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Dynamics of Transit Oriented Development, Role of Greenhouse Gases and Urban Environment: A Study for Management and Policy

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Abstract: The emission and mitigation of greenhouse gases transforms the status of urban environments. However, a policy accounting for all the aspects associated with transport is lacking. Problems related to transport include a greater reliance on cars, increased congestion, and environmental impacts. The absence of an efficient public transport system is a notable cause of the prompt escalation of diverse problems, for example, increases in the number of personal automobiles causes congestion on the road, resulting in air pollution, ubiquitous greenhouse effects and noise pollution, which ultimately affect human health. Transit oriented development (TOD) has been suggested as a solution to these problems. This paper reviews the impacts of transit development on urban development, greenhouse impact, the environment, economy, property value, travel behavior, and health etc., highlighting the policy issues which hinder TOD. Implementation of TOD has a strong impact on shaping the urban form, redevelopment, and the upgradation of old areas. Controlling transit phenomena will also help to control the emission and mitigation of greenhouse gases. This study will help in improving the urban environment and climatic condition of regions.

Keywords: sustainability; urban development; transit; travelling; greenhouse gasses; transport policy

1. Introduction

The development of a transportation system and a policy for public transport is beneficial for the environment. Additionally, the level of convenience and public health are major concerns. Eco-friendly transportation is an important aspect of the development of any community and in recent years transit-oriented development (TOD) has gained increasing significance. Transit-oriented development aims to achieve the production of practical, blended-use, pedestrian-friendly urban neighborhoods that incorporate travel, lodging, schools, parks, and other social and monetary enhancements, benefitting various associated groups accordingly. TOD battles urban sprawl by utilizing dynamic arranging systems, for example, savvy development and green buildings, and by providing access to make transportation decisions instead of using a car. TOD tends to be implemented in well-to-do, white, rural neighborhoods around recently introduced suburbanite rail lines as opposed to in low-wage, nonwhite, inward city neighborhoods that effectively already

have existing travel foundations. A large part of the present TOD literature and practices concentrate on locales situated in rural groups and neglect the potential open doors for TOD in low-salary urban neighborhoods. The development of roadways empowers lodging improvements in areas more distant from the downtown areas and simultaneously draws low-expertise employment far from the urban center. Interest in interstate advancement and auto-arranged transportation approaches energize rural sprawl and deliver negative social and monetary impacts, for example, private isolation and the absence of access to passage level work for minorities [1]. Transportation strategies, along these lines, segregate low-salary, nonwhite inward city neighborhoods in urban focuses with substandard travel frameworks and an absence of access to lodging and different administrations. By diverting open venture towards inward city travel, and also, impelling monetary improvements in urban groups, TOD can function as an instrument for both the reasonable advancement of areas and a method for addressing many years of travel shamefulness in urban territories. In particular, inward city groups have experienced disinvestment out in the open travel. Moreover, the vast increase in urban territory-based nations has “reestablished enthusiasm for rail travel and rail speculation” in the past decade. This has led to Metro transport frameworks in created nations dedicating significantly more financing resources to rail services, in the hope of drawing in the white-collar class, and tempting rural occupants away from their cars. As an example, we can consider the case of the Metro’s rail framework, which serves 6,675,759 month-to-month riders. Since the majority of these transport riders are low-paid and nonwhite citizens, the move towards subsidizing rail travel over other transport options justifiably troubles these poor inward city inhabitants and supports center and high society occupants who more frequently utilize rail services [2]. This study contends that TOD can address travel disparity by diverting ventures and improvements towards transport benefits in the internal city. Planning for TOD in internal city groups, be that as it may, faces many difficulties. Because of the sheer size of urban communities, a solitary exhaustive arrangement cannot provide sensible rules and used devices for the future development of the area. A series of TOD related concepts have been explained in Table 1.

Table 1. Concepts of transit oriented development.

Author	TOD Concepts
Salvesen [3]	Development around a transit station providing opportunities for a diversity of land uses in a specified geographical area.
Boarnet and Crane [4]	The practice concerning the development of densified residential land use around the transit station.
Still [5]	Mixed land use development encouraging people to live around the transit services, at the same time decreasing dependence on a private vehicle.
Cervero, Ferrell [6]	A transit oriented development (TOD) system is mainly designed to enhance the use of public transport/transit and to create an urban setting providing pedestrian-friendly environment.
Loo, Chen [7]	Under the guiding principles of transit-oriented development (TOD), the basic ideas are to design an urban form in a relatively high density, compact and mixed form, and to provide high quality, efficient mass transportation services, together with a pedestrian-friendly environment.
Claudio Sarmiento [8]	Transit oriented development is dense, mix-used development which provides good biking and walking connections in the city, particularly areas served by transit facility.
Ngai Weng Chan [9]	Transit oriented development is the creation of walkable, compact, and mixed-use communities around a high-quality transit facility.

