

# Social, Spatial and Legislative Strategy to Shift Urban Mobility Patterns

Ana-Maria Branea <sup>1</sup>, Marius Gaman <sup>1</sup>, Stefana Badescu <sup>1</sup>

<sup>1</sup> Faculty of Architecture and Urban Planning, Politehnica University of Timisoara, Str. Traian Lalescu, Nr. 2/A, 300 223 – Timisoara, Romania

ana-maria.branea@upt.ro

**Abstract.** A city's predominant transportation mode is crucial in determining its type of urban tissue. A denser and more compact urban development is generated through pedestrian, bicycle and public transit while car based developments tend to be dispersed, characterized by unsustainable low densities. However, a clear implementation strategy eludes many urban planning practitioners and public administrations, thus highlighting the need for further research. Following an international trend, Timisoara's mobility strategy over the past two decades, has been to accommodate an ever-increasing number of vehicles on its underdeveloped infrastructure at the expense of green areas, pedestrian lanes and even travel-turned-parking lanes. Despite the latest, slight, shift towards inner city urban development only 11% of the proposed Urban Mobility Strategy's policies are not centred on cars. Through a 15 criteria analysis of the main means of transportation, pedestrian, bicycle, public transit and car, the authors determined the most sustainable and efficient mode based on the distance – duration relationship as being bicycles, for a city of Timisoara's size and characteristics. Yet, the city's infrastructure scored poorly on safety and comfort due to its incoherence and numerous dysfunctionalities. To better illustrate and understand Timisoara's current state and proposed mobility strategy, the authors undertook a comparative analysis of Timisoara's and Utrecht's bike lane infrastructure. Similarities in size and number of inhabitants were only secondary selection criteria compared to Utrecht's aspiring to model status. The aim of this study is to present the long term, multi-tier implementation strategy proposed to reorient Timisoara's urban development towards a more compact, sustainable typology. Comprising social-educational, spatial and legislative objectives the strategy aspires to modify local behaviour towards and perception of alternative modes of transportation by influencing human behaviour at a strategic and tactical level.

## 1. Introduction

A city's predominant transportation mode is crucial in determining its type of urban tissue. A denser and more compact urban development is generated through pedestrian, bicycle and public transit while car based developments tend to be dispersed, low density and unsustainable.

Timisoara is characterized by a compact urban tissue due to its development following tramlines, starting in 1868, and later on bus lines. Since the inauguration of horse drawn trams in 1868, public transit has been the main mode of transportation supplemented by cycling and pedestrian transit. Between 1948-1989, during the communist regime, car traffic was discouraged through a central policy approach, by impeding car ownership – low production for internal use resulting in acquisition waiting



lists spanning several years; driving restrictions – alternate weekends driving based on car numbers, even or odd; and resource rationing – limited amount of fuel available for each citizen. As a result, Timisoara developed in a compact manner along the public transit routes. It has a concentric structure, with a diameter of approximately 8 km. After 1990, following the shift to a democratic regime and a capitalist economy, the circumstances changed dramatically, car ownership therefore increasing. As a consequence of 2000's economic boom the city began expanding chaotically with urban sprawl type urban developments.

Timisoara's 2015 Sustainable Urban Mobility Plan proposes 18 infrastructure development projects for automobiles, 7 for public transit and only two each for cycling and pedestrians [1], thus further encouraging the unsustainable urban sprawl development.

Through a 15 criteria analysis of the main modes of transportation, the authors proved Cycling to be the most efficient from a speed/distance stand point and Walking the most sustainable. [2] The comfort and safety criteria, both influenced by the infrastructure's incoherence, state and development, hurt cycling scores. In order to encourage cycling, the least used transportation mode in Timișoara nowadays compared to the other three types, the infrastructure must be adapted influencing human behaviour on a strategic and tactic level. [3]

