothetical urban area would not be a desirable choice. Use of a model for a specific urban area was needed.

Travel demand models include elements that estimate the number of trips generated in the entire area, distribute those trips between origin and destination zones, estimate the number of trips made by the different modes available, and assign those trips to the various modal networks. Estimating the travelers' mode choice is only one step in the process. While travel demand models do include algorithms that were developed to predict mode choice they are ultimately calibrated based on local conditions. The logit model is an example of a mode choice model that predicts the choice of travel mode based upon the utility of a mode. The logit model expresses the probability of selecting a mode as;

$$U_c = \sum_{i=1}^{n} a_i X_i$$

Where:

$U_{c=Utliity\ of\ Mode\ X}$

$n = number\ of\ attributes$

$X_{i=Atrribute\ value\ (time,cost\ and\ so\ forth)}$

$a_{i=Coefficent\ value\ of\ attributes\ i\ (\ negative,since\ the\ value\ are\ disutilities)}$

While this type of mode split model could be used to predict mode choices in very simplified situations, it would not provide the ultimate measures of performance needed to determine the impact on a transportation system of travelers shifting their choice of mode from single occupant automobiles to transit, bicycle, or pedestrian modes.

Ideally several major urban areas that represent varying degrees of alternative mode choices, types of transportation networks and demographics would be desirable to test the hypothesis. However, testing the hypothesis in one urban area that currently has many mode choices for travelers would provide valuable insight into the potential success of this funding method. For this reason the hypothesis was tested by both the survey results and the City of Pittsburgh transportation planning model.

The City of Pittsburgh model, which included all land area within the city limits, was selected because it represents an urban area with an extensive multi-modal transit system that includes light rail, on-street buses and dedicated busways. Two high occupancy vehicles (HOV)

facilities also serve the city. This wide variety of transit options was important to test the hypothesis. In addition, the city has an extensive network of sidewalks and other pedestrian features along with numerous biking routes available for commuters.

Based upon the options available, testing of the hypothesis using the survey and the City of Pittsburgh travel demand model was selected.

2.3 LITERATURE REVIEW

A literature review was conducted to obtain information on the current state of the practice of using impact fees to fund alternative mode transportation projects in urban areas and how these practices influence land use planning. The identification of these sources included use of the Transportation Research Board (TRB) Transportation Research Information Services (TRIS). This research database includes published research as well as research in progress. In addition, many relevant research publications were identified through the survey and contacts of urban area transportation planners.

The use traffic impact fees for the funding of transportation projects has been in practice since the 1980s. States and local governments that were experiencing substantial growth in the 1980s due to expansion of housing, jobs and industry had difficulty funding the needed expansion of highway systems to accommodate this growth. This need for an alternative funding sources lead to the idea of funding transportation highway expansion directly by land developments that create localized traffic impacts. This method of funding became popular because it did not require the use of state or federal transportation funding sources.

Sussna[1] discussed the legal precedents that were established in 1990s confirming the right for states and local governments to charge impact fees to fund capital improvements for transportation infrastructure. Sussna[2] concluded that impact fees can only provide a small portion of the needed revenues to improve infrastructure. There was no mention of impact fees relative to promoting alternative transportation modes in Sussna[3]'s work. This is a relatively new concept.

2.3.1 Impact Fees and Land Use Planning

Lari[4] identified 27 states; including Pennsylvania, that currently have legislation that permits traffic impact fees to be charged. Based upon the court precedents, identified by Sussna[5], all of these states have some type of land use evaluation required, in order to charge impact fees. This link of a traffic impact fees to land use plans is made to ensure that the fees charged can accommodate all of the potential uses permitted by the land use regulations and fund a program to accommodate all future projected traffic volume increases. If a fee amount had no basis, the courts determined that it was arbitrary and the taxing body did not have a rational method of determining the fee structure. The fee charged has to be determined by the cost of constructing the necessary highway improvements to accommodate all future development permitted by the land use regulations.

---

[1] Sussna

[2] Sussna

[3] Sussna

[4] Lari

[5] Sussna

Lari also provides a perspective of how early impact fee programs attempted to control land use. However, even though impact fees are directly linked to land use changes, the fees charged are based on the maximum land density currently permitted by the local land use regulations. The regulations typically do not promote changes in land use patterns that may reduce the future impact on the highway system, through the fees charged. An example of this would be increasing density of housing near transit lines to promote more transit utilization thus reducing impact on the highways. However, there is an implied transportation system benefit feature to impact fees. For example, if a green field site is developed it will pay a higher fee than redevelopment of a site with an existing use. This would represent the maximum impact on the transportation system from that particular land area. However, in an urban area replacing one land use with an alternative land use, which may generate less traffic volumes, would both be an economic benefit in an urban area and not result in the maximum impact on the transportation system.

The Association of Metropolitan Planning Organizations (AMPO) was contacted for information on the use of traffic impact fees to fund alternative mode transportation projects in urban areas. No research or published information was available from AMPO.

Based upon the author's personal experience, when future land use projections are used to estimate impacts on transportation capacity, local jurisdictions may consider changing the zoning to be more in line with what reasonable transportation improvements can be constructed.

2.3.2 Use of Impact Fees for Multi-Modal Projects

There were few examples identified in the research where impact fees are used to fund multi-modal projects. Hendricks[6] identified Hillsborough County, Florida as one local government that used impact fees to fund transit projects early on in the history of their use. Hendricks[7] also identified Broward County, Florida as having a separate impact fee used exclusively to fund transit projects. However, Hendricks concluded that past attempts to use impact fees to fund transit projects were not effective for bus transit projects.

In 2005 Florida created a law that permitted transportation concurrency exceptions areas. Previous to 2005 any county in Florida could impose traffic impact fees. To encourage development in urban areas cities were exempted from the law in 2005. This was done to encourage more urban infill development through reducing fees paid by developers. Theoretically, these urban infill developments would have less impact on the transportation system due to its close proximity to public transit and work destinations. While not using impact fees to fund transit, this law encourages more urban development that should result in less impact on the transportation infrastructure. Collins[8] provides information on the expected outcomes of this law on future land use patterns and traditional level of service evaluations of traffic impacts, respectively.

---

[6] Hendricks

[7] Hendricks

[8] Collins

The U.S. Government Accounting Office (GAO)[9] published a review on value capture strategies that have been used by states to encourage transit oriented development. The GAO report concluded that many different strategies, including traffic impact fees, have been used by local governments and transit agencies to fund joint transit developments. One negative aspect of using impact fees, identified by the GAO, was the variable nature of when the fees are collected. The amounts of the fees that are collected are highly dependent upon the state of the economy and land development. The report also identified Sacramento County, California as a local government that is planning to dedicate a portion of the traffic impact fees they charge to fund bus rapid transit projects.

2.3.3 Relationship of Impact Fees to Overall Transportation Funding

Much of the literature reviewed related to the debate, at the time of this research, about how to replace gas tax revenues with a vehicle miles travel (VMT) tax or fee. This is relevant to this research topic because many of the evaluations of a VMT fees also consider the funding of alternate modes and impacts on land use patterns. Guo[10] details the results of a pilot study done in Oregon for a road user or VMT fee. A portion of the study evaluated how the VMT fee would impact travel patterns and change travelers travel choices to encourage more alternative mode

[9] Gao Report

[10] Guo

trips. The study concluded that when charged a higher rate for VMT during peak congestion hours, travelers in denser and mixed use neighborhoods did reduce their VMT by using alternative modes.

Another study of alternative transportation funding examined was the use of a transportation utility fee (TUF). A TUF is a method of funding transportation, used in Oregon, which requires users of the transportation system pay specifically for the maintenance of the system through a fee paid monthly. The fee is based upon the expected usage of the system by land use types such as a single family home. Seggerman[11] evaluated employing such a fee for the maintenance costs of transportation infrastructure in Oregon. This evaluation concluded that the public was not in favor of these fees even when they were shown the direct relationship between the maintenance needs and the miles traveled. The fee was based on the expected trip generation, trip lengths and destinations for each parcel in the study area

An interesting study by McMullin[12] evaluated the impact of a VMT tax replacing the gas tax which users, urban or rural, would pay a higher transportation costs. The interesting conclusion was that rural transportation users would actually pay lower costs with a VMT fee because their vehicles generally have a higher rate of fuel consumption.

[11] Seggerman

[12] McMillan

2.4 COMPARISON OF THE REASEARCH PURPOSE TO LITERATURE REVIEW

Appendix A provides a summary of the literature review. This information shows a comparison of the literature review and how it relates to the research process that was used. The state of Pennsylvania published a transportation impact fee handbook in 2009[13]. This handbook provided guidance to municipalities on how to implement traffic impact fees. The enabling legislation to establish and regulate traffic impact fee assessment and collection was enacted in 1990, and this handbook provides a detailed process for a municipality to follow if they choose to use impact fees. There was no discussion or provision in the law to permit the use of impact fees to fund alternative transportation projects.

The State of Florida is leading an effort to recognize the sustainability aspects of promoting more infill and urban development. By exempting impact fees in urban areas it is hoped that more trips will be made in these areas by alternative modes of transportation. This shift to transit, bikes or walking should result in fewer impacts on the highways system. However, this approach is eliminating impacts fees to encourage this type of development and is not creating a revenue source to pay for transportation projects that would encourage these alternative mode trips.

Although impact fees are a small portion of how transportation is funded, they are based upon the expected direct impact on a transportation system by a land development and are more like a VMT tax than the current gas tax that is used to fund transportation on both a federal and state level. Johnson[14] does provide some insight into the political and legal issues associated

[13] Transportation Impact Fees A Handbook for Pennsylvania's Municipalities

[14] Johnson

with using impact fees for transit improvements. Johnson[15] concludes that impact fees for transit are underutilized as a resource for capital improvements for transit infrastructure in the United States.

Based upon this review of the literature, there does not seem to be any significant body of work on implementing the use of traffic impact fees to fund alternative mode transportation projects. In addition, there is no research on how to measure the potential impact of using these fees to encourage multi-modal usage or promote land use that encourages urban infill development.

The literature research reaffirmed the conclusion that evaluating the theory of this funding type and its impact on urban travel characteristics has not been evaluated in a substantial manner. The following chapter presents the research methodology and results.

[15] Johnson

3.0 MATERIALS AND METHODS

The research approach began with making initial contacts of cities that have used impact fees to fund alternative model projects on a limited basis. Once these cities were identified interviews of government officials and agencies in those cities were conducted to obtain information on their experience. This was then followed by a broader survey of government agency representatives that do not specifically fund alternative modes with the fees but have experience with using impact fees for highway capacity adding projects. These interviews and the survey served as the basis of establishing the feasibility and testing of the hypothesis through attitudinal information.

The second method used to evaluate the feasibility of the concept in a major urban area was using a transportation planning model to test the hypothesis within the City of Pittsburgh, Pennsylvania. In summary major steps in the research process included:

- Establishing contacts with cities that have used impact fees on a limited basis for alternative mode project funding
- Phone interviews with those government agencies that were identified that use impact fees on a limited basis for alternative mode projects;
- A broad survey of government agency representatives that use impact fees for highway capacity adding projects to obtain attitudinal information on alternative mode funding;

- A Test of the hypothesis using a transportation planning model to predict travel characteristic changes with the funding of alternative mode projects in the City of Pittsburgh, Pennsylvania.

3.1 INTERVIEW OF GOVERNMENT AGENCIES WITH ALTERNATIVE MODE IMPACT FEES

The goal of this work was to develop a database of contacts and agencies that have experience with the topic and to obtain information on their use of these fees. The contacts were selected because they represented a cross section of states that permit impact fees to be used for alternative modes funding and to illustrate differences in the enabling legislation. Based on the results of these initial interviews the broader survey was developed. Two case studies were created, based on the interviews, detailing the results of the experience of using traffic impact fees for the funding of alternate mode projects. The interviews obtained information on other potential methods of funding transportation such as parking fees, congestion fees and tax increment financing to achieve the same goal of funding alternative mode projects.

3.1.1 Identification of Government Agencies

A list of state and local agencies that have either implemented impact fees or administer the law or policy on a statewide level and have used impact fees for alternative mode projects was developed through the literature research. The agencies included Hillsborough and Broward Counties in Florida, the City of San Francisco California and the City of Portland Oregon. Each

agency was contacted and the appropriate key person to interview was identified. The key person was then contacted and asked to review the broader draft survey. The four agency key persons were also interviewed to determine what the history had been of using impact fees in this manner, and whether there have been any studies of the long term impacts on modal behavior of travelers or land use changes. The following specific information was requested from each key person at the agency to conduct the research:

- Confirmation that impact fees are used for alternative transportation projects
- What specific method was used to develop the program?
- Does the enabling legislation specifically permit funding alternative transportation Projects?
- What types of alternative mode projects were funded with impact fees?
- Have studies been performed to determine the effectiveness of using the fees for this purpose?
- What measures of effectiveness were used?
- In addition to impact fees, are there other methods used to fund alternative mode projects?

Table 1 provides a summary of the results of the interviews.

Table 1 Contact Base and Interview Summary

Contact	Impact Fees are used for Alternative Transportation Projects	Specific Method Used to Develop Program	Legislation Permits funding alternative Transportation Projects	Type of Projects Funded with Fees	Used Studies to Determine Effectiveness	Measures of Effectiveness	Alternative Methods of Funding Used
Broward County Florida	Yes	No	Yes	bus stops, shelters, lighting, buses, sidewalks, ADA ramps, bike	No	None measured	None
Hillsborough County Florida	Yes	No	Yes	Bus pull off lanes, widening intersections that have high volumes of bus traffic	No	None measured	None
San Francisco Municipal Transportation Authority (SFMTA)	Yes	No	Unsure	Transit Headway Improvements, Service Expansions, Transit Reliability	Yes	transit travel time and transit crowding	Parking revenues and Sales tax
Portland Bureau of Transportation	Yes	No	Yes	intersection improvements, development of a light rail expansion, bikeways, sidewalks	No	None measured	Parking revenues

3.1.2 Revisions to Broader Survey

Based upon the interviews that were conducted, the following information was suggested to be included in the survey to be conducted of key agency representatives:

Additional types of alternative mode projects were added to the survey. This was based upon the experience of these agencies in using impact fees to fund these types of projects. The additional alternative mode project types included:

- Bus pull off areas
- Bus shelters
- ADA ramps

Two additional measures of effectiveness were suggested to be added to the survey by the City of San Francisco. This was suggested because the City of San Francisco used the following measures in their assessment of effectiveness:

- Transit crowding – measurement of number of transit users in a vehicle
- Transit travel times – travel times that may be impacted by a specific land development

These changes, as suggested, were incorporated into the broader survey prior to it being conducted. The survey results are discussed in more detail in the next section.