The land use element of the city's advancement plan, in this manner, partitions the city into community-based planned areas. In the literature, TOD is defined in many ways with no single definition of TOD prevailing.

2. Characteristics of TOD

Transport is directly related to the urban economy following the principles of Transit Oriented Development as shown in Figure 1. A series of characteristics of a typical Transit Oriented Development [10] are given below:

1. TOD provides the benefit of mix-use development which can be seen on a single parcel of land or throughout the transit corridor.
2. TOD provides the opportunity of walking by providing the transit stations at the most convenient places.
3. The benefit of high-rise development is also associated with TOD.
4. TOD provides more opportunities for pedestrians and cyclists.
5. Public participation is an important part of TOD.

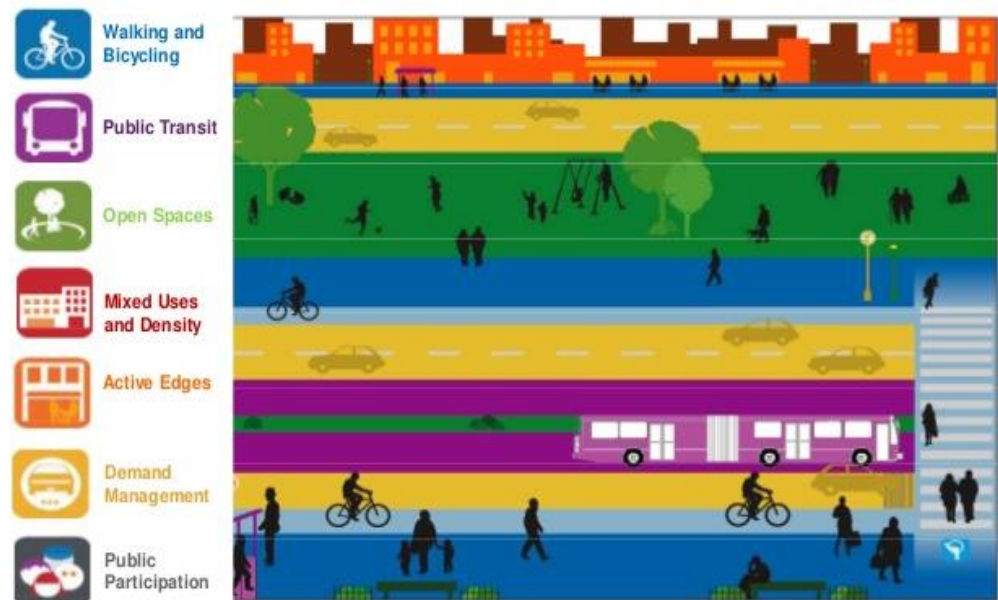


Figure 1. Principles of transit oriented development. Source: [11].

As transport becomes cheaper, companies and households prefer to move to a peripheral location to reduce the higher rent charges in the center of the city and other costs like congestion, crime, and pollution in inner areas of the city. This gives them better opportunities to expand their market to increase profitability through investing in land and labor and spending less on transport. Transit Oriented Development provides companies with an environment to enhance profitability and by providing easy access to households to fulfill their needs with reduced cost [12]. The benefits that can be gained from TOD are shown in Figure 2.

Many studies have been carried out to understand the effect of mass transit systems on health and other related outcomes in recent years. There is a perception that built environment has an effect on travel choice, peoples' behavior, and their physical activity, but no efforts have been made to understand the benefits arising in monetary terms (in dollars) from the introduction of land-use policies that encourage walking, biking, and use of transit facilities. There is very little difference between the health cost-saving and the cost required for the construction and operation of transit facilities like light rail. The construction of such facilities indirectly compensates the cost required for health care, as the walking and biking integration into transit system has a positive impact on the health of people and will save money spent on health [13]. In this respect, efforts should be made

to design a parallel transport culture and create a healthy environment which encourages people to use walking, biking, and share public transport as a means of travel to avoid pollution and congestion. Transit Oriented Development (TOD) affects the different aspects of living including economic development, housing, housing density, property values, urban environment, health, travel behavior, and travel choice.

