

# Bicycle Planning in European Cities and Its Applicability to American Cities



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Senior Project 2018

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# I. Introduction

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## I.1 Acknowledgements

This project was completed with guidance, support, review, and approval by senior project advisor Amir Hajrasouliha, PhD., Professor of City and Regional Planning at Cal Poly San Luis Obispo. In addition, personal knowledge on this subject was developed through a summer interning with the San Francisco Bicycle Coalition.

## I.2 Project Purpose

The purpose of this project is to assess the successes that European cities have had with making bicycling an accessible and reliable form of transportation and how these practices can be utilized in American cities. The objective is to use the bicycling successes of European cities such as Copenhagen and Amsterdam to compare it to relatively successful bicycle cities in America to see how they can further their successes. This project will focus on two major US cities, Minneapolis and Portland. These cities will be pursued because they are recognized as being the most successful bicycle cities in America, they will be examined to determine what is preventing them from being as effective as European cities.

## I.3 Project Methodology

This paper will first examine how urban cycling has evolved recently, why cycling is beneficial, needs of cyclists, and why the United States is lagging in cycling levels when compared to Europe. It will then establish the five parameters that are used to measure if a city is successful in establishing cycling for transportation. These five parameters: planning, land use, policy, infrastructure, and culture will be applied to four case studies cities. Two of these cities are the most recognized European cities for success in urban cycling: Copenhagen and Amsterdam. The two other cities are American cities recognized for being successful in urban cycling, Portland and Minneapolis. After addressing the five parameters for each of these cities, the European cities will be analyzed and compared to the American cities, and conclusions will be drawn on why the American cities persistently fall behind the European cities in successful urban cycling. Information on the topic will be obtained through published case studies, books, journals and reports.

## I.4 Relevance to Urban Planning

As climate change becomes an increasing threat, bicycle planning is more prevalent in urban planning, and more specifically transportation planning. Especially in dense urban settings, cars are being regarded as an unsustainable mode of transportation, and alternatives modes, such as bicycles, are being put at a higher priority. Increasingly more city governments as well as private firms and non-profit agencies are hiring Bicycle/Pedestrian Planners in order to put a specialized focus on increased bicycle safety and adequate infrastructure.

## I.5 Literature Review

### *Urban Cycling Revolution:*

Whether it's the ever-growing cost of living, a new environmentally conscious generation, or healthier ambitions; an interest in cycling around the world has boomed. Cyclists, governmental agencies, non-profits and private companies have all shown an increased interest in improving the sustainability of cities through advocacy for cycling. As groups are officially recognizing the importance of cycling as a practical and legitimate mode of urban transportation, research on cycling has vastly improved with more adequate research and publications with the main goal being an increase in ridership and increased safety.

After decades of the majority of the population residing in car-culture societies, cycle ridership levels have doubled or even tripled in many American, Canadian, and Australian cities. More traditionally bike-oriented countries in northern Europe are seeing cycling as the mode of transportation in up to a third of all trips (Pucher & Buehler, 2012). In the US, bike trips have tripled between 1977 and 2009. In 1977, there were 1272 million annual bike trips, and that number rose to 4081 million by 2009. In this time, the number of bike related fatalities have fallen by 21% (Pucher et al., 2011). This decrease in fatalities is likely attributed to two factors. First, an increase in adequate infrastructure for cyclists. Second, an increase in ridership led to said increase in infrastructure. But why the sharp increase in ridership?

The increase in ridership in the US has been mostly concentrated in central cities, especially in areas near universities and where neighborhoods have either experienced gentrification or are in process of gentrification. Portland and Minneapolis are the two US cities to see the sharpest increase in cycling. They have reported doubling or tripling cycling levels since 2000, and in response these cities by far have the largest supply of bike lanes/paths for capita in the US (Pucher et al., 2011).

There's no tangible evidence on why bike culture is rapidly expanding, or why millennials, (people born in the 80s and 90s) specifically are embracing alternative transportation so warmly. But there are a few factors that could've led to this movement.

First, millennials were unleashed in a professional world where jobs are hard to come by, student debt is skyrocketing, and ownership is not a priority. In an effort to save money, millennials are making use of the flexibility and affordability that cycling offers. Especially in the urban areas where millennials are choosing to live, biking causes a significant decrease in expenses.

Another possibility is that millennials are more environmentally-conscious. Unlike generations before, millennials were born into a world where a lack of resources and the ever-approaching threats of climate change were standard and factual. Cycling is the only mode of transportation, besides walking, that emits no emissions.