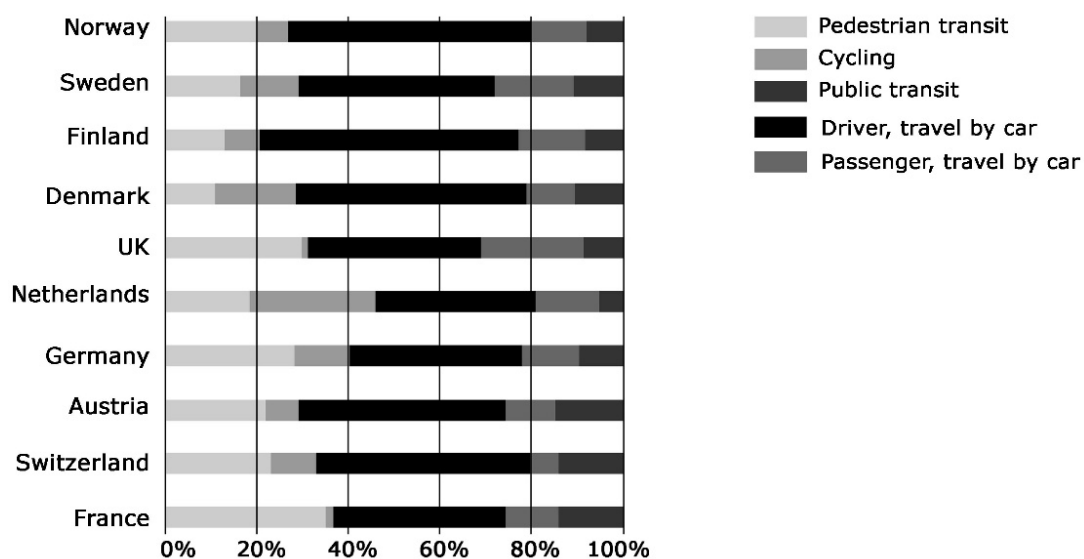
The study proposes a strategy to change mobility patterns in order to determine a more sustainable development.

## 2. Analysis methodology

The proposed strategy is based on a benchmarking projects' analysis with an emphasis on European ones due to context similarities, as opposed to those from other continents.

### 2.1. Cycling infrastructure analysis on a European level

Bicycle use varies from country to country based on climate, economy, landscape typology, culture and implemented policies. Western European countries have an average between 5-10% of all trips done by bicycle while central and Eastern European ones only 1-5%. [4] Figure 1 illustrates the percentages of different transportation modes used, highlighting the Netherlands' over 27% of trips over 500 m undertaken using a bicycle, well over Western Europe's average. [5] This difference determined the authors' selection of the Netherlands' infrastructure for analysis.



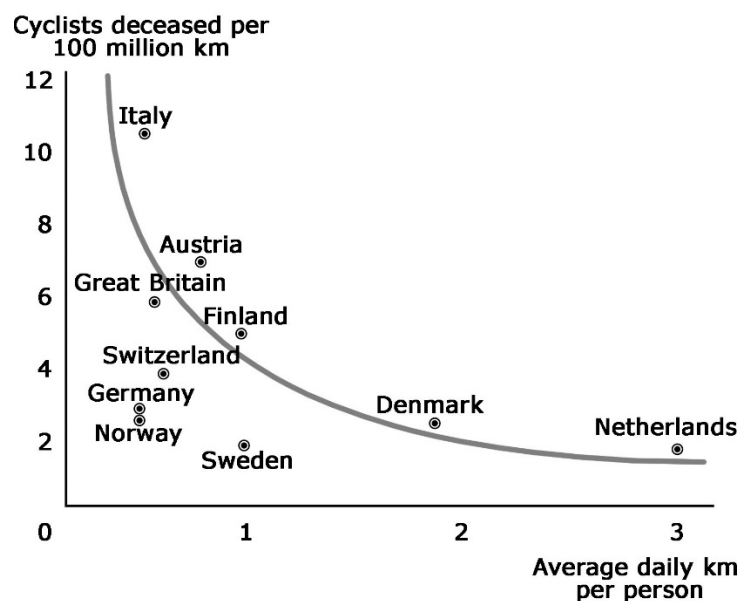
**Figure 1.** A comparison of trips with a distance over 500 m by transport mode for 10 Western European countries [5]

### 2.2. The Netherlands' cycling infrastructure analysis

The high number of bicycle trips in the Netherlands is facilitated by an up to date infrastructure composed of bicycle lanes, protected intersections, design elements aimed at protecting cyclists, highly available and secure bicycle parking and a high enough infrastructure lanes density to create shortcuts, making a cycling trip more efficient than a car one. The infrastructure network extends beyond the city limits, connecting both cities and natural landmarks as part of the Netherlands' national cycling infrastructure. [6]