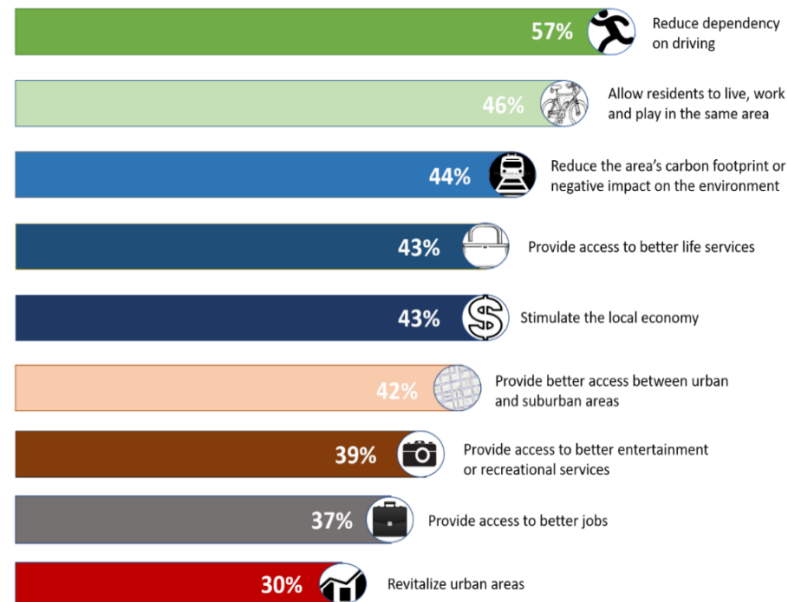


Figure 2. Benefits of transit oriented development. Source: [14].

3. Rationale of the Study

The purpose of the study is to analyze the external impacts associated with the development of a transit facility and how these impacts can be streamlined to encourage Transit Oriented Development (TOD). In the last few decades, many such projects have been launched in Asia. Such projects are important for the development of cities and provide the basis to decide the faith of the city. However, it is imperative in developing countries that external benefits related to transit investments are mostly ignored. In such a scenario, we suppress the city-shaping benefits of transport investment. All these external benefits—including economic, environmental, urban development, and social—can be integrated to capitalize on the limited resources and to promote TOD. Transit oriented development is not only the development of one transit facility, but also the impact on other credentials of development as well. Therefore, this study will focus on the impacts of transit development, which should be considered while developing such a facility, and how the integration of its external benefits can help to solve major problems of cities like congestion, uneven population density, haphazard growth, and urban sprawl. This study will be beneficial for assessing the components of TOD for its development in an integrated way. Moreover, by knowing the impacts of transit, the related components can be planned in a better way by the concerned authorities.

This section is divided by subheadings. It will provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

4. Objective of the Study

Major objectives of this study are:

1. To study the impact of transit on economic growth, housing, housing density, property values, urbanization, urban environment, health, travel behavior, and travel choice.

2. To explore the principle and component of Transit Oriented Development regarding the emission and mitigation of greenhouse gas that transforms the status of an urban environment.
3. To outline the problems in integrating externalities attached with transit development and promoting Transit Oriented Development.

5. Methodology

This research methodology has been developed and is shown in Figure 3. Data from secondary sources have been used in this research and no primary study is being carried out for this paper. One of the main concerns relates to post-industrialization impacts, including the dependency on the private vehicle which has grown at a tremendous rate in the last few decades. Germany and the USA have the highest motorization rate [15] around the globe, with 75% of trips in Germany executed by car [16]. Usage of the car as a transport mode has increased from 23–25% from 1991 to 2001 in Porto, Portugal [17]. Similarly, in the USA the number of people driving alone has increased from 73% to 75% in ten years [18]. To resolve this dependency on private vehicles, many theories have come into existence from the field of planning and architecture, including Smart Growth, Multi-Model Theory, Transit Oriented Development (TOD), and many others. Out of all these, Transit Oriented Development is the theory that focuses on the development of transit facilities, decreasing the dependency on automobiles and encouraging densification. According to Goetz [19] in the United States, Transit Oriented Development is an important part of the broader smart growth strategy for urban development including urban infill, historical preservation, inclusionary zoning, affordable housing, and new urbanism. In China, a lack of integration between urban development and transport influenced the planning and design practices, and furthermore, the benefits of TOD could not be witnessed in real terms [20]. Densification has many other factors relating to it, such as a reduction in energy consumption and decreased dependency on automobiles—which in return reduces congestion and traffic. One of the factors associated with the development of transit includes the increase of land prices along with the transit facility, which aids in regional economic development [21].