Lastly, most millennials follow the trends of “hipsters”, or young people who are seen as trendy, stylist, and desirable. Bicycling has been associated with hipsters, which is why bicycling is possibly so huge in Portland and Minneapolis- these cities have been dubbed as hipster cities. Millennials also tend to follow the influence of celebrities. As more celebrities are photographed on bicycles, it’s becoming a more legitimized mode of transportation.



Figure 1: Leonardo DiCaprio on a Citi Bike in New York City from (Bicycle Unchained, n.d.).

### *Basic Benefits of Cycling:*

The benefits of cycling are seemingly endless. Governmental entities, advocacy groups, and all decision-makers should be pushing for increased cycling for the following direct consequences: lower levels of noise and air pollution, a decrease in emissions fueling climate change, increased physical activity among citizens, better cardiovascular health, reduced roadway congestion and economic benefits (Birk, 2010).

Climate change is constantly becoming a bigger concern all over the world. In 2015, leaders from around the world first came together to sign the Paris Climate Agreement, which recognized that climate change is a legitimate threat to humanity and that it must be mitigated effectively and urgently (United States Environmental Protection Agency, 2017). Now that a majority of the world is trying to combat climate change,

its’ sources must be examined and possibly redesigned. Transportation is one of these sources.

Behind electricity, transportation is the largest source of greenhouse gas emissions (27% of emissions) in the United States as of 2015. Since 1990, US greenhouse gas emissions have increased by 4%. The largest sources of transportation greenhouse gas emissions are from cars, trucks, and minivans, these account for over half of the emissions. The remainder come from freight trucks, aircraft, ships, boats and trains (United States Environmental Protection Agency, 2017). Bicycles contribute absolutely zero greenhouse gas emissions.

Consequences of climate change include: sea level rise, poor air quality, extreme weather events, mental health and stress disorders (Pucher & Buehler, 2012). Motor vehicles are the main source of air pollution, especially in major cities (Bureau of Transport and Regional Economics, 2005). In Australia, air pollution caused by motor vehicles accounted for about 2,000 premature deaths. Death by air pollution has been referred to as “the silent road toll” (Pucher & Buehler, 2012). Air pollution isn’t cheaper either. These premature deaths due to air pollution costed an estimated \$1.2-2.7 billion dollars (Bureau of Transport and Regional Economics, 2005). A lesser recognized type of pollution is noise pollution, which is obviously a big source of disruption in any sort of urban setting. Cycling can directly decrease both these types of pollution.

Cycling is a great way to incorporate physical activity into everyday life without the huge time commitment. Population health is reliant on daily moderate-intensity physical activity. Research shows that at least thirty minutes a day of moderate-intensity exercise will result in a wide variety of physical health benefits. Some documented health benefits include chronic disease prevention and decreased risk of high blood pressure and obesity (Pucher & Buehler, 2012). Cycling for transportation is accessible and appealing to those population groups that normally might have low levels of participation in sports or other leisure-time physical activity. Americans typically rely on automobiles for all transportation, specifically commuting to and from work, although driving to work has been associated with a 13% risk increase of being overweight or obese (Wen et al., 2006).

While biking is easily linked to physical health, it also has a multitude of mental health benefits. There's a link between exercise and mental health that has been proven to improve your mood, as well as combat stress and depression. But, taking occasional exercise and making it a lifestyle change instead results in a better mood and increased overall well-being. Biking is an easy way to integrate physical activity into an everyday hectic schedule. Lastly, based on a 2011 study done by the Peninsula College of Medicine found that partaking in physical activity outdoors as opposed to indoors creates greater feelings of revitalization, positive engagement, and increased energy (Angus, 2016).

In addition to mental health, cycling can contribute to social health. Urban environments that promote cycling and walking improve social interactions, community identity, livability and amenity. This kind of urban environment is known as "living streets". Living streets encourage social interaction while at the same time reduces crime. High speed travel comes with the cost of urban sprawl, community disruption and social isolation (Litman & Doherty, 2009). In addition, there are numerous cycling associations across the world which build a community for those who cycle. Some examples are: The Women's Cycling Association, Red Bike and Green, Cycling Without Age, Women Bike, Black Girls Do Bike- just to name a few.

Some may argue that the health risk compared to the health benefit of cycling for transportation is too high for it to be a primary mode of transportation, but cycling itself is benign. It's the dangerous environments that are a risk. Arguably most of the danger in urban cycling is mental. Although there are occasional traffic related deaths that stem from cycling. Without the very best infrastructure, there will always be some risk when a cyclist hits the streets. But, a study in the Netherlands found that people who switched from primarily driving to primarily cycling gained nine more years to their life (de Hartog et al., 2010). When looking at it that way, the benefit outweighs the risk.