Starting with 1890', after the WWII, the high number of bikes in the Netherlands was being replaced by cars similarly to all western European countries. After the petrol crisis of '73 - '74 and the increase in fuel cost, the government began taking measures to reduce the number of car trips and encourage the use of different modes of transport, emphasizing cycling. Thus, the four decades of social policies and infrastructure development have transformed the Netherlands into the most bicycle friendly country. The number of covered km has increased after 1980 while that of cyclist deaths while travelling decreased from 426 deaths per year in 1980 to 181 in 2005. [7]

A well-developed infrastructure results in an increase in bicycle trips and also cyclists' safety as can be noted in figure 2. Compared to other western European countries the Netherlands has a relatively low number of deaths for the high-count of travelled km. [7]



**Figure 2.** Relationship between bicycle use frequency as a transport means and number of deaths in Western European countries [7]

### 2.3. Utrecht's cycling infrastructure analysis

For further analysis, the authors selected the city of Utrecht, fourth in size in the Netherlands, due to its population of 330,772 inhabitants in 2014 similar to that of Timisoara, despite the fact that it does not possess the most developed cycling infrastructure in the country. A study conducted by Copenhagenize, a Danish consulting and communications company, analysed 150 cities from around the world in order to determine the best ones for cycling and placed Utrecht as the third highest. [8] It accumulated a score of 77 out of 100 points, having been outranked by Copenhagen with 81 and Amsterdam with 83 points, based on a 13 criteria analysis: cycling facilities, culture, renting centres, support and encouragement policies, etc.

From an infrastructure standpoint Utrecht is characterised by:

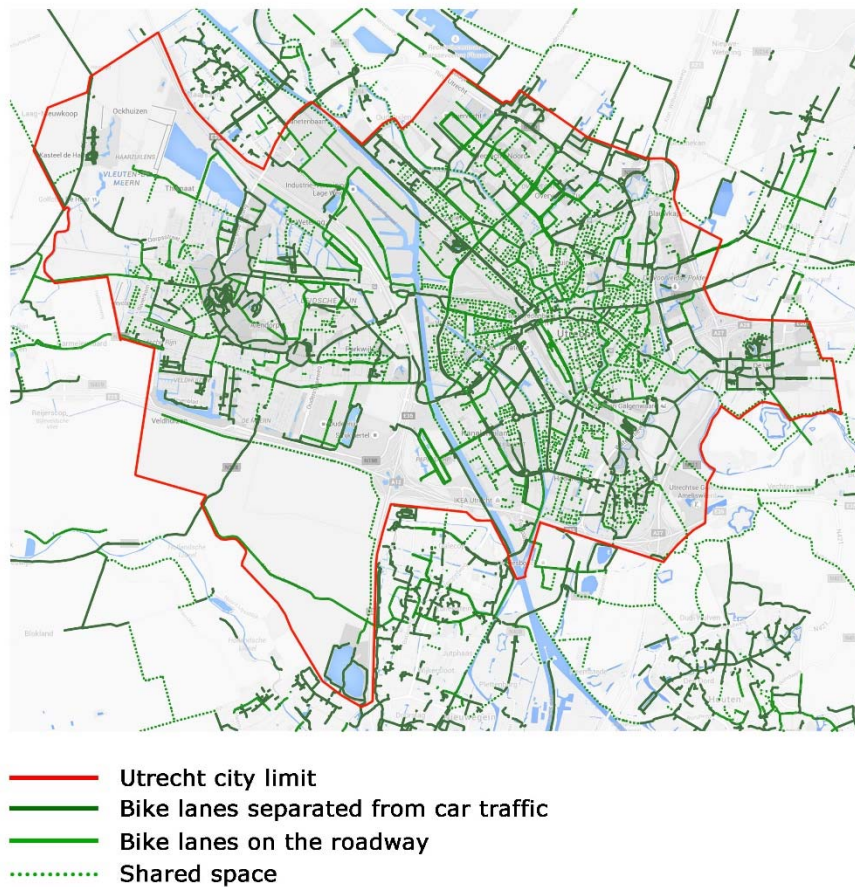
- Bike lanes on both sides of main, high traffic, roads;
- Width of lane between 1.50 and 5 meters;
- 100,000 bicycles cross the city center daily;
- Low intensity traffic roads are transformed in shared space streets, mixed traffic – car, cycling and pedestrian;
- 22,000 bicycle parking spaces near the railway station and the city center;
- 13 secured parking locations;
- Bicycle parking at public transit stations;
- Implemented speed slowing systems to reduce speeds from 50 to 30 km/h;
- 400-500 m average distance between bike lanes;
- In newly built residential areas bike lanes are either on the sidewalk, with a width of 3.5 m near the 1.2 m wide sidewalk, or on the drive lane, 1.5 m wide while drive lanes are reduced to a width of 3 m;
- A bike renting system with 160,000 subscribers;
- All schools and universities are connected to the bike lanes network;
- Areas near schools have a speed limit of 30 km/h and some are closed temporarily in the mornings and afternoons;
- Primary and secondary schools teach classes on using a bicycle in an urban environment and organize exams before high-school, written and practical;
- Bicycle lanes connect Utrecht to neighbouring cities and nearby natural landmarks;
- Car parking in central or high-density areas is intentionally limited to discourage private car use [6] [7] [9].