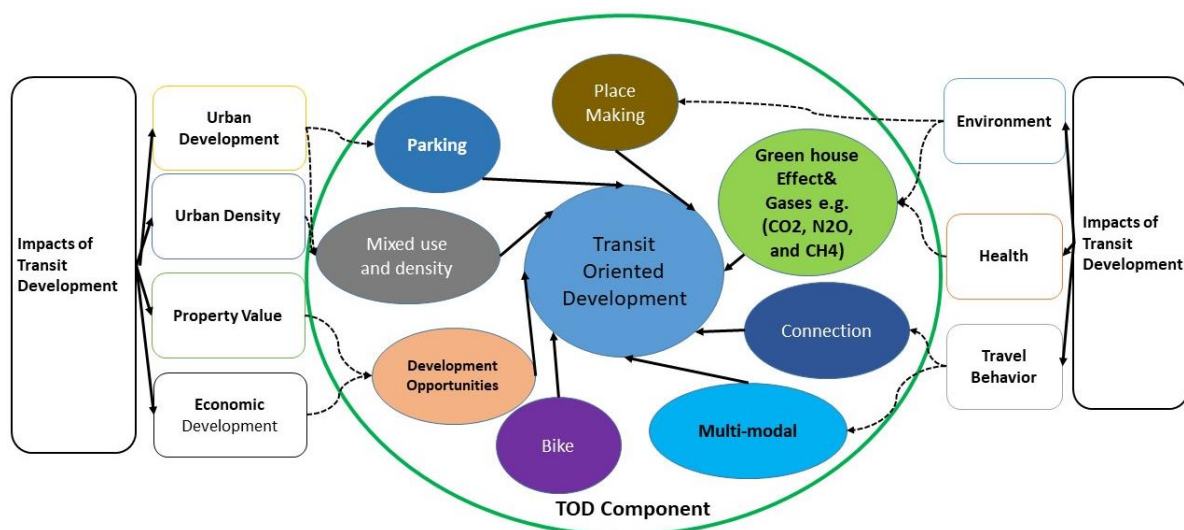


Figure 3. Research methodology for transit oriented development (TOD) Analysis.

6. Analysis and Discussion

6.1. Impact of Transit on Density

The development of transit facilities has an impact on the land use and urban form of the area. According to Ratner and Goetz [22] in Denver, due to the development of transit facility, there was an increase of 3309 to 3979 persons per square mile in the density of the

urban area between 1990 and 2000. From the period 2000–2006, the increase in housing density was from 1379 to 1429 units per km². The analysis of the whole region of Denver shows that in downtown areas the density of housing is far more than the other areas. Moreover, the areas served by transit have higher densities than the whole region itself. From 1997 to 2010, within the half-mile of the transit station, the development of 18,000 residential units was observed. Furthermore, in this same period, 6.2 million square feet of space for medical, 5.4 million square feet of space for office use, and 5.3 million square feet of space for retail were witnessed. These factors demonstrate that the development of transit facility and density of the area has a positive relation. In Tokyo, transit serves as a successful tool for compact and high-density urban development around transit stations [23]. Based on the literature review Puget Sound Regional Council (PSRC) [24], recommended the density and employment benchmarks for the different transit systems to be cost-effective as shown in Table 2.

Table 2. Density and employment benchmarks by transit mode.

	Light Rail Transit	Commuter Rail	Bus Rapid Transit
Walk distance	$\frac{1}{2}$ mile	$\frac{1}{2}$ mile	$\frac{1}{4}$ mile
Residential density	16–67+ residents per gross acre	n/a *	7–8+ housing units per gross acre
Employment	100,000–150,000+ jobs in CBD	CBD employment key	n/a
Activity units	56–116+ residents and jobs per gross acre	n/a	17 +/- residents and jobs per gross acre

* n/a indicates that these metrics were not addressed in the literature reviewed. Source: [24].

6.2. Impacts of Transit of Development

Transit oriented development provides an opportunity for land use and transport planning which can further the goal of sustainable transport and compact urban development [25]. It helps to control urban growth and an efficient use of transport infrastructure can be achieved in urban regions [26]. According to Goodman [27], the development of transit has shown a positive impact on land-use patterns and development around rail stations in Portland, Oregon. In California, the areas that experienced land-use change due to Bay Area Rapid Transit (BART) includes downtown San Francisco, Oakland, and other suburban stations. In San Francisco alone, the rise in the density of office buildings was 70%. Washington, D.C has also experienced development, mainly due to its rail system in the downtown area. Sixty-two percent of office space was planned within a radius of one mile from the Metrorail station. A similar effect was seen in Rosslyn-Ballston where a substantial trend was observed in commercial development and a huge amount of investment was witnessed in private sector projects. In Lahore, Pakistan, substantial land-use transformation was observed after the implementation of the transit facility [28]. In Copenhagen, TOD helped to expand its central business district, which ultimately provides a highly accessible neighborhood for media, office, leisure, and retail activities [29].