Cycling is also so beneficial simply because of space. In urban areas, space is always a significant factor to take into account, it brings up the idea of "who owns the street" or who is more entitled to take up more space. Figure 2, commonly referenced by bicycle advocates shows the simple logic as to why bicycles are so useful when trying to combat traffic congestion. In cities with millions of residents, all entities are constantly competing for street space. Since bikes are physically smaller than cars and public transit, they will always be contributing to less congestion on city streets.

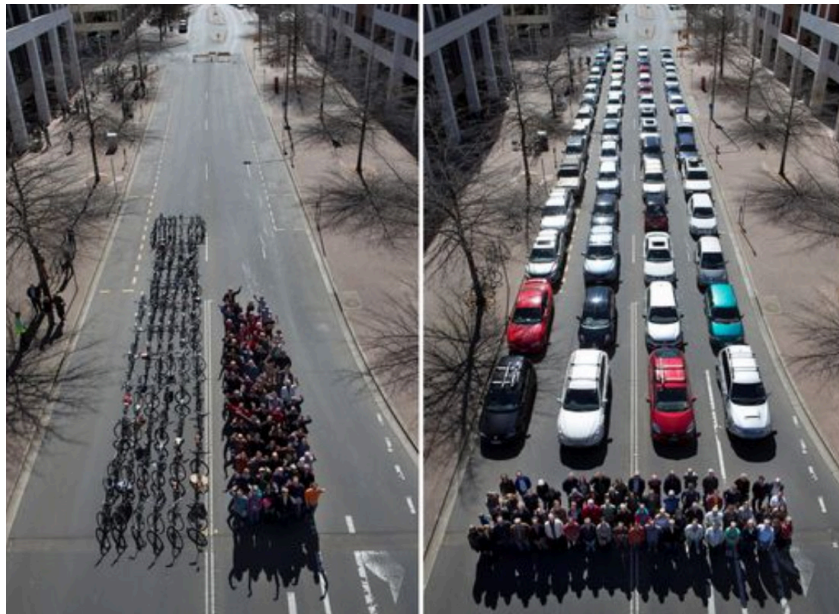


Figure 2: Transporting 60 People from (Transporting 60 People, n.d.).

Equity is another benefit that a rise in cycling is contributing to. In 2009 in the United States, African Americans took 461 million bike trips, Hispanics took 196 million bike trips, Asian Americans took 92 million trips, and Native Americans took 91 million trips. These diverse populations are commuted by bike significantly more than white populations. The United States' poorest families spend the highest portion of their income on their commute. In the US, the average family with an income less than \$50,000 spends 30% of their income on transportation. Also, the cost of owning and operating a car leads to an average cost of \$8,220, while it's only \$308 for a bicycle. Residents living with an income of less than \$30,000 accounted for 28% of all bike trips in 2009 in the United States (The League of American Bicyclists & Sierra Club, 2013). As people from diverse backgrounds and socio-economic statuses are given equal access to transportation, previously neglected communities are given the same opportunities to access jobs, schools, and basic needs. Cycling is an effective way ease into a fairer society.

Although most probably assume that the bicycle will always be slower than the car, this is not always the case. Not only are bicycles often faster than cars on very congested urban roads, but when considering effective speed, bicycles are always faster. Effective speed is when the amount of time spent earning the money to pay for the ownership and operation of a car. Although cars do have a higher operating speed than bicycles, the car has the requirement of constant high prices. Not only are bikes effective budgeting for an individual, but they save money for city governments. It's been recorded that cities where biking/walking have higher rates, spend a lower proportion of their budget on transportation. For example, in Copenhagen the city government only spent \$97 per person on roads in 1999 (Pucher & Buehler, 2012). Saving time, and inherently money is an important rationale for a cycling preference.

### *Needs of a Cyclist:*

In order for cycling to be a preferred mode of transportation, it must be feasible, convenient, reliable and safe for everyone. It needs to be welcoming for women as well as men. It needs to be accessible for all age groups and for people with various physical abilities. In order to have infrastructure adequate enough that people feel comfortable biking, policies must be put in place. Cyclists also must take priority. Most of these policies are implemented at the local level. Governments, from local to national, influence cycling through their policies, but also dedicated funding, regulations, and design standards.

Safety with regards to cycling is directly associated with risk. Perceived risks that urban cycling present usually exceed the actual risks of cycling. Currently, most focus of cycling safety has been put on bike helmets, although requiring helmet use is not an effective strategy. The key to cycling safety is to slow down vehicles, reduce vehicle use, and providing physical barriers between cyclists and vehicles. The most crucial and basic need of a cyclist is safety where all perceived risks are eliminated. This means that before anything else, a cyclist needs adequate infrastructure.