3.1.3 Case Studies

Two case studies were developed based on the interviews. These case studies were representative of the state of Florida, which has several counties that use impact fees to fund alternative mode projects, and the State of California which also permits use of these fees for alternative mode projects. The cast study for San Francisco was selected because it was the only identified urban area that charged an impact fee that was used exclusively for transit, an alternative mode transportation improvement.

3.1.3.1 Hillsborough County Florida Case Study

Because the State of Florida has been a pioneer in the use of traffic impact fees to fund transportation improvements since the 1980s it was selected for one of the case studies. Based upon Florida counties identified in the literature research, Hillsborough County was selected for the case study because of its rational approach to using these fees to fund transit. Hillsborough County is located outside of the City of Tampa it is a fast growing suburban county that is anticipated to benefit from transit improvements.

The Florida law that permits impact fees must follow a specific methodology to impose these fees. The counties must justify the amount traffic impact fees to be collected by creating a county wide transportation model and projecting future traffic conditions with land use changes in place. These future traffic conditions, which would create congested conditions, are then mitigated by a future selected program of traffic improvements. The cost of program of improvements is then paid for by the impact fees.

For most counties in Florida, these improvements have only been highway capacity adding projects. These would be projects such as widening existing highway or adding new highways to the system. These plans and models are updated every 5 years to reflect changing development rates and patterns.

In 1995 Hillsborough County revised its impact fee study and ordinance. The modification included provisions that permit funding of transit and alternative mode projects in addition to highway capacity projects.

The changes included a “Mass Transit Modal Split Adjustment” change to calculate trip generation which in turn calculates the required impact fee. The factor then adjusts the fees downward. This adjustment factor is permitted for developments that have provisions to

encourage utilization of public transit facilities and therefore reduce traffic impact on the highways. The use of traffic impact fees to support the local transit agency "The Hillsborough Area Regional Transit Authority" (HART) was also permitted by the changes.

To ensure that the fee being diverted to the public transit agency is used to reduce traffic congestion, a "Rational Nexus Restriction" was applied to the use of impact fees to fund transit projects. This restriction required that HART demonstrate that any use of impact fees for transit must provide a benefit to the highway system performance.

Based upon discussions with the contact at Hillsborough County, the fee reductions were also limited based upon the anticipated mode split in specific areas of the county. Only portions of the county that had a substantial amount of transit service qualified for the reduction. The portion of the fee collected that could be used for transit projects was also limited to the anticipated percentage of trips that would use public transit. This resulted in a restriction that only 1-3% of the fees could be used for public transit. The fees have been used primarily to fund transit projects such as bus pull off areas along highways and other highway related transit projects.

While the Hillsborough County impact fee model, as well as other impact fee counties in Florida, have attempted to use traffic impact fees to fund alternative mode projects, the level of funding was not significant. This is evidenced through the restriction that only 1-3% of the revenues are being permitted for funding of transit improvements. Although a long rang transportation planning model is updated every 5 years to evaluate impacts of development, and those model results provide rational for funding transportation projects, no measures of effectiveness related to transit were considered when selecting transit projects or determining the amount of funding that would be dedicated to transit from the impact fees. Based upon this review it was concluded that the transit projects being funded were not factored into any mode

split assumptions in the model to test the benefits of funding transit projects. The benefits could be tested through the model measures of effectiveness such as traffic congestion and transit utilization but were not.

This case study illustrates an attempt to shift some funding from traffic impact fees that fund traditional capacity adding projects to alternative mode project funding. The case study also demonstrated that suburban areas, which have traditionally used traffic impact fees, are not measuring the benefits of diverting impact fee revenues to transit. Also the county was not considering the use of alternative mode projects as a traffic impact mitigation strategy for future land use growth.

3.1.3.2 San Francisco Municipal Transportation Authority

The State of California has charged impact fees, including impact traffic fees, for many years. It was originally permitted under the taxing powers given to local governments. In 1987, a California law reaffirmed the right to charge traffic impact fees if a specific benefit was derived to the land developer paying the fee.

The City of San Francisco revised the traffic impact fee law in 1973 by adopting a “Transit First” policy. This policy change encouraged the development of types of land development that have multi modal accessibility and the construction of alternative mode transportation projects. The motivation for this change was to encourage more urban development where land uses can locate near alternative modes such as transit, biking and walking. By locating in these urban areas the trips generated by auto might be lessened and the impact on the highway system would be reduced. However, even with this change, the regulations on traffic impact studies still

required a traditional traffic impact analysis. The traditional method of analysis only evaluated the impact of new development on highway capacity and traffic levels of service and not alternative mode capacity.

In 2003, the City of San Francisco modified the traffic impact analysis methodology to require an evaluation of a new development's impact on the transit system in addition to highways. This type of study quantified the impacts that new development had on the transit system as well as the highway system. In 2009, the City further refined the requirements to eliminate the standard level of service requirement, as defined by the Highway Capacity Manual (HCM). The HCM is the most used method of measuring traffic impacts on highway capacity due to new development's increased traffic volumes. The 2009 regulations now require that new developments evaluate impacts on the transit system not the highway system. The previous traffic fee charged to developments is now diverted to transit improvements. This new transit impact fee is referenced as the "Transit Impact Development Fee" (TIDF).

In order to quantify the benefits of charging a transit impact fee in lieu of a traffic impact fee in 2009 the City commissioned a study by Cambridge Systematics titled "San Francisco Transportation Sustainability Fee Nexus Study" or the "Nexus" study. The purpose of this study was to establish the nexus between new development and the impact on the existing transit system. Establishing a nexus between a fee charged and the benefits of the fee is the basis of any transportation impact fee. Traffic impact fee laws establish this nexus by using a transportation planning model to predict benefits of specific transportation projects and then using the costs to calculate the fee.

The TIDF fee, which was being used to make transit improvements, had no direct link, or nexus, between the fee being charged and the need or benefit of transit or other alternative mode improvement projects. The study was the basis of a proposal to supplement the current TIDF with the "Transportation Sustainability Fee" (TSF).

The Nexus study established a definitive link between the impact of new development on transit service and the need to add capacity to the transit system. The study developed a list of $1.367 billion of transit projects needed by the year 2030 to offset transit demands created by new development. This impact fee revenue is expected to provide approximately 50% of the funding needed for the program. The remaining funding would come from other sources.

The TSF is proposed to be charged in addition to the TIDF. It includes a provision to give credit for developments that are already making a contribution to transit improvements through the TIDF. A major policy change in the TSF proposal, as compared to the current TIDF regulations, is that the fee would apply to residential developments, which the TIDF has never been applied to.

At the time of this research, the City was beginning the process to obtain approval for the TSF fee. The City planned to obtain approval to use the TSF by complying with the California Environmental Quality Act, (CEQA). This state law requires modification of the traffic impact study standards. In addition, public hearings were expected to be held. It was expected that the process to obtain approval may be completed in 18 months.

What is unique about this approach to using impact fees for alternative mode projects is that the nexus study attempts to quantify the benefits of charging an impact fee to fund multi-modal projects specifically. However, the Nexus study only measures the performance of the transit systems under the impact of future development and creates a program of improvements on that

basis. The two transportation measures of performance to be used are transit crowding and transit travel times. This research effort attempted to evaluate the impact of a multi-modal funding plan on broader measures of performance such as traffic congestion and level of service for all modes. The TSF fee only evaluates transit performance.

This case study provided an example of an attempt to quantify the benefits of using impact fees to fund alternative mode projects. While the use of the TSF is unique, it does not fully integrate the evaluation of the complete transportation system performance of all modes by charging such an impact fee.

3.2 SURVEY OF GOVERNMENT AGENCIES WITH IMPACT FEES

State and local agency representatives that have either implemented impact fees or administer the law or policy on a statewide or local level were surveyed for this research. Transportation planning professionals were requested to participate in the survey in order to determine what the impediments and attitudes may be to using impact fees for the funding of alternative mode projects. Potential recipients of the survey were identified through the Institute of Transportation (ITE) member community form. ITE is a recognized international association for transportation planning professionals.

The following sections details the survey structure, survey questions, the method of survey and the results of the survey.

3.2.1 Survey structure

The survey was structured to screen respondents and to categorizer respondents into three types:

- Respondents that worked for agencies that use traffic impact fees. These respondents were then asked questions on whether they used impact fees to fund alternative mode projects,
- Respondents from agencies that used impact fees for alternative mode projects. Information was then requested on the types of projects funded, enabling legislation, methods to select projects and studies on effectiveness of the funding.
- The third type of respondents were professionals with no experience using traffic impact fees,

All respondents, including those with no experience with traffic impact fees, were asked attitudinal questions on what the potential effectiveness of such measures might be. They were also asked about the feasibility of changing current legislation that permits the use of traffic impacts fees to also allow the funding of alternative mode projects. In addition, all respondents were asked to provide any additional information they might have on the topic.

In summary the survey was structured as follows:

- Whether the respondents were from an agency using impacts fee (Y/N)
- If the agency was using impact fees for alternative mode projects (Y/N)

- If Yes and Yes to the first parts of the survey, information was then requested (multiple choice) on methods, legislation, type of projects funded, studies and measures of effectiveness. All respondents were asked to provide their opinion on the topic. Specifically they were as about the potential impacts of the additional funding. on mode split in an urban area and the political feasibility of changing regulations to permit fees to be used for alternative mode project funding. Finally, they were requested to provide any relevant information they might be aware of on the topic.

3.2.2 Survey questions

There were 11 questions in the survey. Appendix B provides the survey questionnaire with the detailed structure and response options. The questions were as follows:

1. Does your City of Municipality currently collect traffic impact fees?
2. Have you used your traffic impact fees to fund alternative transportation projects such as transit, pedestrian or bicycle capital improvement projects?
3. What method did you use to determine which alternative mode projects were to be funded with traffic impact fees?
4. Does the enabling legislation that permits you to impose traffic impact fees permit funding alternative transportation projects such as transit, pedestrian and bicycle capital improvement projects?
5. What types of alternative mode projects have you funded with traffic impact fees?
6. Have you ever conducted a study to determine the effectiveness of funding alternative transportation projects either before or after implementation?

7. Please check the following if they were measures of effectiveness for the funding of alternative transportation projects

8. Does the enabling legislation that permits you to impose traffic impact fees also permit funding of alternative transportation projects such as transit, pedestrian and bicycle capital improvement projects with traffic impact fees?

9. In an urban or suburban area where transit it provided and walking/biking are realistic alternatives to auto travel, do you feel that funding of capital improvement projects for alternative modes would result in a significant shift in mode choice by travelers and help reduce congestion?

10. If not currently permitted by governing legislation, do you think that is would be politically feasible to change the governing legislation for impact fees to permit funding of alternative mode projects by traffic impact fees in areas where transit service and waling/biking are viable alternative transportation choices?

11. Please provide any additional information that you feel maybe relevant to this research inquiry. Items such as studies and legislation that enacted impact fees and permit Alternative mode funding and studies that have evaluated the effectiveness of such fees are requested.

3.2.3 Method of survey

This ITE forum has been established for members to provide an opportunity for transportation professionals to contact and obtain information from other professionals in the organization on a variety of technical issues. A variety of specific forums are available for this purpose. The “All Member Forum” was utilized and the following request was made to members of the forum:

"As a transportation planning professional I am asking that you complete my survey on using traffic impact fees to fund alternative mode transportation projects. This survey is being conducted as part of a PhD dissertation to identify if using traffic impact fees in urban and suburban areas to fund alternative mode projects such as pedestrian, bicycle and transit improvements are a viable method of reducing traffic congestion. Please use the link below to complete the survey.

"If you are not the person in your government organization that is most familiar with traffic impact fees please forward this to the appropriate person.
I appreciate your assistance in completing the survey.
https://www.surveymonkey.com/s/KPXLV2D"

The ITE organization agreed to use the forum for this purpose. The survey was successfully solicited through several requests over a four week period. Three email blasts were sent over 4 weeks with a request to complete survey. There were 44 responses received. Based upon information provided by ITE, the member forum has approximately 10,000 registered members. While the 44 responses represents a very small percentage of the total members, it is not unexpected due to the highly focused subject of the survey and the limited number of ITE members that have experience or an interest in this funding subject area.

The survey results revealed that, 64% of respondents were from municipalities that use impact fees and therefore those respondents completed questions 1-3 and 7-9. Also, 20% of respondents were from municipalities that use impact fees to fund alternative mode projects. These respondents completed all questions.

3.2.4 Results of survey

The results of the survey provided significant insight into the current practice and use of traffic impact fees for alternative mode projects. The results helped guide the research as to the types of alternative mode projects that are being funded, methods used to establish project priorities and professional's attitudes toward using traffic impact fees in this manner in an urban or suburban area. Appendix C provides the detailed survey responses. The following are summaries of the responses to each question.

Questions 1 and 2 screened respondents as to whether they have experience with impact fees and have they used them for alternative mode projects. Over 60% of the respondents had experience with impact fees. If they had experience with impact fees they were then asked to identify what method was used to determine which alternative mode projects were to be funded with impact fees. Very few respondents, two, identified a method to select projects the question.