6.3. Impacts of TOD on Economic Development

There is a strong relation between transportation, economic development, and the social system present in a region. The policies and decisions made for the development of the transportation system have a great impact on peoples' daily life. The essence behind the development of transit facilities is that they can be used to enhance the urban environment, economic growth, and create new opportunities in a particular area [29,30]. The development of transportation policies not only accounts for transportation improvement, but also all aspects of social life and economic development. These are interrelated in such a way that it is necessary to take transportation policy as a whole and evaluate whether this policy complies with other existing or proposed policies or not. In return, such policies help in the

development of the economy. By considering the high level of interaction between people and business, the development of transportation projects can help in the development of the regional economy with additional benefits to enhance the choice of transportation facilities that are more effective, easily accessible, and have a minimum environmental impact. Different studies have illustrated that investment in public infrastructure promulgates economic development [31]. An inward investment of \$1.2 billion was observed near the rail station through the development of light rail operating from downtown to Gresham. Economic development as result of rapid rail transit can be seen also at the local or regional level [32]. In a study by Green and James [33], the economic development impacts of the rapid transit system were evaluated in Washington D.C. Besides inward investments, there were also other benefits associated with this phenomenon e.g., an extension of the labor market. The study revealed that the zones which contain stations had 2.5 times more jobs than the zones not served by rail stations. According to Bollinger and Ihlanfeldt [34], investment in rapid rail transit based on cost-benefit analysis is difficult and in the absence of economic development the benefits are limited. Thus, besides cost-benefit analysis, there is a need to evaluate the economic impact of transit facilities. An increase in property values is also one of the economic impacts associated with transit development.

6.4. Impacts of Transit on Property Values

The impact of transportation improvement on urban real estate, mainly in terms of higher values of property and densification, has been admitted at large [35]. In San Jose, during the development of the transit facility in 1996–2003, an increase of 7.3% was observed in home prices and this value increased to 18.5% after the development of transit (2004–2006). This impact was observed within 1/8 mile of the distance around transit. This huge increase in home values suggests that transit has a positive impact on home values [36]. In Buffalo, New York the average property values increased by USD 2.31 while moving closer to the light rail station by every foot [37]. According to Wang, Potoglou [37], in Cardiff, Wales, the number of bus stops (within walking distance from a property) is positively associated with property prices. Impacts of transit on land prices have largely been ignored, but transit creates high density and higher land prices as in Seoul, Korea, where the regular operation of the bus service was modified, and a median lane bus service was introduced. As a result of this improvement, property owners adjusting to this corridor transformed their residential single-family houses into apartments with higher density. On the other hand, land prices for residential use upsurge up to 10% within a 300 m buffer of a transit facility. For a buffer of 150 m and non-residential use, the price increase was more than 25% [34]. Therefore, transit development impacts the economic growth parameter as well as the environmental conditions of the area [38]. Table 3 presents findings from different researchers on the impact of transit on land values.

6.5. Impacts of Transit on Urban Environment

In Indonesia, a high flow of motor vehicles was observed due to growing urbanization and prosperous economic growth. The detailed study of the feasibility of transit development revealed that it can help in achieving the extra benefit of urban environment quality, with basic benefits related to its development such as the reformation of land use growth and an increase in the mode share of public transport [48]. Densification can address the prevailing concerns of developed nations e.g., environmental footprints and energy. This can be achieved through the introduction of public transportation, which results in a decline in consumption of energy and air pollution. The issues of environment and energy-related to transportation and land use are interdependent and smart growth strategies are a way to solve the problem of environment and human health. TOD can help in reducing greenhouse gas (GHG) emissions and building life-cycle energy consumption by 9%–25%. The overall impact of GHG can be reduced by 36%, respiratory impacts by 8.4%, and smog by 25% through the proper planning of transportation and buildings. This planning includes reducing automobile use and improving access to the transit facility. Thus, it

can be concluded that a proper transportation system and land use development (higher density) that reduces dependency on an automobile can help in achieving environmental benefits [21]. Figure 4 shows the relationship between urban density (persons/hectare) and transport-related energy consumptions. A decline in transport-related energy consumption can be observed with an increase in urban density e.g., Hong Kong, with the highest urban density, has the lowest transported-related energy consumption. Similarly, investment in transit systems provides the city administration with an opportunity to transform their urban areas and to reduce transport related energy consumption, which ultimately helps to create environmentally friendly neighborhoods. One of the ways of doing this is to use transit investment as tool to encourage transit oriented development.

Table 3. Analysis of Association between Transit Development and Property Values.