The entire available infrastructure doubled by cultural stimuli and education makes it possible to achieve 43% of trips under 7.5 km undertaken by bicycle and an additional 16% of those over 7.5 km [9] as illustrated in Table 1.

**Table 1.** Trips by transportation mode in Utrecht, based on distance, for 2012 [9].

	<7,5 km	7,5- 15km	>15km
<b>Pedestrian transit</b>	30.50%	0%	0%
<b>Bicycle transit</b>	43.10%	16.40%	1.70%
<b>Public transit</b>	3.90%	15.10%	29.70%
<b>Car transit</b>	21.30%	64.60%	66.80%
<b>Other transit</b>	1.20%	3.90%	1.80%

The type of cycling lane used in Utrecht is determined by street importance. Thus, high traffic streets have bike lanes separated from driving lanes through parking or trees. Medium traffic streets, initially designed with separated lanes, have been, over the past decade, created near the drive lanes, with a width between 1.5 and 1.8 m and only differentiated through colour. Low volume traffic streets have been transformed into shared streets, mixing traffic areas accommodating cars, bicycles and sometimes even pedestrians, cars having to give right of way. As illustrated in figure 3, Utrecht has 161 km of bike lanes separated from car traffic, 100 km of lanes alongside driving lanes and 136 km as shared streets.



**Figure 3.** Utrecht's cycling infrastructure

**Utrecht - 398,850 km  
of bicycle lanes**

**Timisoara - 44,150 km  
of bicycle lanes**



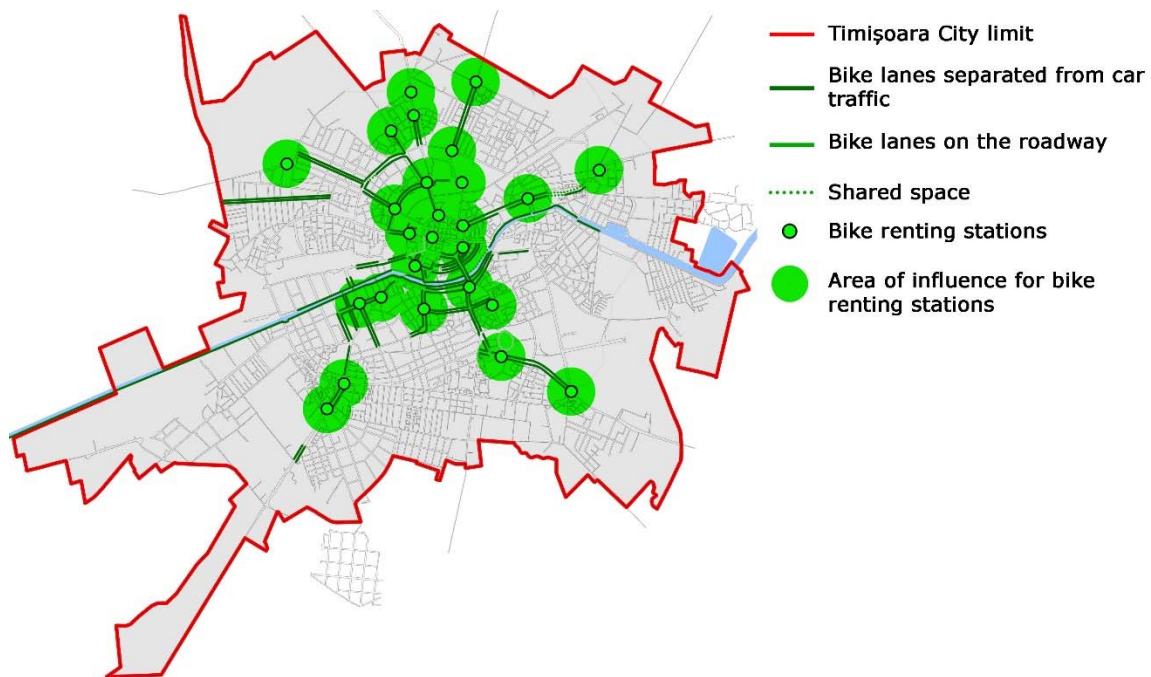
**Figure 4.** Comparison of Utrecht's and Timisoara's cycling infrastructure