An important part of the data gathered in the survey was information on legislation permitting impact fees in question 4. Specifically a question was asked about whether permitting the use of impact funds for alternative transportation projects was cited in the legislation or was it being done based upon an interpretation of the legislation. As shown in Figure 1, nearly half of the agencies do clearly permit this type of use for traffic impact fees.

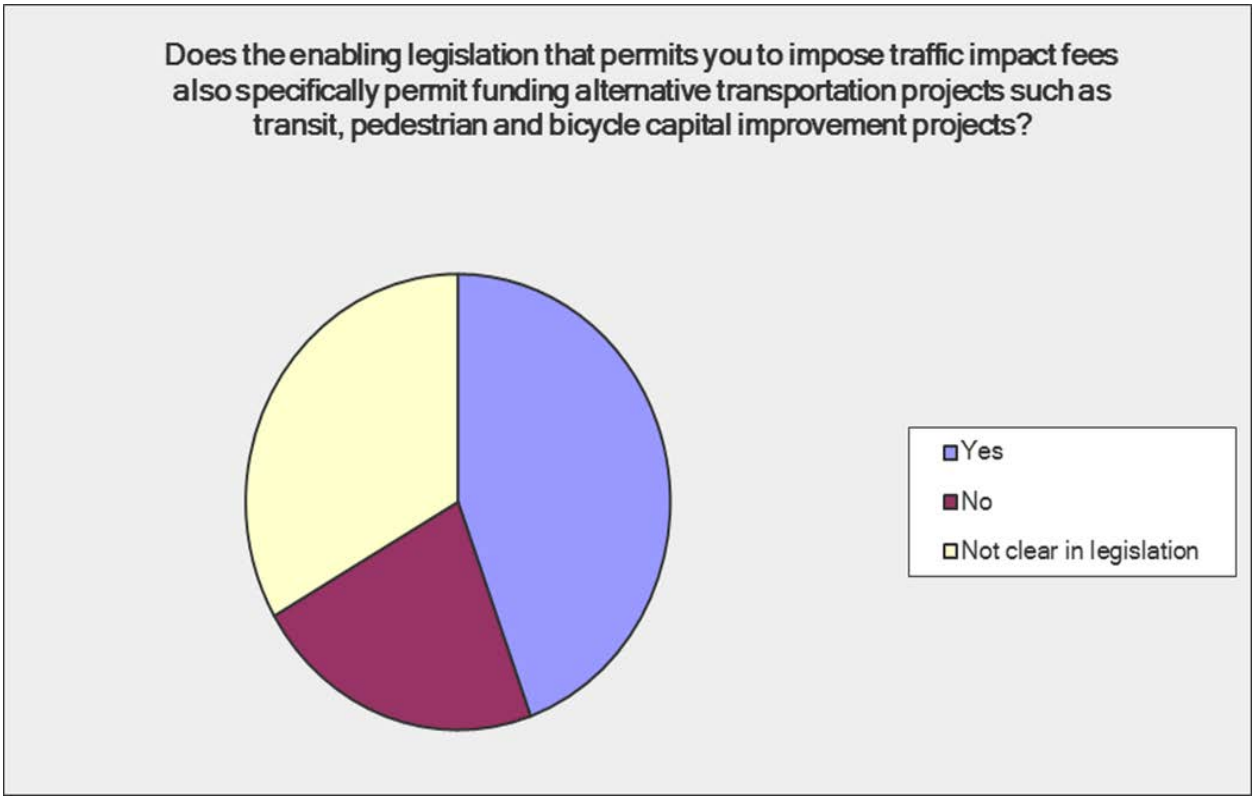

Figure 1 Survey Question 4 Responses

As shown in Table 2 transit improvements, pedestrian facilities and bicycle projects are all being funded through traditional traffic impact fees based on the response to question 5. The survey revealed that much of the funding is being used for compliance with the Americans with Disabilities Act (ADA) requirements in conjunction with improving pedestrian facilities. The ADA requires that any transportation improvement, including alternative mode projects such as pedestrian facilities, must provide accessibility for disabled users of the system. Because of this mandate many pedestrian mode project costs have increased in cost to comply with this requirement. As shown more than half of the respondents' agencies do not use impact fees for alternative transportation projects.

Table 2 Survey Question 5 Responses

Have you used your traffic impact fees to fund alternative transportation projects such as transit, pedestrian or bicycle capital improvement		
Answer Options	**Response Percent**	**Response Count**
Transit Stations	0.0%	0
Transit stops	8.3%	2
Transit service	0.0%	0
Bus pull off areas	12.5%	3
Bus shelters	8.3%	2
Sidewalks	37.5%	9
ADA ramps	25.0%	6
Walking trails or paths	20.8%	5
Bicycle parking racks or other bicycle station facilities	4.2%	1
Bike lanes	16.7%	4
Bike recreational paths	8.3%	2
Others describe	4.2%	1
No	58.3%	14

In order to guide the testing of the research thorough the transportation modeling process information was also requested on whether transportation planning studies had been conducted to determine the effectiveness of alternative mode projects. The results shown in Table 3, for question 6, show that few respondents were aware of any studies that measured the effectiveness of using the funding in this manner.

Table 3 Survey Question 6 Responses

Have you ever conducted a study to determine the effectiveness of funding alternative transportation projects either before or after		
Answer Options	**Response Percent**	**Response Count**
Yes	16.7%	1
No	83.3%	5

The types of measures of effectiveness that were used for the funding of alternative transportation projects were requested to be identified in question 7. Only 3 respondents identified any measures that were used.

Respondents were asked to identify if the enabling legislation permitted the funding of alternative mode projects with traffic impact fees. 43% responded yes to question 8.

The purpose of survey question 9 was to gauge the broad attitudes of the potential effectiveness of using impact fees for alternative mode projects in urban and suburban settings. It

was important to determine if this funding strategy was perceived to be a good tool to reduce traffic congestion in both urban and suburban areas. Approximately half of the respondents did not think that this was a feasible tool to reduce congestion.

Table 4 Survey Question 9 Responses

In an urban or suburban area where transit is provided and walking/biking are realistic alternatives to auto travel, do you feel that funding of capital improvement projects for alternative modes would result in a significant shift in mode choice by travelers and help reduce congestion?		
Answer Options	**Response Percent**	**Response Count**
Yes definitely	9.4%	3
Yes somewhat	43.8%	14
No	46.9%	15
Other (please specify)		1

The use of impact fees in urban areas for alternative mode projects most likely will require enabling legislation for their application in most states and cities. An opinion on the feasibility of implementing such legislation by elected officials was solicited of the transportation professionals in question 10. As shown they did not anticipate significant support for this type of legislation by elected officials.

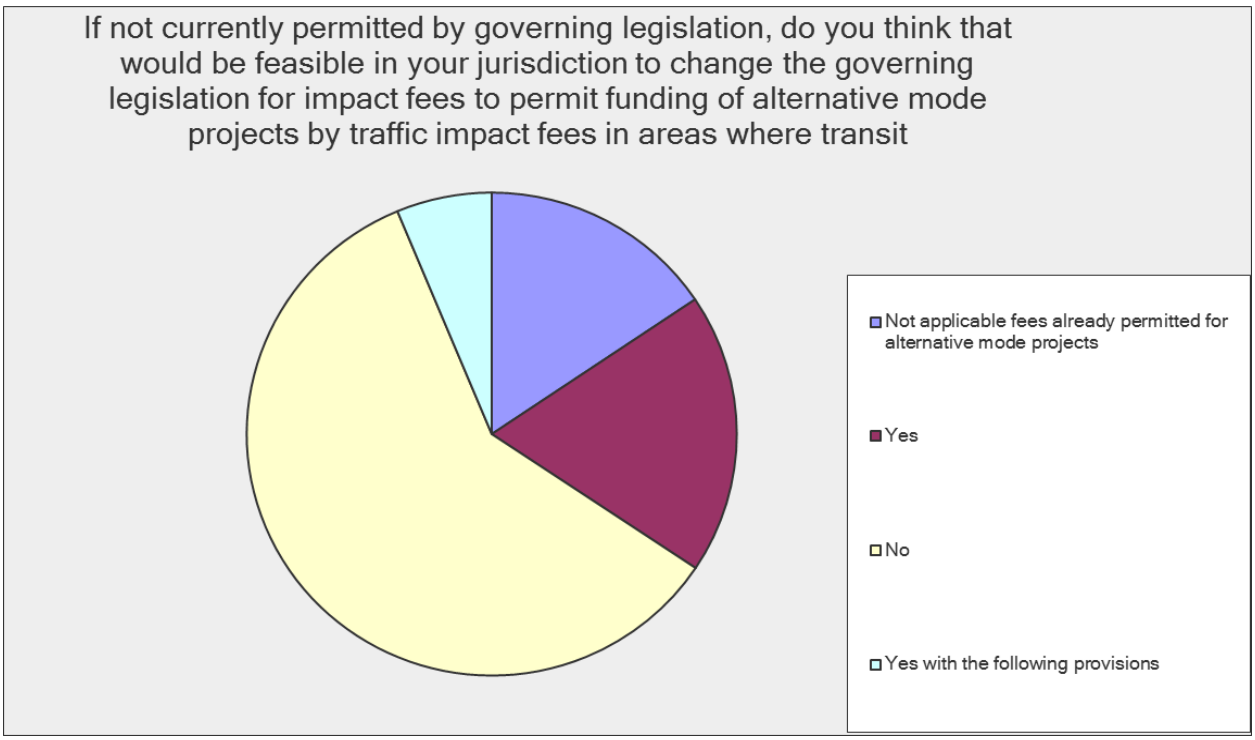

Figure 2 Survey Question 10 Responses

3.3 TESTING THE HYPOTHESIS

A test of the hypothesis was conducted using a travel demand model developed by the City of Pittsburgh, Pennsylvania based on the regional MPO software. This long range transportation planning model was developed by the City of Pittsburgh to determine the impacts of future growth on the transportation system. The results of the model helped guide the creation of long range transportation project needs for the City of Pittsburgh. These model results were used as a tool to evaluate the hypothesis.

There were two purposes in using the model for the research. The first purpose was to estimate revenues that may be collected through impact fees and then compare those revenues to construction costs of alternative mode projects. The second purpose was to determine, if the alternative mode projects were implemented, would they have a positive influence in reducing congestion in the City?

To evaluate these transportation and financial impacts of implementing impact fees a significant program of alternative mode projects were used in the model assumptions. The model growth and land use projections were a key factor used to conduct a financial analysis of the potential revenues from impact fees in this urban area. Future growth, associated with land use changes, assumed in the model was used to estimate revenues that might be collected by traffic impact fees. The financial analysis compared the potential revenues that the City of Pittsburgh may collect, using such fees in the future, and the funding need to construct alternative mode enhancement projects assumed in the long range plan. The impact fee revenues and construction costs were compared to determine the feasibility of such a program of impact fees, in the City of Pittsburgh. Feasibility was defined as revenues meeting or exceeding the project costs. The model also compared measures of effectiveness of the transportation system due to implementation of the alternative mode projects.

The following sections detail how the model was used to predict the existing year and future baseline year travel conditions test the alternative mode enhancements, projected revenues and costs from a hypothetical impact fee program and report the results of the analysis.

3.3.1 Travel Demand Model Background

The City of Pittsburgh developed their first ever city wide long range transportation plan designated as MOVEPGH. As part of this plan's scope, a travel demand model was developed to forecast the long range transportation needs of all modes of transportation. This model included forecasts of land use changes that impact travel demand. The Southwestern Pennsylvania Commission (SPC), the metropolitan planning organization (MPO) for the region, provided the regional travel demand model as the basis for the study. Trans Associates (The modeling consultant) and AECOM (The prime consultant) agreed to use of the model for this research. Work completed by the City of Pittsburgh, prior to providing the model results, included reducing the regional model scale to only include the City of Pittsburgh, developing a program of alternative mode projects that were incorporated into the model and running the model for a future year model forecasted condition.

This information from the model results was used to test the hypothesis. The MOVEPGH consultant team was responsible for using the SPC model to develop the transportation plan.

The consultant team used the regional calibrated and validated model to evaluate land use and transportation changes within the city boundaries. Model variables such as land use changes, transit service, highway links and trip generation were revised to model future year conditions by the consultant team. Model results for the conditions to be compared, were provided by the MOVEPGH consultants for this research. For analysis purposes, the assumptions and modifications to the model parameters were reviewed for consistency with the hypothesis by the researcher. This consistency review included an evaluation of the types and scope of the alternative mode projects in the model. The review concluded that all types of alternative mode

enhancements including transit, bicycle and pedestrian mode were represented in the projects selected. It was determined that the model and the results were acceptable to test the hypothesis.

The SPC model is based upon the TP+ travel demand model software which is an integrated travel demand model for planning applications. The model modules include highway and transit networks, an origin and destination matrix and highway and transit assignments. It has integrated modules for trip generation and distribution. Figure 3 shows the current SPC regional model traffic analysis zone (TAZ) structure. As shown in Figure 3 the regional model includes a 10 county area of southwestern Pennsylvania. The regional model area was modified to only include TAZs within the City of Pittsburgh municipal boundary. This modification was done to measure the effectiveness of the transportation projects within the boundary of the City only.