Author	Study Area	Findings
Dziauddin [39]	Kuala Lumpur, Malaysia	Condominium located within 800 m to light rail transit station valued \$43,226 (30%) more compared to other parts of the city.
Xu, Zhang [40]	Wuhan, China	Properties with 100 m of transit access received a premium of 16.7% whereas a premium of 8% was observed for properties falling within 100–400 m.
Duncan [41]	San Diego, CA (hedonic price model)	The properties having a good pedestrian environment and near to rail station has a significantly higher value compared to the property not near to rail station in the same neighborhood
Cervero and Murakami [42]	Hong Kong (hedonic price model)	The increase in housing price was observed in the range of 5–30%.
Perk and Catala [43]	Pittsburgh (USA)	Property in 100 feet from transit station valued \$9745 more compared to a property 1,000 feet away from the transit station.
Cervero and Duncan [44]	Santa Clara County, California (hedonic price model)	An increase in the values of commercial properties near the transit station and as well as in the central business district was observed.
Al-Mosaind, Dueker [45]	Portland metropolitan region (hedonic price model)	The property values are positively associated with LRT within 500 m. As the distance increase from the LRT station these values decline at a rate of USD21.75/m.
Cervero and Duncan [46]	Los Angeles County (hedonic price model)	The residential land use near transit stations face a decline in prices whereas, an upsurge in the value of the commercial property was observed
Nelson [47]	Atlanta (MARTA)	The study found that low-income neighborhoods experienced an increase in property values but the situation is the opposite for high-income neighborhoods.

6.6. Impacts of Transit on Health

There has been a lot of research on the impacts of the built environment on health. The results of this research show that extra benefits of health can be achieved through the use of light rail. Taking into account the construction cost of light rail, the corresponding health benefit is relatively small. There is a view that reforms in the built environment (like provision of public transport) can help in reducing the obesity trend, as such systems enhance the opportunity for a walk and other physical activities. There is an estimate that spending one-hour in a car per day can increase the probability of obesity by 6% [50]. Thus, transit pattern effects on the health of the people have been studied as, in King County, Washington neighborhoods with mixed land use and better street network result in an increase of biking and walking which ultimately helps in achieving the goal of decrease in BMI (Body Mass Index). There is a chance that if you spend more time in the car, it can increase the risk of obesity (every 30-min staying in a car increase the risk increased by 3%).

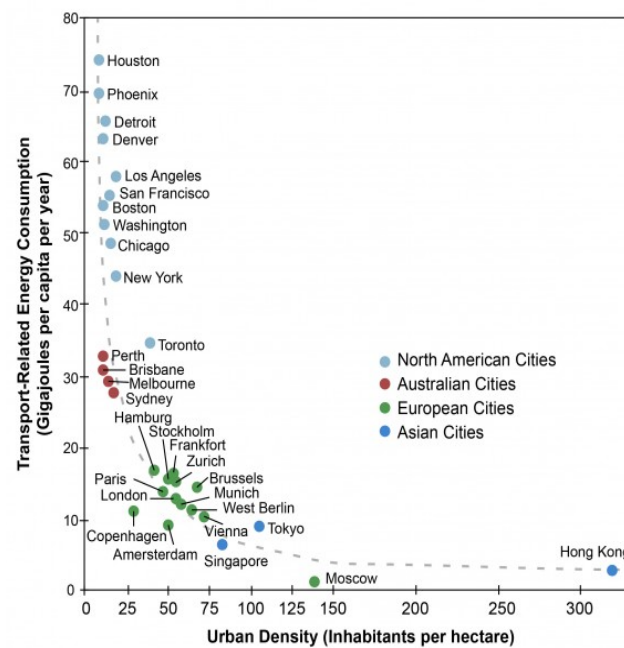


Figure 4. Urban density and transport-related energy consumptions. Source: [49].

On the other hand, walking can be a tool to reduce the probability of being obese, as with each kilometer of walk every day there is a probability of 4.8% that this risk can be reduced [49]. Many problems are associated with obesity like heart disease, high blood pressure, cancer, diabetes, and many others. The direct medical cost spends yearly increased by USD 458 because of obesity [51]. Through the implementation of TOD, a total health care cost of 12.6 million USD can be saved over nine years. The other associated benefits: alongside better conditions for bicyclists and pedestrians, lower pollution, urban development, and redevelopment benefits can be achieved [13]. As a replacement to vehicular traffic, with rail transit the chance of walking at least 30 min per day enhances by 67% [52]. The development of transit facility encourages people to walk which enhances physical activity and helps to achieve the goal of good health. Reduced medical cost and enhanced economic productivity are the main outcomes of physical fitness, Shatu and Kamruzzaman [53] as transit users have more probability to walk compared to non-transit users, as shown in Table 4.

Table 4. Walking activity by transit use.