#### 2.4. Timisoara's cycling infrastructure analysis

In 2015, Timisoara's urban area contained 41.95 km of bike lanes separated from car traffic, 1.5 km alongside driving lanes and 0.7 km on shared pedestrian-cycling routes. Timisoara's total bike lanes' length represents only 11.06% of Utrecht's (figure 4). For a more accurate comparison, taking into account that both Utrecht's urban area and population are larger than Timisoara's, the authors calculated the number of bike lane meters per inhabitant. With a population of 330,772 inhabitants and 398.85 km of bike lanes, Utrecht has an average of 1.2 m per inhabitant while Timisoara's 319,279 inhabitants and 44.15 km average 0.13 m/inhabit. Coupled with a very small number of bicycle parking spaces, of which none is secured, the m/inhabit. average translates into a low number of bicycle trips when compared to Utrecht.

July 2015 saw the implementation of a public transit stations' modernization project in Timisoara entitled VeloTM by the city hall. It consisted of a free bike sharing network of 25 stations, 23 km or repaired bike lanes and intersection redesigns (Figure 5). However, in Timisoara, bike lanes are created on pedestrian lanes by painting sections over, as streets cannot be widened due to the built tissue. Thus, pedestrian transit is affected, over two thirds being undersized.



**Figure 5.** Current VeloTM infrastructure

### 3. Results and discussions

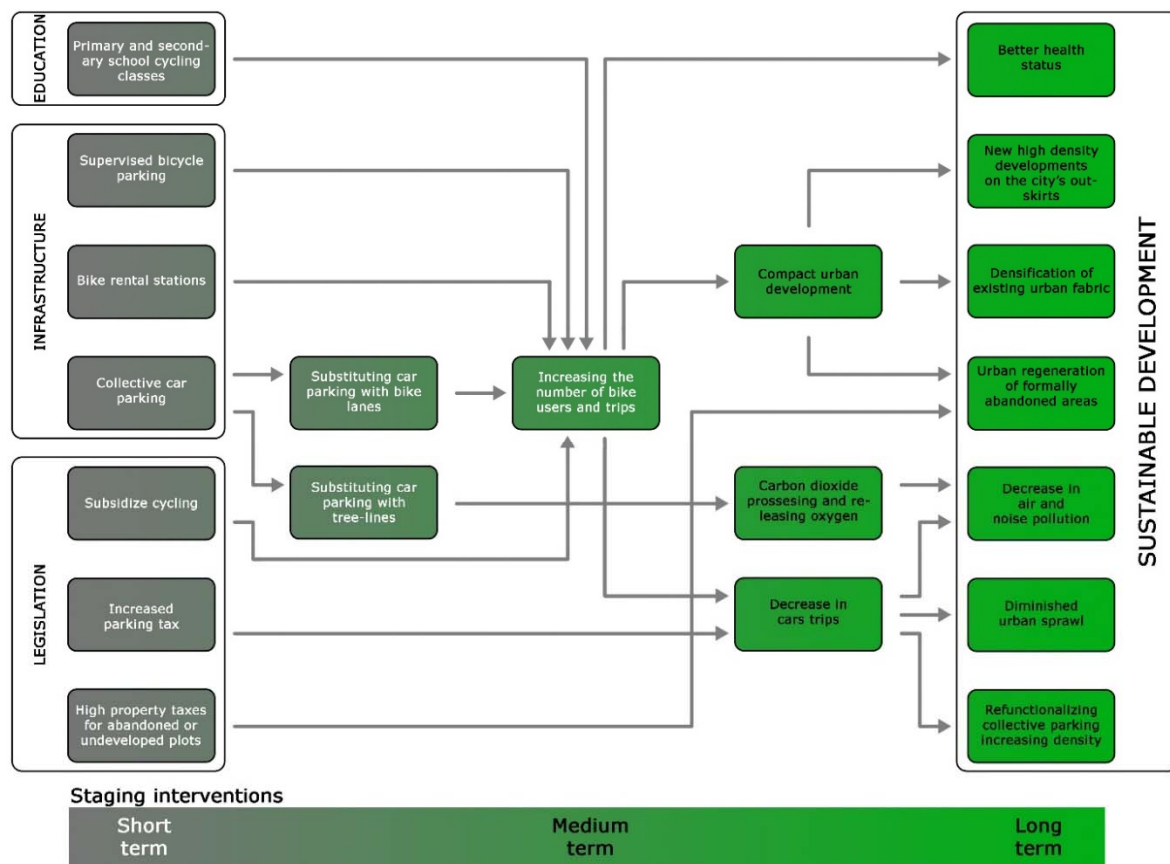
#### *Proposed social, spatial and legislative strategy to shift urban mobility patterns*