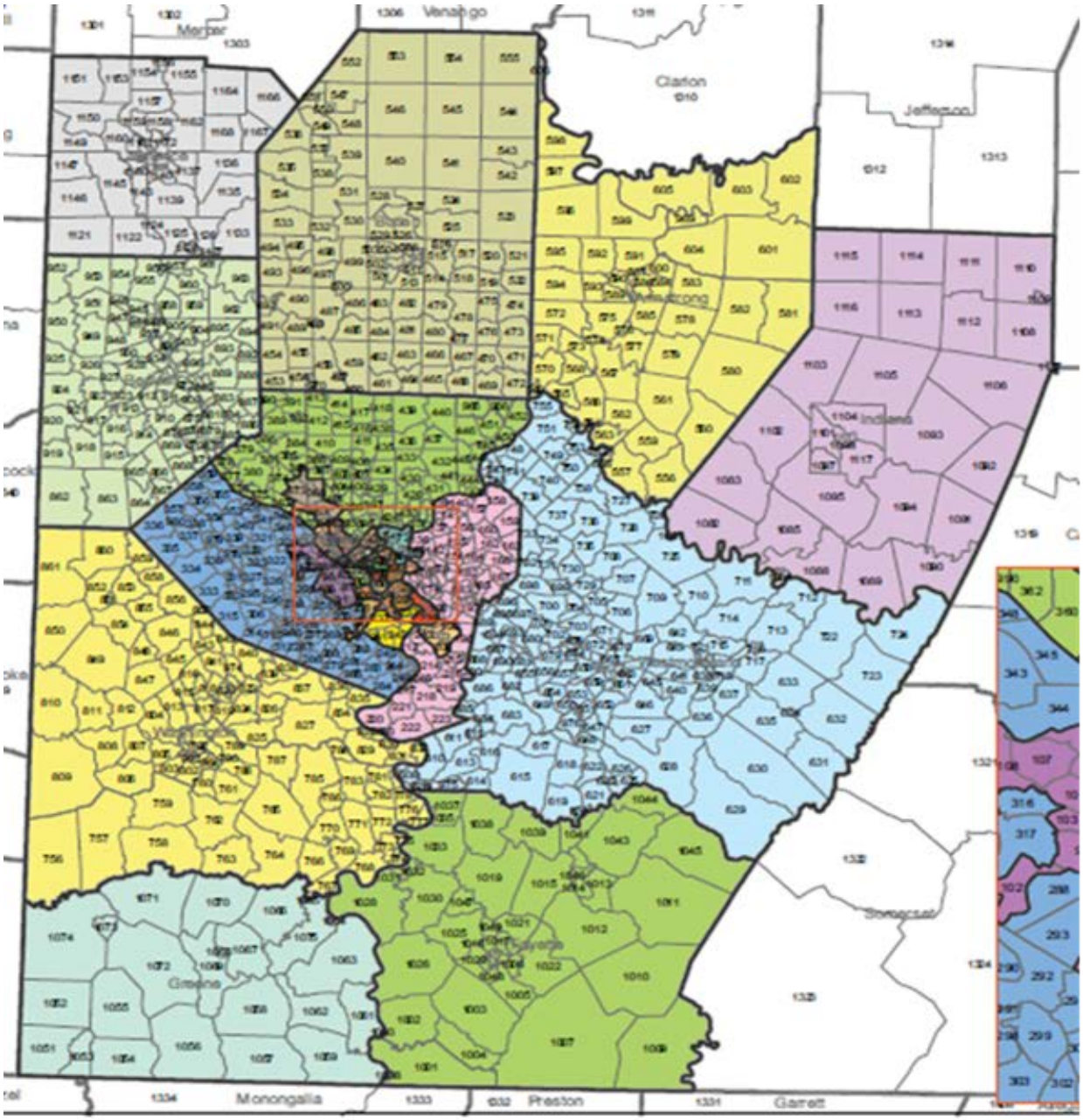

Figure 3 SPC Regional TAZ Structure

The TAZ structure within the City of Pittsburgh, as show in the Figure 4, includes 174 TAZs. The complete regional model has 1,604 TAZs. This reduction in the number of zones allows the model to test the impacts of future land use and travel conditions within the City of Pittsburgh only and provides a more detailed network for testing purposes.

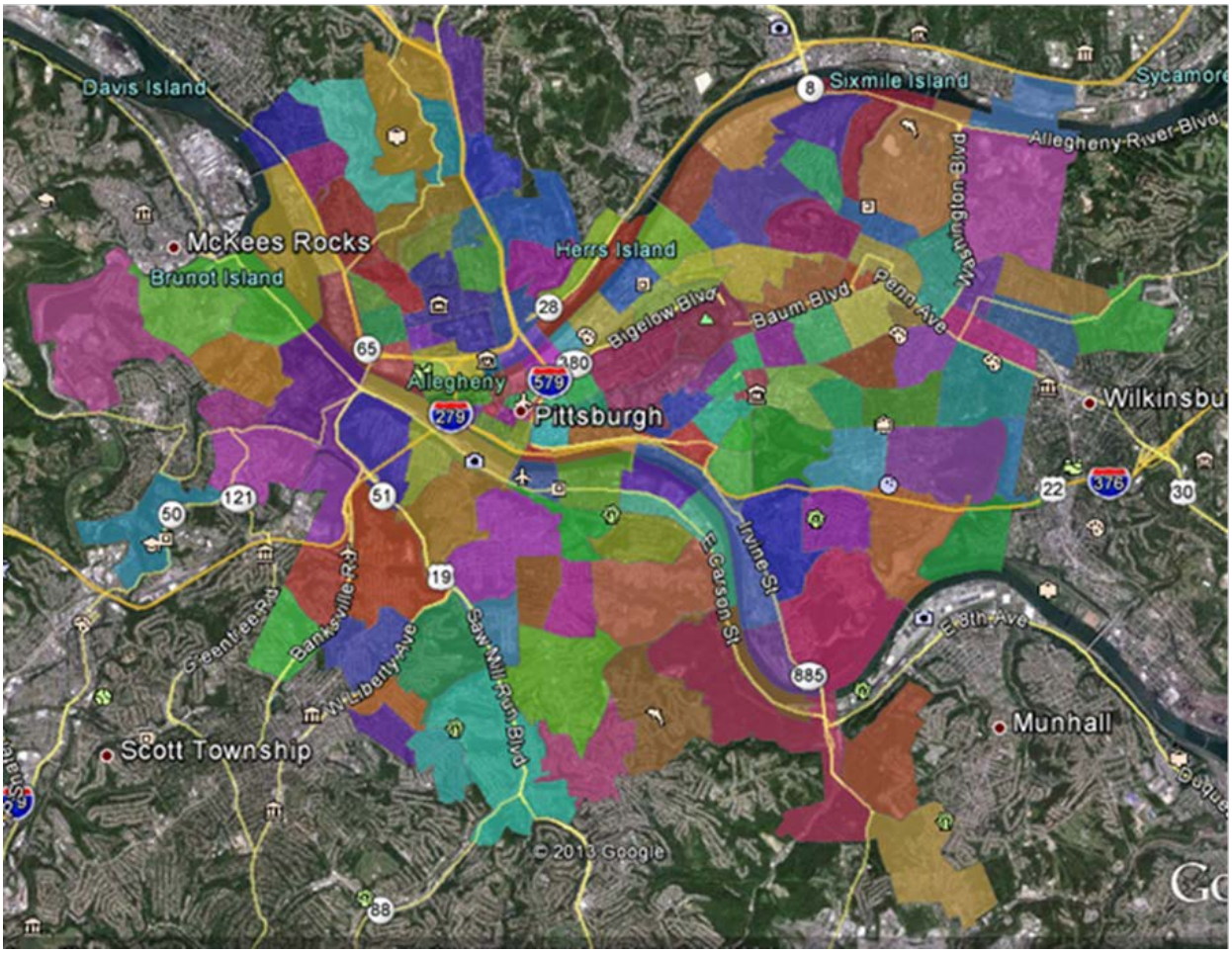

Figure 4 City of Pittsburgh TAZ Structure

In summary the model used to test the hypothesis was developed by the City of Pittsburgh for a long range transportation model. The researchers used the results of the model and input data to test the hypothesis. The alternative mode projects included in the model were selected by the City of Pittsburgh.

3.3.2 Existing Baseline

The existing transportation network baseline condition is a representation of the current transportation conditions in the city of Pittsburgh, at the time of the model development. The City of Pittsburgh provided the baseline transportation conditions for the year 2011 conditions, which was the commencement year of the MOVEPGH study. These current baseline conditions reflect measurements of travel in the year 2011 with the current highway, transit network and land uses. The measures of effectiveness (MOE) available for the baseline 2011 year were reviewed to determine which might be appropriate to test the hypothesis. The appropriate MOEs should be indicators of the traffic congestion, use of transit facilities and travel time/speed characteristics of the City transportation network. The model results provided MOEs for items such as network delay, fuel consumption, modal choice etc.

The following MOEs, as shown in Table 4, were selected for use in the research. The MOEs selected were categorized as measures of congestion and mode choice. These two general categories of MOEs are reflective of travel characteristics changes that were deemed to be important in determining the success of alternative mode projects effecting travel conditions in the future.

Table 4 Model Measures of Effectiveness

Measures of Effectiveness from MOVEPGH Model and Applicability to Hypothesis		
Measure of Effectiveness	**Units for Total Network**	**Type of Measure**
Vehicle Trips	Trips via vehicles (auto)	Congestion and Mode Choice
Vehicle Trips (persons)	Person trips via vehicles (auto)	Mode Choice
Average Auto Occupancy (persons)	Persons per auto (auto occupancy)	Mode Choice
Transit Trips (persons)	Person trips via transit	Mode Choice
Transit Split (%)	Percent trips via transit	Mode Choice
Total Travel Time (veh*hr)	Vehicle hours of travel	Congestion
Total Distance (veh*mi)	Vehicle miles of travel	Congestion
Average Travel Time (min)	Average Trip Travel time (minutes)	Mode Choice and Congestion
Average Travel Distance (mile)	Average Trip travel distance (miles)	Congestion
Average Speed (MPH)	Average Trip speed (mph)	Congestion
Number of Congested Links (vc>=1)	Number of roadway segments in Failure	Congestion

3.3.3 Future Baseline

Use of the with/without principal is critical in transportation planning evaluations when the impacts of a specific action is being evaluated. This principal, as researched by Magalotti[16], states that future no-build conditions, if no action were take relative to transportation network changes, must be compared to the action alternative (with condition). Both of these conditions are at the same point in time in the future and represent alternative scenarios that might happen. The comparison of existing no-build conditions to future build conditions, with the action implemented, is not a true comparison of potential future outcomes but can be used as another point of reference.

If few alternative mode projects were included in the future build conditions, which is typical of an urban long range transportation plan, but future traffic growth was expected based upon the projected land use changes, what level of mode use and general network measures of effectiveness are expected? This future condition defines the future no-build baseline condition for the testing of the hypothesis. The year 2035 was selected by MOVEPGH as the future year of land use and traffic projections. A 24 year planning horizon was used; typical horizons are a minimum of 20 years due to federal funding requirements. The future no-build and build conditions in the MOVEPGH model included the same growth within the city and region for the next 24 years. The future no-build base year condition was compared to future build conditions with the MOVEPGH alternative mode projects implemented in the next 24 years.

[16] Magalotti

3.3.4 Alternative Mode Enhancements

A substantial number of alternative mode enhancement projects were added to the travel demand model network structure for the year 2035 build conditions by the City of Pittsburgh. Transportation projects included in the 2035 build condition were primarily alternative mode enhancement projects. The projects, for purposes of this research were categorized as:

- Intersection Improvements
- Complete Streets and Road Diets
- Street Network Modifications
- Bicycle and Pedestrian Enhancements
- Reconfiguration of Streets
- Transit
- Other Types of Projects

Table 5 provides a more detailed categorization of project types within the seven primary types selected:

Table 5 Project Types Incorporated into MOVEPGH Model

Project Type	Typical Project Recommended
Intersection Improvement	Reconfigure intersection to an at-grade roundabout
	Realign intersection
	Modify traffic signal phasing
	Create raised intersections
Complete Street and Road Diet	Apply a complete streets standard (pedestrian scale lighting, bicycle racks, street trees, and new landscaping)
	Improve pedestrian and bicycle friendliness of roadways
	Install a new traffic signal controller to accommodate bicycles and pedestrians
	Removal of one travel lane to allow for the addition of a buffered bike lane
Local Street Network Modifications	Extension of existing roads to new intersection points
	New network of local streets in redevelopment area
	Build multi-modal roadways

Table 5 (continued)

Bicycle and Pedestrian Enhancements	New pedestrian and bicycle paths
	Remove on-street parking and add a bicycle lanes
	Pedestrian bridges
	Add sidewalks
	Repair/replace sidewalks/stairs
Reconfiguration of Streets	Remove parking, restore two-way travel
	Reverse direction of streets
Transit	Establish a unique urban circulator system using fixed-rail trolley cars
	Commuter rail using existing AVR tracks that follow Allegheny River into the city
	Construct a new station along the East Busway
	New Busway ramps
Other Types of Projects	Primarily Bridge Projects for vehicular, bike and pedestrian improvements

As part of the MOVEPGH project, by the City of Pittsburgh, maps were developed to show the geographic location and type of projects assumed in the future 2035 build condition. The locations of the projects were factored into the model. Figures 5 and 6 show the location of all of the projects within the City boundary and a typical project detail.