### *Bridging the Gap in the United States:*

European cities were developed far before any mode of transportation besides walking was established. Therefore, cities were designed to be fully walkable. After the bicycle was invented in the early 1800's, there was more freedom for development. By the late 1880's the automobile was first introduced. By the 1950's and 60's, motorization levels in Europe had increased, sprawl increased, and policies began to favor car-use (Pucher & Buehler, 2012). This increase in car use rapidly led to pollution, congestion and fatalities. In response, there was a dramatic reversal of policies, especially in German, Dutch and Danish cities (Buehler et al., 2009). Europe has been successful in maintaining its' bike culture by "accepting the cyclist as a 'normal' traffic participant with equal rights...and the realization of an infrastructure of cars does not occur at the expense of cyclists" (Bruekel, 2010). Through planning successes, in 2010 Amsterdam had 28% of the population cycling, and Copenhagen had 32% (Bruekel, 2010). Unlike the United States, Europe never had a chance to fully adapt to car-culture, which is why bicycling has for the most part been maintained as an accepted mode of transportation.

To put it simply, American cities were designed for the car. In the United States, the cost of owning a car is lower than in Europe. It's much easier, at a lower cost, and at a younger age that Americans can have access to a driver's license. American culture and lifestyle have been conditioned to rely on cars, mostly due to the high levels of mobility, the maximum possible comfort, ease, convenience, and speed. Lastly, Americans stay in their cars due to the perceived safety as opposed to walking or cycling (Pucher & Dijkstra, 2000).



The most bike-oriented cities in the United States have lower levels of cycling than the least bike-friendly cities in the Netherlands, Germany and Denmark. Portland, Oregon, which is regarded as the most bike-oriented large city in the United States has a bike mode share of 6 percent, which is the same as Stuttgart, Germany which is regarded as an unfriendly bike city (Pucher & Buehler, 2012).

Difference in biking in The Netherlands vs the United States becomes even more dramatic when the statistics are disaggregated by age group. As shown in Figures 1.5.4 and 1.5.5, the small percentage of Americans who bike, are mostly under 24. In the Netherlands, however, all age groups make a high percentage of trips by bike. In the Netherlands, 24% of trips for ages 75+, are made on a bike. The number is practically inconceivable for the United States (Pucher & Dijkstra, 2000).

Table 1: Transportation Choice by Age Groups in the Netherlands in 1998 (percentage of all trips by all modes) from (Pucher & Dijkstra, 2000).

	Ages 18-24	Ages 25-39	Ages 40-64	Ages 65-74	Ages 75+
Private Car	36%	61%	59%	51%	43%
Public Transport	16%	5%	4%	4%	7%
<b>Bicycle</b>	<b>30%</b>	<b>19%</b>	<b>22%</b>	<b>25%</b>	<b>24%</b>
Walk	12%	13%	14%	19%	24%

Table 2: Transportation Choice by Age Groups in the US in 1995 (percentage of all trips by all modes) from (Pucher & Dijkstra, 2000).

	Ages 16-24	Ages 25-39	Ages 40-64	Ages 65+
Private Car	87%	89%	92%	91%
Public Transport	3%	2%	2%	2%
<b>Bicycle</b>	<b>1%</b>	<b>0.5%</b>	<b>0.3%</b>	<b>0.2%</b>
Walk	7%	5%	4%	6%

European countries account for high cycling levels during the planning process where as the United States does not. Bicyclist safety is central to transportation and land use planning in Europe, but never in the US. Thus, in the United States, most cycling is on roads with no provisions or with inadequate or unprotected bike lanes. There are other factors that most likely explain the higher share of bike trips in Europe. In this report, the five parameters used to measure the success of a city for being bicycle-friendly are: planning, land use, policy, infrastructure and culture. In this report, these five parameters will be applied to two cities in Europe: Amsterdam and Copenhagen, which are regarded as successful bicycle-oriented cities. Then, these five parameters will be applied to two cities in the United States: Minneapolis and Portland which, for American standards, are successful bicycle-oriented cities. Finally, recommendations for the American cities will be addressed based on the conclusions drawn through this research.

## 2. Five Parameters to a Successful Bicycling City

The five parameters used to analyze what makes a city a successful bicycling city are: planning, land use, policy, infrastructure and culture. The planning section will explore if the cities have their own bicycle plans or, if not, how they plan for cycling. The land use section will cover how the types of land uses in a city can make bicycling a more reliable transportation mode. The policy section will explore how governmental policies are influential in advancing bike-friendliness. The infrastructure section will explore how bicycle infrastructure in each city contributes to its success. Lastly, the culture section will provide information on how residents make a city more bicycle friendly through things like education, advocacy groups and socioeconomic statuses. These five parameters were inspired by the figure below. This visual representation was altered for this paper however to better address more specific principles in bicycle planning. The following paragraphs will go into further details as to how these parameters will be discussed and explored for each case study city.