	Transit User	No Transit Use
At least one walk trip	58.9%	9.3%
Average walk distance	1.72	0.16

6.7. Impacts of Transit on Travel Behavior and Travel Choice

The policy measures for the reduction of automobile use have been of major focus in the last few years because of its negative impact on the environment and social life of people. Imposing road pricing, traffic calming techniques, parking control, and giving the facility of park-and-ride were adopted as major techniques to reduce automobile use. Despite these policy decisions, many other factors influence the travel behavior of people. Land-use planning is one of the major factors which significantly affects the travel behavior of people. Transit facilities can be implemented to mitigate the issues of automobile dependency. Development at the fringes of the city, by providing industrial units, offices, and residential estates, can affect the urban structure of the city. This shift of land uses with socio-economic variables can impact the transit ridership at a significant rate [7]. In Copenhagen, investment in transit has increased the accessibility of central parts which

encourages commuting from a wider area, including 19,380 passengers per day from Sweden [29]. Transit Oriented Development is one of the elucidations that can provide an urban mobility level as that of a car while maintaining sustainability. Figure 5 compares the mobility level of a car-dependent city and a transit-oriented city. Analysis shows that, a car-dependent and transit-oriented city have a similar level of urban mobility.

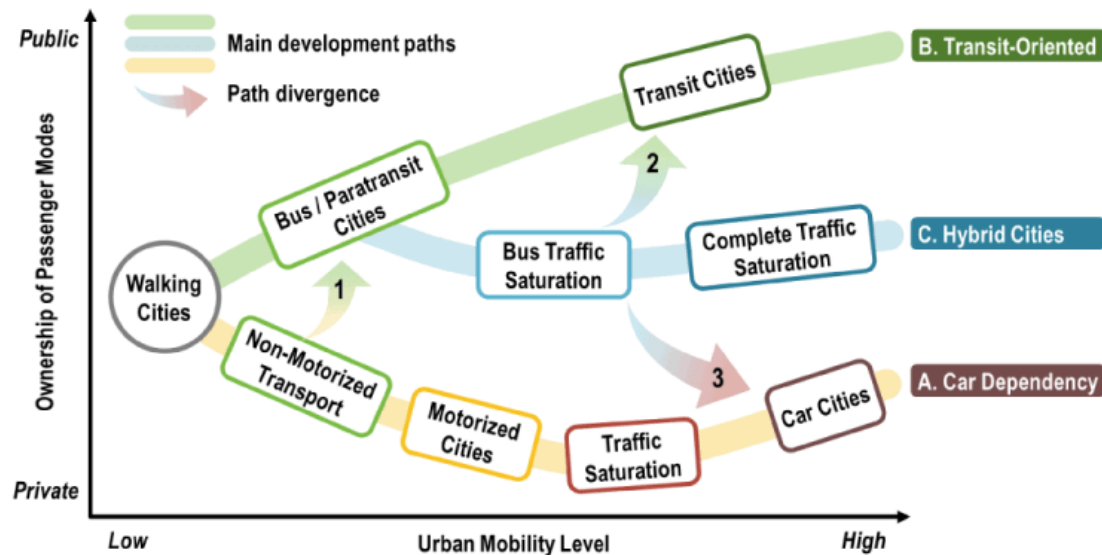


Figure 5. Urban Mobility Levels. Source: [54].

In Brisbane, Australia, studies showed that transit development resulted in car use reduction by 5% and enhanced the public transport use by 4% because of the opportunity of accessibility provided by transit [53]. In Washington D.C., areas served by transit experienced a decrease in trips by 30% compared to other areas not served by transit. Moreover, in transit areas, the primary mode to travel is biking and walking, which is different to other areas. Despite these effects, the use of the personal vehicle is still high. The reason behind this fact is that the transit network present is not saturated, and the facility is only available in certain geographical areas. If the trip ends in a non-transit area, people face problems furthering their journey and prefer to use a personal car in such a case [10]. In Denver, Colorado, studies showed that people residing near a transit facility have less dependency on the automobile. There was an increase of 61% for the use of non-car modes. If we compare the mean distance of the trip, people residing in TOD areas have a lower mean distance of trip compared to people living in other areas. This lower distance of trip reflects the benefits of mixed land-use and high-rise development, and the convenience arising from it. No doubt, the distance of trip for TOD residents is less but they make more trips than others [55]. Therefore, it can be concluded that TOD results in high-density development which generates more trips and less trip distance with decreased dependency on the car. A reduction in vehicle mile travel is due to transit use as shown in Table 5. A significant reduction in vehicle travel miles is evident after the implementation of transit facility. This shows a noteworthy model shift to a more sustainable mode of transportation.

Table 5. (Vehicle Miles Traveled) VMT decline due to Transit.