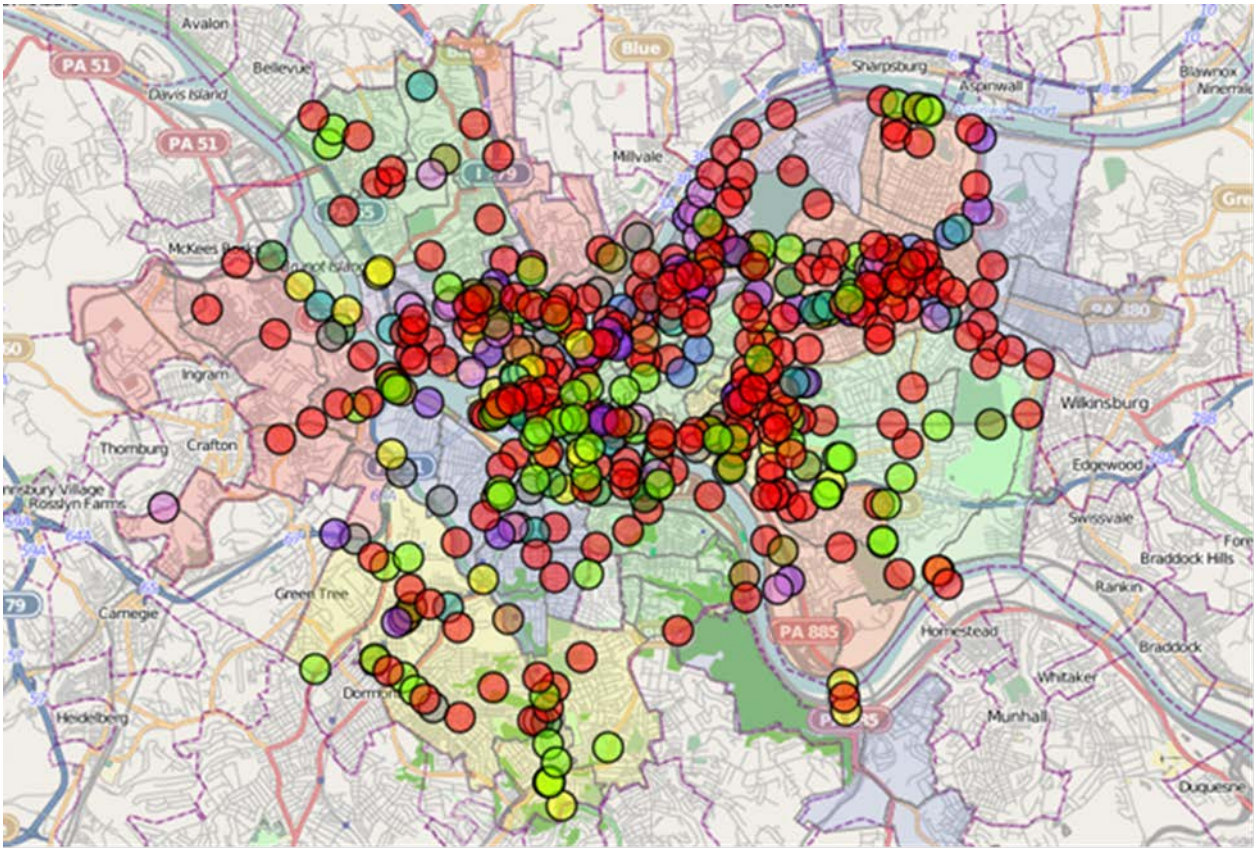

Figure 5 MOVEPGH Future Project Locations

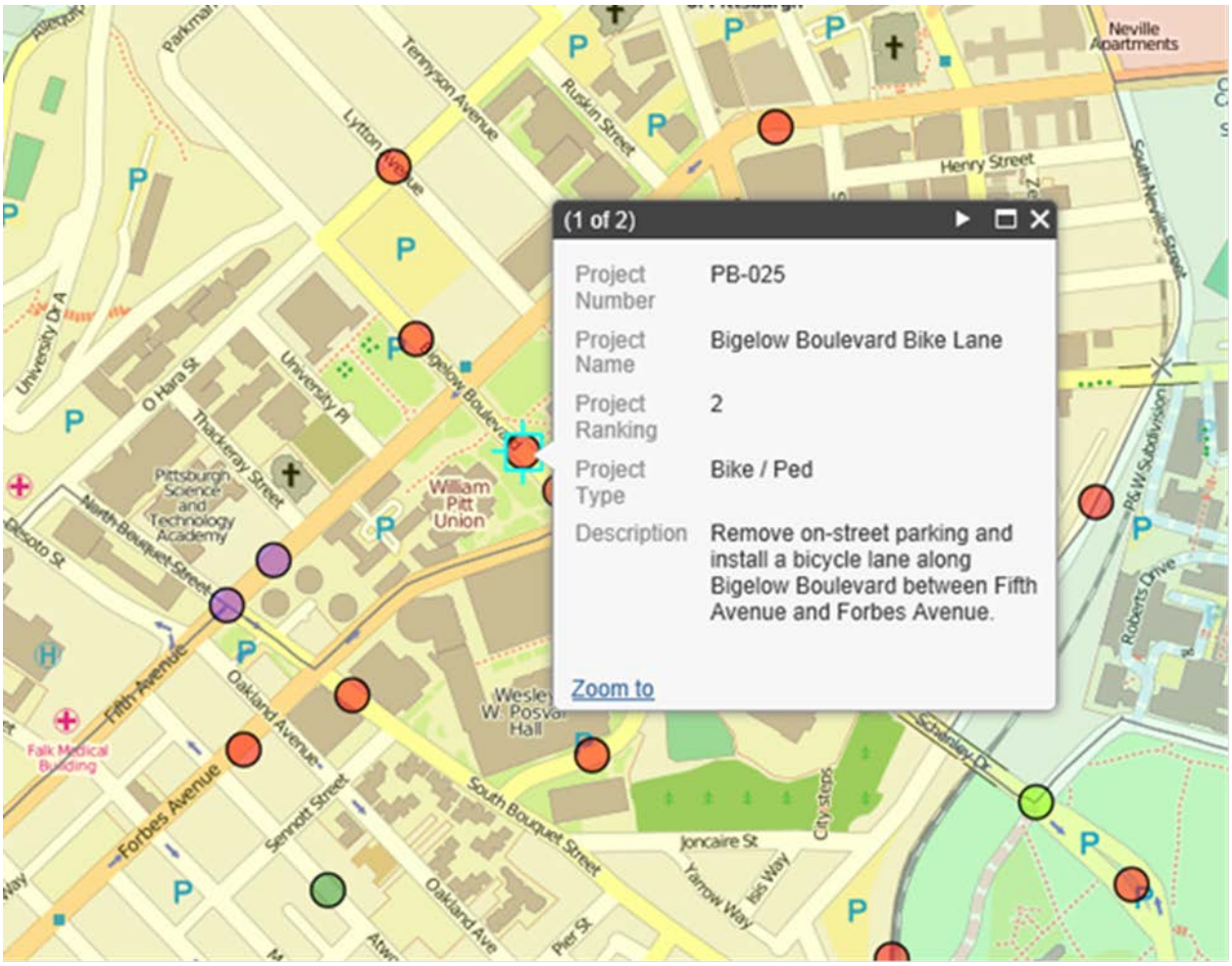

Figure 6 MOVEPGH Typical Project Description

3.3.5 Program Costs

The capital construction costs of the alternate mode projects, incorporated into the year 2035 model, were determined for capital budget purposes by City of Pittsburgh. These costs estimates, provided by the City of Pittsburgh, were based upon previous engineering design studies of the projects or used cost estimating methods acceptable for project programming purposes. Project programming construction cost estimates are not always based upon engineering design studies. Some cost estimates are based upon a comparison of project costs for similar projects which have been constructed.

The estimated capital construction costs for the all the alternative mode projects input into the MOVEPGH model, to be constructed from 2011 to 2035, was estimated to be $298,300,000. This was based on present day construction costs. This cost represents only projects designated as alternative mode projects and does not include infrastructure maintenance projects such as bridge and highway reconstruction. The infrastructure maintenance projects represent the vast majority of the transportation costs to be incurred over the next 24 years. However, for purposes of this research the traffic impact fees were only assumed to fund the alternative mode projects. The following is a breakdown of the constructions costs by the project type categories used in Table 5, as shown in Table 6.

Table 6 Capital Project Costs in MOVEPGH Model

Project Type	Estimated Capital Costs
Intersection Improvement	$24,600,000
Complete Street and Road Diets	$41,500,000
Local Street Network Modifications	$51,000,000
Bicycle and Pedestrian Enhancements	$111,900,000
Reconfiguration of Streets	$22,100,000
Transit	$5,300,000
Other Types of Projects	$41,900,000
Total	**$298,300,000**

Construction cost estimates were based on the year 2011 costs. It is expected that these are estimated construction project costs that will be incurred over the 24 years of the transportation plan implementation. There is no estimated year for implementation currently for individual

projects. The costs for rehabilitation of the alternative mode projects were not considered because that would fall into the category of infrastructure rehabilitation, a different funding source.

In order to provide a perspective of the estimated cost of the alternative transportation project program these future costs were compared to what was currently in the transportation funding plan for the City of Pittsburgh. The current transportation improvement program, at the time of this research, for the years 2013-2016 totaled $241,857,848. This is four year program of costs compared to the MOVEPGH plan which is 24 years. If the current four year plan was extrapolated to a 24 year time period is would be projected to be $1,451,147,000. This current four year plan does not include significant funding for alternative mode projects. This current four year plan includes $15,000,000 for alternative mode projects such as transit projects. This represents or 6% of the total funding program. Extrapolated over 24 years the total alternative mode project funding would be $90,000,000 under the current plan. This compares to the MOVEPGH alternative mode funding program of $298,300,000 for the same time period.

This comparison demonstrated that the MOVEPGH program for the alternative mode projects is a significant increase in funding dedicated to these types of projects over the next 24 year period. If current funding levels remain constant over the 24 years for traditional type projects and the projected $298,300,000 is expended during this period for alternative mode projects, the alternative mode funding would represent 22% of the total funds. Currently only 6% of funding is projected to be spent on transit projects. This would be a significant increase in this type of funding and is expected to have a significant positive impact on travel conditions in the City. However this increase in funding for alternative mode projects could negatively impact

capacity adding projects. There may be situations where capacity adding project are feasible and are needed to alleviate congestion. These types of projects should be considered when feasible.

Another important assumption in the comparison of revenues and project costs is the portion of the project costs that may be eligible for federal funding. Under current federal funding cost sharing formulas these alternative mode projects could receive from 50% to 80% of the total project costs from federal funds with the remainder expected to be matched from impact fee revenues. These types of assumptions were used in the financial feasibility analysis when comparing revenues to costs. Current impact fee programs make similar cost sharing assumptions for capital funding sources based upon federal funding formulas.

These alternative mode project capital construction cost estimates were used in the testing of the hypothesis. The projected revenues, to be derived by charging the impact fee on all future land use changes, in the future were then compared to the construction costs. However in order to make this comparison revenues need to be estimated on the basis of a hypothetical impact fee structure.

3.3.6 Hypothetical Fee Structure and Revenues

In order to estimate the potential revenues that could be generated over the 24 years of the transportation plan, a traffic impact fee structure was developed. This fee was used to project future revenues for funding of the alternative transportation projects. A fee structure is the estimated cost per trip that would be charged for new development projects to mitigate their traffic impacts. This cost per trip was applied to estimated new total trips to be generated by

future land development. The number of new trips generated, estimated to be generated between 2011 and 2035 was then applied to the fee structure developed. This trip generation is based upon empirical relationships between numbers of trips and demographic characteristics.

The impact fee to be charged per trip was developed and used based on the historic levels of traffic impact fees charges established by local governments in the state of Pennsylvania. The Pennsylvania the transportation impact fee handbook[17] was used as a guide. A comparison of communities in Western Pennsylvania that currently have impact fees was also used as a benchmark for determining an appropriate impact fee that may be charged by the City of Pittsburgh. It is noted that current Pennsylvania law permits impact fees to be collected on the basis of the weekday evening (PM Peak) projected traffic volumes for new land development. The impact fee, or cost per trip, is applied to the weekday evening peak hour estimated number of trips for the new development.

The amount of revenue that maybe expected, if the projected land use changes occurred, in the 24 year horizon timeline for the model, was then calculated. As shown in Table 7, impact fees per weekday evening peak hour trip vary by the region of the state with a statewide average of $1,235 per PM peak hour trip charged in 2009. These data were also used to determine that a $1,094 per trip fee was the average for Allegheny County, where the City of Pittsburgh is located. The researchers decided that a range of potential impact fee rates would be used to project revenues. This decision was based upon the need to consider a range reflecting the current rates charged in the region and the anticipated desire by the City to charge a rate competitive to other municipalities in the region.

[17] Transportation Impact Fees A Handbook for Pennsylvania's Municipalities

The range selected was:

- Western Pennsylvania average - $1,094 per trip
- Statewide average- $1,235 per trip
- Allegheny County average - $1,124 per trip

Table 7 Pennsylvania Impact Fee Summary

2007 Pennsylvania Traffic Impact Fee Costs	
Region	**Average for Region**
Southeast (Berks, Chester, Lehigh, Montgomery, Northampton Counties)	**$953**
Central (Adams, Franklin, Lancaster and York Counties)	**$1,659**
Western (Allegheny, Butler and Washington Counties)	**$1,094**
Statewide Wide Average	**$1,235**

In order to translate the impact fee rates into total revenues over the 24 year planning horizon, the number of new trips to be generated by land development, within the City of Pittsburgh, was estimated. The number of new vehicle trips average daily trips (ADT) to be generated within the City of Pittsburgh from 2011 to 2035 was projected by the model. The type of model used only estimates ADT trips and not weekday PM peak hour trips. Because impact fees revenues are charged based upon weekday PM peak hour trips in the state of Pennsylvania, the ADT trips from them model were translated into weekday PM peak hour trips.

Data provide from the model includes a classification of the number of trips by type. The trip types included the following:

- Home Based Other Trips (HBO) – Trip productions originate from home such as recreational or shopping trips
- Non-Home Based Trips (NHB) – Trips produced within zones that have uses such as employment or retail centers.
- Home Based Work Trips (HBW) – Trips that begin at home and are destined to a work zone.

The total number of new regional trips, estimated by the SPC model and within the City of Pittsburgh, are shown in Table 8 for comparison purposes. It is noted that the City will generate 5.8% of all new regional trips through the year 2035.

Table 8 Trip Types from SPC Model for Region and City of Pittsburgh

Trip Type (Average Daily Traffic ADT)	SPC Model		MovePGH Model	
	Total Number of Trips	Percent of total	Total Number of Trips	Percent of Total
Home Based Origin Productions (HBO)	738,832	59.72%	42,806	59.72%
Non-Home Based Origin Productions (NHBO)	204,512	16.53%	11,849	16.53%
Home Based Work Productions (HBWO)	293,721	23.74%	17,018	23.74%
Total	1,237,065		71,673	

In order to translate these ADT trips into evening, or PM peak hour, trips conversion factors were utilized. These factors were based upon National Cooperative Highway Research Program (NCHRP) Report 716[18]. This research report is the accepted standard for modeling conversions for ADT trips to weekday PM peak hour trips.