The aim of the proposed strategy is to establish planning typologies to influence human behaviour on a strategic level by encouraging bike trips without being detrimental to pedestrians, as the two means of transportation are the most sustainable. Pedestrian transit has the ability to generate sustainable developments at a neighbourhood level by facilitating community formation while bicycle transit can have effects at a city level encouraging high-density developments. Bicycle lanes need to be designed taking space from car lanes and not pedestrian ones. In order to stop the uncontrolled urban expansion, the authors propose a shift from cars, as the main means of transportation, to bicycles at the city level and on foot at the neighbourhood one. A holistic, long term, strategy based on educational, legislative and infrastructure development measures is proposed in order to promote a sustainable development of Timisoara through a change in mobility patterns, (Figure 6).

On an educational level, the population must be informed both about the advantages of each means of transport and about City hall's strategy in order to embrace it. Primary and secondary schools must include cycling classes and be connected to the cycling infrastructure network to ease access, all part of a long-term strategy to accustom traffic participants, parents and children to bicycles as a means of transport.

On a legislative level, local authorities can subsidize cycling related products to encourage new users. At the same time, increases in parking fees would discourage car use and increase use and frequency of bike rides. Tax increases should be carried out gradually, over a long period, not to put excessive pressure on drivers. Even more successful indirect measure would be property tax increases for abandoned or poorly maintained plots within the urban tissue, which will lead to urban regeneration projects, high-density developments, for profitability's sake where inhabitants are not car dependent.

From an infrastructure development standpoint, new bike lanes must be designed to create a coherent network that does not infringe on the pedestrians' space, but from car dedicated one. Considering the high number of cars and the overwhelming parking deficiency, collective car parking is proposed, both above and below ground, depending on location, to free the space for bike lane creation. This intervention will be carried out over a long time due to the considerable costs. Should the strategy result in a massive decrease in car ownership, some of the parking buildings can be re-functionalized, considering their open plan layout, further increasing the areas' density. In order to mitigate the safety issue, secured bike parking needs to be created in dense residential areas, downtowns and city centres, near education faculties and public transit stations and can also be housed in the car parking buildings. The local authority can continue its VeloTM project by extending the network to cover and service the entire city. These interventions lead to a sustainable development influencing multiple sustainability sub-parameters [2] all based on a shift in mobility patterns towards cycling.



**Figure 6.** Phasing of the strategy to shift urban mobility patterns

#### 4. Conclusions

The proposed strategy spans a long-term implementation process and comprises a series of interdependent steps that need to be undertaken in a specific succession. It is highly dependent on the local authority's desire and willingness to intervene and apply hard policies in order to follow long-term objectives yet with clearly quantifiable results. The strategy deals with three levels of in order to shift mobility patterns, creating the conditions necessary through infrastructure development, ensuring its adoption through education and creating the incentives to follow it through rewards and penalties, in the form of subsidies and taxes. Collective parking clears the way for bike lanes and parking, facilitating cycling which in turn diminishes traffic, parking space requirements and promotes a more sustainable compact development.

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