Authors	Vehicle Mile Reduction per Passenger Mile
Ewing and Hamidi [56]	3.0
Holtzclaw [57]	9.0
Litman [58]	4.4
Pushkarev and Zupan [59]	4.0
Wedderburn and Buchanan [60]	4.9

6.8. Impacts of Transit on Green House Effect and Environmental Impact

The shape our urban areas take through the turn of events, framework, and transportation powerfully affect ozone-harming substance creation. Transportation contributes an expected 28% of all GHG discharges—and up to 40% in certain states for example—and transit oriented development is a blend of private and business advancement inside strolling distance of public transportation, and can have a considerable impact in reducing greenhouse gas emissions [61]. By basically living in a local area that is inside a half-mile of public transportation, this investigation shows that in the Metropolitan Region such family units have lower transportation-related reducing greenhouse gas emissions (GHG) outflows from automobile use, 43% lower than families living in the normal area in the Metropolitan Region [62–64]. Families living in midtown—which regularly have the most noteworthy grouping of travel, occupations, lodging, shopping, and different objections—have 78% lower emissions. While this investigation centers around the Chicago Metropolitan Area, comparable family conduct is seen in other metropolitan zones and is anticipated to bring about comparable decreases. To lessen ozone-depleting substance outflows we should diminish driving. To diminish driving we need to also make it workable for individuals to walk, bicycle, and take travel, partially by modifying our networks so that individuals live near positions, schools, shopping, and different objections—a more reduced method of living. This examination uncovers that when families decide to live in such neighborhoods, they do in reality lessen their driving. Kept rambling advancement with a went with increment in miles driven (projected to rise a stunning 60% by 2030, as per the U.S. Branch of Transportation) will invalidate any increases from more productive vehicles and low-carbon fills.

7. Conclusions

The mitigation of greenhouse gas emissions transforms the status of the urban environment. Greenhouse gas emissions affect the climatic pattern of the region and TOD is directly a major contributor in this regard. Keeping in mind the end goal to battle the unfavorable impacts of phase-changing suburbanization and urbanization, organizers, designers, and developers have started thinking about the diverse vast urban communities as a natural entirety as opposed to an arrangement of divided rural areas, urban neighborhoods, and downtown areas. A large number of benefits can be witnessed for transit development taking from Macro level (Regional Economic Development) to Micro Level (Decrease in Body Mass Index). The transit facility provides an opportunity for economic development by enhancing choices of travel and centers for the development of the economy. But such transport investment should be incorporated with other development initiatives for efficient working and outcomes of TOD policy. TOD development can help in the reduction of automobile use by providing a safer environment for pedestrians and bicycle users. Moreover, the decrease in car use also helps in achieving the goal of environmental improvement which is of main concern these days. Health issues raised because of the increase in car use can also be resolved through TOD. Transit Oriented Development provides an environment for walking which increases physical activity and hence helps in the reduction of health costs and more economic productivity. TOD also provides the benefit of redevelopment and rehabilitation of neglected areas with a friendly environment for bicycles and walking. Therefore, there is a need to devise such coordinated policies allowing the development of TOD providing the opportunity for the above-mentioned goals [65]. It is not obvious that every area experiences the same development pattern with transit. As in Atlanta, no such benefit was observed. Similarly, in Bay Area Rapid Transit (BART) there was no induced impacts on development [27]. Thus, there is a need to do a complete feasibility study before the implementation of such an initiative which requires a huge amount of investment. A TOD plan including all externalities associated with transit development (economy, travel choices, travel behavior, transport, and other policies) should be carried out before transport investment.

The question arises here that despite investing a lot of resources in transit services, developing countries could not capitalize on the external benefits of transit and were not able to promote transit-oriented development. The first and foremost reason for not going toward TOD is that most of the transit systems in developing countries are implemented to gain political momentum. Therefore, these systems solely served the purpose of transportation, and their ability to shape urban areas remains unexplored. Lack of funding, absence of TOD plan, weak institutional coordination, weak political support, and zoning restrictions are the reasons identified by Cervero and Dai [66], restricting transit oriented development. In developing countries where public resources are limited, a public–private partnership could help to achieve the goal of TOD. The local authorities only need to work on their TOD plan, relaxation of zoning restrictions, and strong coordination—which does not require a lot of resources. Most of the transit systems implemented in developing countries have stimulated some type of urban transformation without government intervention as discussed earlier, therefore, the government can intervene here and can streamline these externalities attached with transport investment which could help in the creation of sustainable neighborhoods.

8. Limitations of the Study

This study was limited to the scope of the greenhouse gas emissions with reference to the urban environment following the transit-oriented development, leading towards feasibility and impact of these factors on sustainability of the system. Still, factors like socio-economy, technical, as well engineering, and financial impact can be discussed in future studies.

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