Table 9 shows the results of this conversion. The total number of weekday; PM peak hour trips projected to be generated within the City of Pittsburgh was 4,907.

[18] NCHRP Report 716

Table 9 Conversion of ADT to PM Peak Hour Trips

Trip Type	MovePGH Model Data		
	Total Number of Average Daily Traffic (ADT)Trips	Conversion Factor To PM Peak Hour Trips	PM Peak Hour Trips Used for Analysis
Home Based Other Productions (HBO)	42,806	5.20%	2,226
Non-Home Based Origin Productions (NHBO)	11,849	7.40%	877
Home Based Work Productions (HBWO)	17,018	10.60%	1,804
Total	71,673		4,907

After the number of PM peak hour trips was projected for the future condition of the model, the amount of revenues was then estimated. Table 10 provides the estimated revenues to be collected by the City of Pittsburgh over the 24 year period of the future growth projections. These revenues are shown for the range of potential impact fee rates previously recommended. As shown in Table 10, the revenues are projected to range from $5,517,431 to $6,062,257 based upon each of the three potential impact fees to be charged. It is noted that this is only a projection of potential revenues during the 24 year time period. Experience with municipalities in Pennsylvania has shown that impact fees that are collected versus projected revenues can vary widely due to economic conditions, type of development that occurs and general development patterns in the region.

Table 10 Projected Revenues through the Year 2035

Potential Impact Fee Per Trips	Cost Per PM Peak Hour Trip	Projected 2035 Revenue For City of Pittsburgh
Statewide Average	$1,235	$6,062,257
Western Pennsylvania Average	$1,094	$5,367,399
Allegheny County Average	$1,124	$5,517,431

One of the metrics of the success of any traffic impact fee program is the ability of the program to generate revenues sufficient to implement the needed transportation projects. For traditional impact fee programs, the needed improvements are defined as the additional transportation capacity on the roadways required to accommodate the future growth. However for this research evaluation, the success of such a program was measured by two parameters. The first parameter was the ability of the program to generate sufficient revenues to fund the anticipated alternative mode improvements.

The second parameter was the impact on the travel characteristics in the City. The success of the program was not be measured by an increase of the roadway capacity, which is required for a typical impact fee program, but improved travel conditions. Improved travel conditions can be achieved by shifting travel modes from auto to transit, bicycles and pedestrians. This change in traveler behavior can have the same impact on reducing traffic congestion as a traditional approach of increasing roadway capacity without expanding the roadway system

The City of Pittsburgh including in their model a list of alternative mode projects without knowing what the impact on the transportation travel characteristics would be. It was assumed by the City of Pittsburgh that they would result in a positive impact on travel conditions. However, there was no specified funding source for these projects, as part of the MOVEPGH plan, except the historical local and federal transportation funds.

Based upon the researcher's experience, most impact fee programs in the State of Pennsylvania assume a significant amount of federal transportation funding to be used in conjunction with the revenues generated by local traffic impact fees. This is due to the historical nature of transportation funding and the federal laws that permit local matching funds for many types of projects. This method permits states to match federal funds with state generated transportation revenues.

Under the current traffic impact law in Pennsylvania revenues from impact fees can only be used to fund up to 50% of the cost of the improvements to state highways. For purpose of this research, it was assumed that 80% of the cost of the alternative mode projects would be funded from other sources such as traditional federal transportation funds as a possible funding scenario. This provides a more realistic approach given federal funding formulas but would require a change to the state legislation for implementation, as would the use of impact fees for this purpose. External, or a federal funding subsidy of 80% was assumed. A scenario of all funding being generated by the impact fees was also considered. This range of funding subsidy provides several scenarios of external funding that may exist over the lifetime of the impact fee program. In addition, the range of impact fee rates was also applied. These two variables provide six different possible future results relative to projected revenues and the ability of the impact fee revenues to fund the program, in the City of Pittsburgh.

When these funding formulas were applied to the range of impact fees and federal funding levels, the revenues were then compared to the capital costs of the program. The results project a deficit of funding in all cases, as shown in Table 11.

Table 11 Project Impact Fee Program Deficits

Historical Rate Source	Potential PM Peak Hour Impact Fee Rates	Projected Capital Improvement Program Cost	Projected 2035 Revenue For City of Pittsburgh	Projected Program Surplus or Deficit (Complete funding by Impact Fees)	Projected Program Surplus or Deficit (Provide Match funding at 20% of Capital Costs)
Statewide Average	$1,235	$298,300,000	$6,062,257	-$292,237,743	-$53,597,743
Western Pennsylvania Average	$1,094	$298,300,000	$5,367,399	-$292,932,601	-$54,292,601
Allegheny County Average	$1,124	$298,300,000	$5,517,431	-$292,782,569	-$54,142,569

The projected deficits vary from $53,597,743 to $292,932,601 for the six funding scenarios projected. While this is a wide range of projected deficits it is consistent with many current impact fee funding programs. In all scenarios the projected revenues do not provide sufficient funding for the program proposed.

This shortfall in revenue could be could be overcome by various sources of additional revenue. Currently public transit in Allegheny County is funded by an alcohol drink tax, expansion of this source could be considered. Also other non-traditional federal funding sources for public transit and bicycle/pedestrian projects could be utilized. One example is the Transportation Alternatives (TA) program which was authorized as part of the MAP 21funding authorization, which could be

an alternative funding source. TA projects are defined as federally funded, community-based projects that expand travel choices and enhance the transportation experience by integrating modes and improving the cultural, historic, and environmental aspects of our transportation infrastructure. Traditionally this type of funding has been used for bicycle and pedestrian projects.

3.3.7 Model Run Results

The second purpose of using the MOVEPGH model was to test the hypothetical City of Pittsburgh impact fee program's ability to improve or maintain current transportation conditions in the City and accommodate future growth. The improvement or maintenance of conditions was defined by the measures of effectiveness selected from the model results.

The model was used for this purpose. The model was run by MOVEPGH with the alternative mode projects in place, in the future 2035 build condition, and the results were compared to future 2035 no build condition. This comparison of MOEs was used to determine the positive or negative impacts that that program could have on the transportation and travel conditions in the future year 2035.

When MOVEPGH was being developed by the City of Pittsburgh, it was determined that many of the proposed alternative mode project impacts on mode choice could not be accurately projected using the traditional modeling process. The traditional process estimates how travelers will choose a mode of travel based upon their origin, destination, costs and travel choices available for that trip. However, many of the types of mode enhancements proposed such as bicycle and pedestrian improvements cannot be reflected in traveler's mode choices because of the model only assigns trips between the auto and transit modes and does not assign trips to

pedestrian or bicycle modes. Traditional models do estimate travel choices between auto and transit well enough to reflect the impact of transit enhancements but not bicycle or pedestrian modes changes due to enhancements in those modes of travel.

The MOVEPGH consultants determined that by directly reducing the number of projected auto trips in the trip generation estimates, to reflect the use of alternative modes choices such as bicycles and pedestrians, would be a reasonable method to reflect the impact of these proposed enhancements for bicycles and pedestrians.

A review of current research to address this modeling issue revealed that predicting mode shifts to pedestrian and bicycle modes is a complex process with many variables. Buehler[19], in a study by the Brookings Institute, reports that transportation policies and land use patterns variables can account for up to 25 percent of the reasons for these mode shifts. Providing more options through transportation funding of bicycle and pedestrian facilities is classified as a change in transportation policy. Transportation policy changes are not easily incorporated into a travel demand model.

Horowitz[20] attempted to forecast bicycle and pedestrian traffic on the I-5 Bridge across the Columbia River using mode share data from the US Census, information from local travel surveys and results from a bicycle trip study. This type of evaluation revealed that data, not typically considered by a travel demand model, may be needed to accurately forecast these modes shifts.

Table 12 provides the trip reduction factors that were applied to the MOVEPGH, by the City of Pittsburgh consultants, for auto trip generation projections to reflect the alternative mode

[19] Buehler

[20] Horowitz

project enhancements for bicycles and pedestrians. These reduction factors and their sources were reviewed by the researchers and it was determined that this was a reasonable approach to addressing the shortfall of the model.

Table 12 Auto Trip Reduction Factors MOVEPGH Model

Location/Zones	Parking Management	Transportation Demand Management	Bicycle and Pedestrian Improvements	Affordable Housing	Total
Pittsburgh City	2.8%	5.2%	6.5%	0.1%	13.9%
Multi-modal Core	3.3%	7.7%	10.1%	0.1%	19.8%
Squirrel Hill	1.5%	6.7%	0.4%	0.1%	7.7%
South Hills	1.9%	5.3%	3.0%	0.2%	10.2%
West-79	2.0%	5.1%	0.3%	0.2%	7.4%
Northwest Multimodal	3.0%	5.0%	3.4%	0.2%	11.1%
Northside	2.0%	6.1%	0.9%	0.2%	8.9%
East Ohio	3.3%	5.3%	1.4%	0.2%	10.0%

These factors were based upon studies of urban areas where alternative mode enhancement projects or policies were implemented and their impacts on mode choice were measured before and after implementation of the policy.

As shown in Table 12, these factors are in the categories of parking management, transportation demand management, bicycle and pedestrian improvements and affordable housing. All of these factors have an impact on modal choice by travelers in an urban area. Also, the reduction rates were varied by geographic zones within the City of Pittsburgh. These geographic zones included specific traffic analysis zones from the model. Application of this

variance, by geographic zone, reflects a more accurate application of the factors to represent variability of the potential impacts of these types of strategies.

Once these reduction factors were applied, by the City of Pittsburgh's consultant, the remainder of the modeling process was completed. The model reflected the most accurate possible estimates of mode shift to transit, bicycle and pedestrian modes possible given the limitations of the model. The final results of the model MOEs are shown in Table 13.

Table 13 Measures of Effectiveness Model Result

Measure of Effectiveness		Existing to Future Comparison		Future Scenario Comparison	
	Units for Total Network	Year 2035 Build	Year 2035 No-Build	2035 No-Build and Build	Analysis Summary
Total Distance (veh*mi)	Vehicle miles of travel	6.6%	13.5%	-7.3%	Reduction is a postive and signficant MOE
Average Travel Time (min)	Average Trip Travel time (minutes)	9.6%	8.4%	1.4%	The increase in average travel time is unexpected with a reduction in total vehicle miles of travel
Average Travel Distance (mile)	Average Trip travel distance (miles)	2.2%	1.8%	0.4%	Similar results to average travel time, negative impact unexpected
Average Speed (MPH)	Average Trip speed (mph)	-8.2%	-7.1%	-1.0%	Negative MOE measure reflects increase in congestion
Number of Congested Links (vc>=1)	Number of roadway segments in Failure	11.5%	11.3%	0.2%	Very slight impact and negative impact but not significant

Five MOEs were selected for comparison of the future no build and build conditions. The MOEs selected represent a variety of network wide performance parameters.

Three comparisons of the model results were made. All comparisons were intended to test the hypothesis concerning the impacts of implementing the alternative mode projects. The most important, of the three comparisons, were the MOEs used to predict change in the year 2035 when the build and no build conditions are compared. The no-build condition model results, as presented in Table 13, represents the future year 2035 predicted condition with the currently funded types of transportation projects implemented. This program of transportation projects has very little funding dedicated to alternative mode projects. This build condition represents the expected change in travel behavior because of the additional opportunities provided to travelers in the transit, pedestrian and bicycle modes with the alternative mode projects funded and in place by 2035.

The other comparisons provided in Table 13 is how conditions can be expected to change overtime, from the year 2011 to 2035, if no changes were made in the types of transportation projects funded or implemented and if the projects were funded. This compares conditions in the year 2011, with no enhancement of alternative modes conditions, to conditions in the year 2035, also with and without any enhancements. This comparison incorporates the expected growth in development and population in the City of Pittsburgh and how travel conditions might change if current policies on funding alternative transportation projects are maintained.

Based upon the MOEs selected for comparison, the goal of alternative mode enhancements reducing traffic congestion by encouraging mode shifts to transit, bicycles and pedestrian modes was tested. The following provides a brief description of each MOE and the results of this comparison.

3.3.7.1 Total Distance Traveled in Vehicle Miles

This MOE measured the total amount of travel on an ADT basis within the entire roadway network. The reduction, when comparing the year 2035 No-Build to the Build condition, revealed a positive impact on the roadway system by implementation of the alternative mode projects. The model estimated a 7% reduction in total distance traveled in vehicle miles. This MOE change reflects a shift in travel choice from auto to transit, which carries more persons per vehicle mile in buses, and a reduction of auto vehicle trips by shifts to bicycle and pedestrian modes.

A comparison of the year 2011 conditions to the year 2035 no build and build conditions was also performed. This comparison showed that if no enhancements were implemented in this time period the model predicts the number of ADT vehicles miles of travel will increase by 13% within the City of Pittsburgh. With the build condtions the increase is 7%.

This MOE comparison clearly demonstrates that, even with growth in travel and the building of the alternative mode projects from the year 2011 to 2035, reductions in total travel were predicted.

3.3.7.2 Average Travel Time

The MOE of average travel time for a trip within the network reflects the level of congestion in the network. When average travel times are predicted to increase this is an indication that additional delays and congestion on roadway segments are causing this change. The results of the model show a slight increase of approximately 1.4% when comparing the year 2035 no build and build conditions. This is a negative indicator of the impact of the alternative transportation

project implementation. However, this increase could be due transportation influences outside the boundary of the City of Pittsburgh, but within the regional model area. One important consideration in reviewing this MOE was that while policies and projects can help to influence travel choices, the external impacts of regional growth could overshadow these positive changes within the City of Pittsburgh.

Comparing the year 2011 conditions to the year 2035 no-build and build reveals that average travel times will increase by over 8% without the alternative mode enhancements being implemented. The increase under the build condtions is 10%. Therefore, it can be concluded that although this MOE shows a negative impact the alternative mode enhancements do a have an impact on travel times by reducing the travel time increase by over 6% from current to future condtions.

3.3.7.3 Average Travel Distance

The average travel distance or length of a trip MOE can be a reflection of development patterns within the city and the availability of highway and transit links for travel. As growth occurs in the City of Pittsburgh the geographic location of employment and housing can reduce or increase the average travel distance for a trip. The model results for the year 2035 no build and build conditions showed an insignificant change in average travel distance. This could be caused by more diverse employment or housing locations within the city. An increase of 1.8% is projected from existing to 2035 no-build conditions, which shows some mitigating factors by the alternative mode enhancements. Under the build condtion the incrase is 2%

3.3.7.4 Average Speed

Travel speeds are an MOE similar to travel time. Reduced speeds reflect increased congestion on the links in the network. The model results revealed an approximate 1% reduction in this MOE when the year 2035 no build and build conditions were compared. The increase that is reported without the mode enhancements, when comparing year 2011 to the year 2035 no build conditions, was over 7%. The year 2011 comparison to 2035 build showed a decrease of 8%. This confirms some minimal positive impacts of the alternative mode projects selected for implementation from the year 2011 through 2035.

3.3.7.5 Number of Congested Links

One MOE or modeling parameter to measure transportation system performance is to determine how the traffic capacity on a particular link in the system compares to the traffic demand. If the traffic demand exceeds the capacity then the link, or the volume to capacity ratio is greater than 1.0, the link is considered to be congested. The number of congested links measured from the year 2011 to the year 2035 under the various conditions is a significant MOE. The model results for this MOE showed a slight increase in the number of links over capacity when comparing the year 2035 no build to build conditions. The number of congested links in the future was projected to increase more significantly, if the alternative mode projects were not implemented. This comparison showed an increase of over 11% as compared to similar incrase in the build condtion.

4.0 RESULTS AND DISCUSSION

The results of this research revealed that using traffic impact fees to fund alternative mode transportation projects to encourage modal shifts in urban areas needs better definition of the goals for this type of transportation funding. The goal of generally improving travel conditions in an urban may be too broad to measure the impacts, which was concluded by the research. The research revealed minimal impacts of a substantial funding program of a broad range alternative transportation projects in an urban area. In San Francisco, the city is dedicating all traffic impact fees one alternative mode which is public transit.

The survey results showed that funding these types of projects using traffic impact fees is being implemented on a limited basis and that some urban areas, such as San Francisco, and that transportation planning professionals consider the concept to be valid.

The use of a transportation planning model to predict outcomes of an alternative transportation funding program using traffic impact fees for the City of Pittsburgh concluded that negligible transportation benefits would be predicted. A financial feasibility analysis predicted a shortfall of revenues to fund the desired alternative mode projects. However, this was a first attempt to explore such a transportation program approach and refinement of the program of projects funded as well as the structure of the traffic impact fees could result in more favorable results.

The research concluded that this type of local transportation funding in an urban area needs to be focused on alternative transportation project types that can have a direct impact on traffic congestion and be matched with other major transportation funding sources to implement projects that can have a direct impact on travel conditions. The following expands on the results in each of the three methods used to explore the hypothesis.

4.1 INTERVIEW OF GOVERNMENT AGENCIES WITH ALTERNATIVE MODE IMPACT FEES

All of the agencies confirmed that they were using impact fees in some manner to fund alternative transportation projects. However, none of the agencies used a specific method to identify what projects were to be funded or how to determine which projects may be most effective in reducing traffic congestion. Most of the agencies (3 out 4) did have specific enabling legislation to use impact fees for this purpose. The types of projects funded varied widely and included bus facilities, light rail expansions, bikeways and sidewalks. These interviews and contacts affirmed that some efforts to use impact fees for this purpose have been implemented on a limited basis. However it was also determined that there was no experience in measuring or predicting of their impact on the transportation system in that specific urban area.

4.2 SURVEY OF GOVERNMENT AGENCIES WITH IMPACT FEES

The survey revealed important information to guide the research. The number of communities that use impact fees to fund alternative transportation projects is very limited, 20% of those surveyed responded positively. Pedestrian and transit facilities are the most frequently funded type of alternative mode improvements projects in conjunction with highway capacity improvements. Based on the survey results, very few transportation planning studies are done to justify the benefits of alternative mode improvements. No methods of studies or planning were identified to select the most effective alternative mode projects. Insightful comments provided in the final question of the survey included:

"*The reality of implementing traffic impact fees or funding alternative mode projects is tied directly to the local or regional political leanings of a given area. More progressive communities will do this, while more conservative communities will not, even if the bottom line is shown to be beneficial"*

"Our impact fees are limited to roadway capacity improvements. Any change to the methodology to allow for alternative Transportation modes would require action by the State legislature which is very unlikely"

"Would be interested to know about impact fee credits for a developer's alternative transportation improvements and criteria to establish"

This survey provided important information in the research process relative to the type of alternative mode projects that transportation professionals feel are important to be funded. It also identified that, without a predictive method to determine the benefits of such funding, it may be difficult to convince elected officials to use this funding method. These survey results helped guide the testing of the hypothesis through the transportation planning modeling process.

4.3 TESTING THE HYPOTHESIS

The testing of the hypothesis using the model involved the review the MOE model results and determining their applicability to the survey results.

4.3.1 Comparison of all Model MOE Results

The conclusion of the hypothesis testing, using the model MOE results, was summarized in several terms. It appeared that limited relative transportation system benefit is projected from the program of alternative mode enhancements improvements that were selected for testing. This conclusion was based upon comparing the year 2035 no build to the year 2035 build conditions. This conclusion is supported by the results that revealed 4 of the 5 MOEs selected for review showed negative results. Negative results were defined as degradation in travel conditions as described by the MOEs.

However, when comparing the future year 2035 no-build travel condition to the year 2011 condition it was concluded that the increase in traffic congestion could have been significantly worse. The researchers concluded that by implementing the alternative mode projects travel conditions by the year 2035 transportation conditions will remain static or be slighted degraded. This was a positive impact projection, given the growth in the City and region that must be accommodated by the transportation system with little or no increase in the highway capacity.

The projected revenues, for all six different funding scenarios, showed that insufficient revenues would be generated to completely fund the program of alternative mode projects selected for testing. This result was expected because local funding sources, such as traffic impact fees, are rarely sufficient for full funding of major transportation investments. However,

as shown in the research results, even with significant funding from alternative sources and assuming 80%, revenues from those sources, revenues still fall short of the 20% local funding level. The conclusion was that the expected revenues are in the range of 1.7% to 2.0% of the total program costs.

The level of capital cost investment in the alternative mode projects, the type of alternative projects selected and the traffic impact fee structure are all variables that could be evaluated further to determine what combination of these could results in a more positive result relative to funding of the alternative mode projects.

It is noted that the model results are based upon many levels of uncertainly. This includes the land use assumptions, growth projections and many other factors that impact the results. Any use of these projections should be validated by period surveys of mode use.

4.3.2 Application of the Research Results to Other Urban Areas

The results of the MOVEPGH transportation planning model MOEs were compared to responses received from the survey. The purpose of this comparison was to determine the applicability of the City of Pittsburgh model results to conditions in other urban areas. This comparison revealed that the transportation planning professionals, while supporting the concept, were split on their predictions as to the effectiveness of such a strategy to address urban congestion. They respondents also had little experience with predicting or demonstrating the effectiveness of such funding being dedicated to alternative mode projects. However the survey respondents recognized the importance of such studies to convince decision makers to implement such a funding program.

5.0 SUMMARY AND CONCLUSION

The purpose of this research is to determine if focusing traffic impact fees on alternative mode capital improvement projects would this result in the enhancement of the transit, bicycle and pedestrian systems in an urban area. Alternative mode transportation projects are defined as improvements to the transit, pedestrian and bicycle facilities in a transportation network.

Based upon a review of the literature, there have been relatively few attempts to use traffic impacts fees to fund alternative transportation mode projects. Traffic impact fees have traditionally been used to fund capacity adding transportation projects to mitigate the impact of growth.

The research involved development of a limited contact base of government agencies that have used impact fees to fund alternative transportation projects. This contact base and interviews with experts in this field, gave a perspective of the limited use of these fees currently.

A national survey of transportation planners and engineers, who work with government agencies and administer traffic impact fees, was also conducted. One purpose of this survey was to further determine if impact fees are used to fund alternative mode projects and how they are implemented. This survey identified alternative mode enhancements, such as pedestrian and transit facilities that are funded by impact fees and the methods of project selection and measuring effectiveness.

A transportation planning model developed for the City of Pittsburgh, Pennsylvania was used to test the effectiveness of alternative mode projects enhancements in an urban transportation network. The model evaluated a significant long-range program of transportation alternative mode enhancements. Measures of effectiveness that were outputs of the model (e.g., average travel speeds, congested links and number of transit trips), were compared in the future no-build and build conditions to determine the impacts on the transportation network.

The model results revealed some positive and negative impacts on future travel conditions due to implementation of these alternative mode projects. The results included a positive impact on the roadway system performance by projecting a 7% reduction in total distance traveled in the roadway network. A negative impact, which was an increase in average travel distance, was also a result.

Potential revenues from the impact fee were estimated based upon the long-range projected growth in the City of Pittsburgh. The projected revenues were compared to the cost of the alternative mode projects to determine the financial feasibility of using impact fees for this purpose.

The results of this work revealed a limited positive impact in overall congestion measures in the City of Pittsburgh, maintenance of expected travel characteristics and a minimum revenue realization compared to transportation project costs. However, employing impact fees as a revenue source for alternative mode enhancements is worth exploring further. One consideration for further research would be concentrating their use in a specific urban neighborhood or corridor which may result in more focused results relative to convincing travelers to shift modes or generally enhancing the transportation travel characteristics of an urban

6.0 FUTURE STUDIES

For the consideration of future research approaches on this subject the foundation of the hypothesis was examined. The foundation is based upon the principal that when travelers are provided alternative mode enhancements a significant modal shift will occur. These modal enhancements could be funded directly by traffic impact fees. Future research should consider the magnitude of the transportation problem that is attempting to be solved by this program and the funding approach selected.

If an urban areas where traffic congestion is so severe that additional transit, bicycle or pedestrian trips will not have a significant impact, this condition may dis-qualify such cities from benefitting from this approach. A process to screen urban areas that may have the potential to experience significant mode shifts should also be considered in the revised hypothesis. Older urban areas that have limited rights of ways for additional public transit, bike lanes and pedestrian facilities may restrict the ability to show success of this approach.

6.1 EXAMPLES OF IMPACT FEES BEING USED

The case studies provided important information about how impact fees were being used and how this could impact urban traffic congestion. The San Francisco case study shows that an

urban area must be committed to a “Transit First" policy. This can be implemented by land use policies as well as transportation project funding. A key to this approach in San Francisco was the limitation of parking that is permitted to be constructed with new land development projects. By limiting the number of parking spaces that can be constructed with a new land development, travelers are forced to considered modes other than the auto because parking is not available.

The state of Florida approach is more likely typical of an approach that would work in most urban areas. This approach dedicated a limited amount of the revenues generated by impact fees to alternative transportation projects. This “Phasing in Approach” would permit some funds to be used for these types of projects which still attempting to increase highway capacity. This would allow transportation planners to establish baselines of travel conditions, such as the MOEs used in the model process for this research, and track those over time through empirical studies to show the success or failure of the specific alternative mode projects, that are funded.

6.2 MEASUREMENT OF BENEFITS AND LIMITED SUPPORT FOR EXPANSION OF SUCH PROGRAMS

Critical to use of traffic impact fees for this purpose is the measurement of the transportation benefits. While transportation planning models attempt to predict long term benefits of such actions more immediate measurements of benefits are needed. Surveys of transportation users to determine modal split shifts soon after alternative mode projects are implemented would be one method to quantify benefits.

Current transportation funding conditions on the federal, state and local levels will find limited support for additional fees to support transportation without showing a direct and cost

effective benefit to the transportation system. However the key to such support is again demonstrating the benefits of such an approach. Benefits can be measured beyond travel modes and traffic congestion and include fuel consumption and air quality benefits.

6.3 FOCUSING THE IMPACT FEE AREA

The experience gained by the researchers concluded that focusing the traffic impact fee areas within a small are of a City may result in more success. Many states that permit impact fees, including Pennsylvania, limit traffic impact fees to smaller geographic areas or districts than the City of Pittsburgh. The purpose of this limitation is to ensure that the revenues generated by a land development realize the benefit in the transportation network in close proximity to the land use that paid the fee. This “Rational Nexus” approach is also used by many other states. It is recommended that future research in this area evaluate corridors or sectors of an urban area and test the effectiveness of alternative mode projects in those smaller geographic areas. The future research should also compare the project costs to revenues that may be realized in this smaller geographic area. Corridor or sectors that have the potential for greater economic growth and demonstrate a need for more transportation alternatives may realize a higher level of transportation benefit.

Focusing the impact fee area should also involve the development of a tool to evaluate projects on an individual basis. This tool could determine the localized and positive benefit of a particular project prior to including it into a larger program of alternative mode improvements. This tool would involve the development of a smaller scale planning model of the area or corridor and specific MOEs related to travel conditions in that area. The MOEs may include

those used for a larger scale model such as vehicle miles of travel or travelers via transit however the project to be evaluated is a bicycle or pedestrian project other MOEs might be more appropriate. These other MOEs may include the number of bicycles using a facility or pedestrian walking times.

6.4 IMPACTS OF TRAVEL OUTSIDE THE URBAN AREA

Use of the transportation planning model in the City of Pittsburgh revealed that when an urban area is a major regional employment and commerce hub the impacts of travel trips, that are originating outside of the urban area, may outweigh the benefits that could be realized by such an traffic impact fee program in the urban area. While mitigation of traffic impacts is the goal of the alternative transportation project funding, the impacts of growth that are originating from outside of the urban area, not just within the city boundary, may be too significant to overcome.

Expansion of the impact area is an option that should also be evaluated to address this issue. Because regions experience economic development on a wide geographic scale, traffic impact fee revenues could be collected on a regional basis. If a significant number of new trips are being generated outside of the city and this growth cannot be accommodated in the City, then the benefits of these alternative mode projects may not be significant. A regional approach would be one alternative to only enacting the traffic impact fees in an urban area. The State of Florida does use such a regional approach by enacting impact fees on a county-wide level. This may be an approach worth consideration.

6.5 IMPROVED MODELING METHODS

Currently many travel demand models cannot predict or even consider bicycle or pedestrian trips in the modal split model. This may require a more microscopic modeling process that replaces the traditional large aggregation of land use characteristics. This microscopic approach will require greater data to develop algorithms to predict such behavior.

6.6 SUMMARY

In summary, this research revealed shortfalls and benefits to using traffic impact fees in urban areas to fund alternative transportation projects. This research advanced the body of knowledge in this area and set forth a framework for continued research work to evaluate this alternative transportation funding approach to address urban traffic congestion. Improvements in modeling techniques, evaluation of smaller or regional areas and better measurement to system benefits were all identified as important areas for future research. These future research areas should include evaluate both the methods used to predict impacts of alternative mode projects and development of a method to screen such projects on an individual basis to assess their benefit to the system.

APPENDIX A

LITERATURE REVIEW SUMMARY

Table 1 Summary of Literature Review

Type of Researcher or Agency	Summary of Findings
Federal Agencies or State Agencies	
General Accounting Office GAO - Value Capture Policies for Transit (1)	Joint Development or TOD developments create value for private development and government agencies but Impact Fees are not used
Oregon DOT - Transportation Utility Fees (2)	Research explored the use of transportation utility fees for funding of capital and operating costs. Using congestion pricing caused some shift to public transit
Study for Minnesota Legislature(3)	Explored the increased value capture of transit related developments and how this could be used for transportation funding
Conference Proceedings and Professional Journals	
ITE conference presentation on Multi-Modal implementation strategies for impact fees (4)	Explanation and hypothesis on new Florida Law that allows fees to be used for alternative mode enhancements
ITE Article on impact fees and proportionate shares (5)	Provides alternative methods to calculate impact fees
ITE international conference (6)	Considers how land patterns may change based upon charging impact fees
Eno Foundation Article (7)	Establishes the legal precedents for charging impact fees
University Based Research	
Oregon State University research on vehicle mileage fees (8)	Evaluated how a VMT fee would compare for urban and rural areas
University of South Florida research on alternative funding sources for transit (9)	Concluded that regulatory and zoning methods maybe more successful than impact fees for public transit

(1) GAO (United States Government Accountability Office), Report to Congressional Committees, Public Transportation, Federal Role in Value Capture Strategies for Transit Is Limited, but Additional Guidance Could Help Clarify Policies, July 2010

(2)McMullen B. Starr, Zhang Lei (2008) Techniques for Assessing the Socio-Economic Effects of Vehicle Mileage Fees ,Oregon State University Report OTREC-RR-08-1 SPR 655

(3)Lari A, Levinson D,Matthew, Zhao Z, Iacono M,James, Aultman S, Das K,Vardhan, Junge J, Larson K, Scharenbroich M (2009) Value Capture for Transportation Finance: Technical Research Report:373

(4)Collins J (2010) Implementing Multi-Modal Enhancements for Downtown Redevelopment Mitigation ITE 2010 Technical Conference and Exhibit. Meeting Transportation's 21st Century Challenges. Compendium of Technical Papers

(5) Jackson (1994) Traffic Impact Study and Proportionate Share Impact Fees, Institute of Transportation Engineers ITE Journal Volume: 64 Issue Number 9

(6) Thompson, B A, Thompson, R J (1992) Managing Traffic Impact Through Land Use Controls. Transportation Engineering in a New Era. Issue Papers for the ITE 1992 Internaational Conference, Monterey, Californaia.

(7) Sussna S (1990) Land-Use Regulation and Financing Transportation Improvements, Transportation Quarterly ENO Foundation 44:p. 389-403

(8) Guo, Zhan, Agrawal, Asha Weinstein, Dill, Jennifer, Quirk, Megam, Reese, Melissa (2011)The Intersection of Urban Form and Mileage Fees: Findings from the Oregon Road User Fee Pilot Program Monograph UC Berkeley Transportation Library

(9) Hendicks SJ (2002) Alternative Funding Sources for Public Transit, Paper presented ITE 2002 Annual Meeting

APPENDIX B

SURVEY QUESTIONARE

Transportation Impact Fee Research Survey

Using Traffic Impact Fees for Alternative Mode Projects

1. Does your City of Municipality currently collect traffic impact fees?
    A. Yes
    B. No (go to question 9)

2. Have you used your traffic impact fees to fund alternative transportation projects such as transit, pedestrian or bicycle capital improvement projects?
    A. Yes (go to question 3)
    B. No (go to question 8)

3. What method did you use to determine which alternative mode projects were to be funded with traffic impact fees?
    A. As part of the impact fee study and analyzed as to the impact on mode choice
    B. As part of the impact fee study and selected without analysis of impacts
    C. Selected for funding but not part of the study that established the fees
    D. Other, please describe _____

4. Does the enabling legislation that permits you to impose traffic impact fees permit funding alternative transportation projects such as transit, pedestrian and bicycle capital improvement projects?
    A. Yes
    B. No
    C. Not clear in legislation
    D. Not sure explain_____

5. What types of alternative mode projects have you funded with traffic impact fees?
    A. Transit Stations
    B. Transit stops
    C. Transit service
    D. Bus pull off areas
    E. Bus shelters
    F. Sidewalks
    G. ADA ramps
    H. Walking trails or paths
    I. Bicycle parking racks or other bicycle station facilities
    J. Bike lanes
    K. Bike recreational paths

L. Others describe _____

6. Have you ever conducted a study to determine the effectiveness of funding alternative transportation projects either before or after implementation?
   A. Yes
   B. No (go to question 8)

7. Please check the following if they were measures of effectiveness for the funding of alternative transportation projects:
   A. Traffic level of service or congestion
   B. Transit ridership
   C. Transit crowding
   D. Transit travel times
   E. Walking or biking activities
   F. Shifts in modal use from auto to transit, pedestrian or bicycle modes
   G. Other studies, please describe _____
   H. Please describe such studies and the results or forward a copy of the study or a link to where it can be accessed

_____

_____

_____

_____

_____

Skip to question 9

8. Does the enabling legislation that permits you to impose traffic impact fees also permit funding of alternative transportation projects such as transit, pedestrian and bicycle capital improvement projects with traffic impact fees?
   E. Yes
   F. No

9. In an urban or suburban area where transit it provided and walking/biking are realistic alternatives to auto travel, do you feel that funding of capital improvement projects for

alternative modes would result in a significant shift in mode choice by travelers and help reduce congestion?

A. Yes defiantly
B. Yes, somewhat
C. Yes, but not sure how much
D. No

10. If not currently permitted by governing legislation, do you think that is would be politically feasible to change the governing legislation for impact fees to permit funding of alternative mode projects by traffic impact fees in areas where transit service and waling/biking are viable alternative transportation choices?
    A. Not applicable fees already permitted for alternative mode projects
    B. Yes
    C. Yes with the following provisions _____
    D. No

Please provide any additional information that you feel maybe relevant to this research inquiry. Items such as studies and legislation that enacted impact fees that permit alternative mode funding and studies that have evaluated the effectiveness of such fees are also requested.

Thanks you for your participation in the survey.

APPENDIX C

SURVEY RESULTS

Traffic impact fees are a permit fee charged to developers to mitigate their impact on transportation facilities. Does your City of Municipality currently collect traffic impact fees?

Answer Options	Response Percent	Response Count
Yes	61.1%	22
No	38.9%	14
answered question		36
skipped question		0

Have you used your traffic impact fees to fund alternative transportation projects such as transit, pedestrian or bicycle capital improvement projects? If so please indicate the types of projects funded.

Answer Options	Response Percent	Response Count
Transit Stations	0.0%	0
Transit stops	0.0%	0
Transit service	0.0%	0
Bus pull off areas	5.0%	1
Bus shelters	5.0%	1
Sidewalks	35.0%	7
ADA ramps	25.0%	5
Walking trails or paths	15.0%	3
Bicycle parking racks or other bicycle station facilities	0.0%	0
Bike lanes	15.0%	3
Bike recreational paths	10.0%	2
Others describe _____	5.0%	1
No	60.0%	12
answered question		20
skipped question		16

Does the enabling legislation that permits you to impose traffic impact fees also specifically permit funding alternative transportation projects such as transit, pedestrian and bicycle capital improvement projects?

Answer Options	Response Percent	Response Count
Yes	42.9%	3
No	28.6%	2
Not clear in legislation	28.6%	2
D. Not sure explain		0
answered question		7
skipped question		29

What method did you use to determine which alternative mode projects were to be funded with traffic impact fees?		
Answer Options	**Response Percent**	**Response Count**
Alternative mode projects were analyzed as to the impact on mode choice and congestion and then made part of the program	0.0%	0
Selected without analysis of impacts on mode choice or roadway congestion	0.0%	0
Selected on the basis of alternative mode projects identified through other studies that needed funding	50.0%	2
Other (please specify)	50.0%	2
answered question		4
skipped question		32

Have you ever conducted a study to determine the effectiveness of funding alternative transportation projects either before or after implementation?		
Answer Options	**Response Percent**	**Response Count**
Yes	25.0%	1
No	75.0%	3
answered question		4
skipped question		32

Please check the following if they were measures of effectiveness for the funding of alternative transportation projects:		
Answer Options	**Response Percent**	**Response Count**
Traffic level of service or congestion	100.0%	1
Transit ridership	0.0%	0
Transit crowding	0.0%	0
Transit travel times	0.0%	0
Walking or biking activities	100.0%	1
Shifts in modal use from auto to transit, pedestrian or bicycle modes	100.0%	1
Please describe such studies and the results or forward a copy of the study or a link to where it can be accessed	0.0%	0
answered question		1
skipped question		35

In an urban or suburban area where transit is provided and walking/biking are realistic alternatives to auto travel, do you feel that funding of capital improvement projects for alternative modes would result in a significant shift in mode choice by travelers and help reduce congestion?		
Answer Options	**Response Percent**	**Response Count**
Yes definitely	7.4%	2
Yes somewhat	44.4%	12
No	48.1%	13
Other (please specify)		1
	answered question	27
	skipped question	9

If not currently permitted by governing legislation, do you think that is would be feasible in your jurisdiction to change the governing legislation for impact fees to permit funding of alternative mode projects by traffic impact fees in areas where transit service and walking/biking are viable alternative transportation choices?		
Answer Options	**Response Percent**	**Response Count**
Not applicable fees already permitted for alternative mode projects	14.8%	4
Yes	18.5%	5
No	59.3%	16
Yes with the following provisions	7.4%	2
	answered question	27
	skipped question	9

BIBLIOGRAPHY

Johnson Jaye Pershing, McDaniel Esq. James B. Uses of Fees or Alternatives to Fund Transit. TCRP Legal Research Digest, Issue 28, 2008, 37p

Sussna S (1990) Land-Use Regulation and Financing Transportation Improvements, Transportation Quarterly 44:p. 389-403

Lari A, Levinson D,Matthew, Zhao Z, Iacono M, James, Aultman S, Das K,Vardhan, Junge J, Larson K, Scharenbroich M (2009) Value Capture for Transportation Finance: Technical Research Report:373

Hendicks SJ (2002) Alternative Funding Sources for Public Transit, Paper presented ITE 2002 Annual Meeting

Collins J (2010) Implementing Multi-Modal Enhancements for Downtown Redevelopment Mitigation ITE 2010 Technical Conference and Exhibit. Meeting Transportation's 21st Century Challenges. Compendium of Technical Papers

GAO (United States Government Accountability Office), Report to Congressional Committees, Public Transportation, Federal Role in Value Capture Strategies for Transit Is Limited, but Additional Guidance Could Help Clarify Policies, July 2010

Guo Z, Agrawal A, Weinstein, Dill J, Quirk M, Reese M (2011) The Intersection of Urban Form and Mileage Fees: Findings from the Oregon Road User Fee Pilot Program, Monograph, UC Berkeley Transportation Library

Seggerman K,E, Nelson A,C, Nicholas J,C, Williams K,M, Lin P, Fabregas A,D (2010) The Transportation Utility Fee, ITE 2010 Technical Conference and Exhibit. Meeting Transportation's 21st Century Challenges. Compendium of Technical Papers

McMullen B. Starr, Zhang Lei (2008) Techniques for Assessing the Socio-Economic Effects of Vehicle Mileage Fees ,Oregon State University Report OTREC-RR-08-1 SPR 655

Transportation Impact Fees A Handbook for Pennsylvania’s Municipalities, Updated March 2009. Published by the Pennsylvania Department of Transportation

Buehler Ralph, Pucher John, Kunert Uwe, Making Transportation Sustainable Insights from Germany, Prepared for the Brookings Institution Metropolitan Policy Program April 2009

Horowitz, Zachary, Parisi, David, Replinger, John; Forecasting Pedestrian and Bicycle Demands Using Regional Travel Demand Models and Local Mode Share/Trip Distance Data, published in the TRB 89th Annual Meeting Compendium of Papers

Implementation of the with-without principle in the assessment of economic, social, and environmental impacts of affirmative transportation actions, Author Mark Joseph Magalotti, 1979.

Travel Demand Forecasting: Parameters and Techniques, NCHRP REPORT 716, published by The Transportation Research Board, Washington D.C. 2012RANSPORTATION RESEARCH BOARD