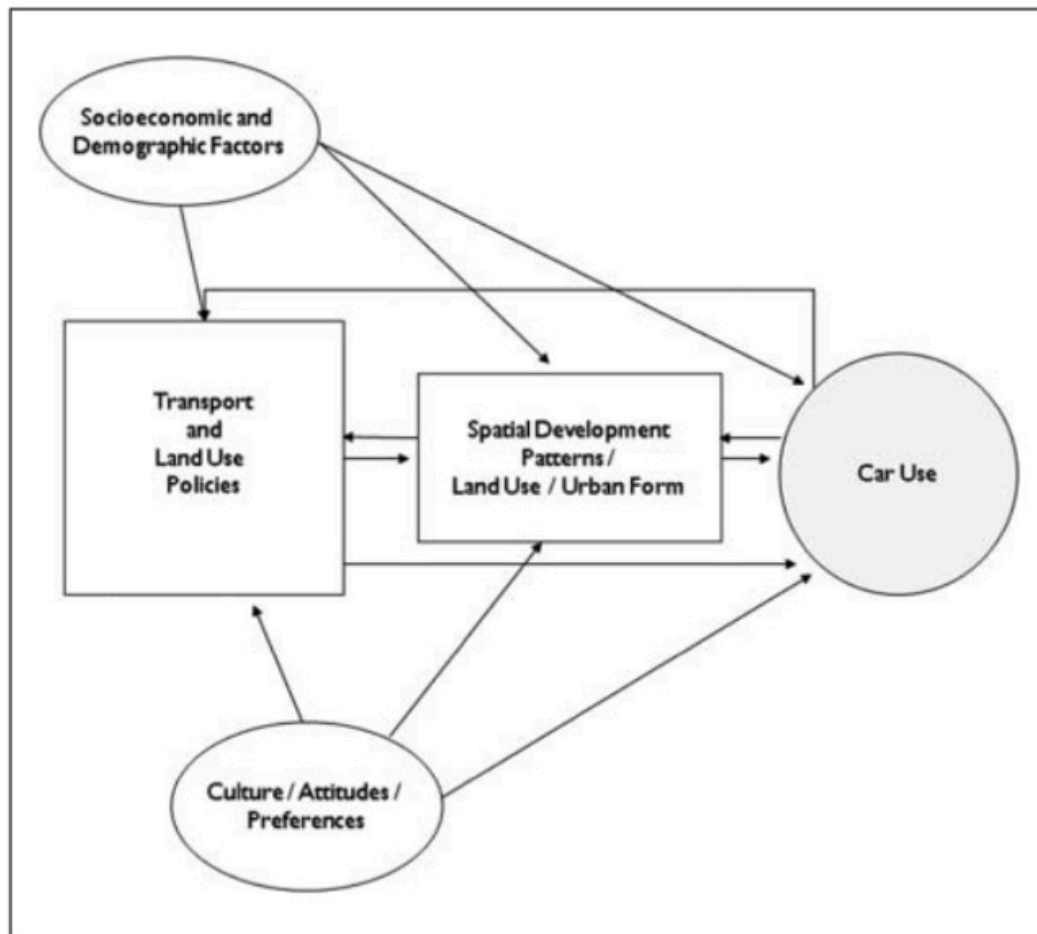


Figure 3: Factors Leading to Car Use from (Breukel, 2010).

## 2.1 Planning

Good transportation planning can have a large effect as to if bicycling is placed as a priority in a city. As cycling is becoming more popular, planning departments are starting to hire Bicycle/Pedestrian Planners, and focusing their transportation planning on sustainable/alternative transportation modes. Portland and Minneapolis have both recently published Bicycle Master Plans to address their future goals for cycling development in their cities. Copenhagen and Amsterdam have similar plans as well as nationwide cycling plans in their respective countries. In this paper, these Bicycle Plans will be evaluated, analyzed and compared to better comprehend what sort of planning is most effective in bicycle planning.

## 2.2 Land Use

Spatial development allows for opportunities in a city that shape the time, cost and convenience of different types of transportation. Areas that are densely populated and full of mixed uses create shorter distances for residents. This in turn creates higher quantities of walking and biking through that community. The higher the population, the more attention is given to infrastructure since it's affecting more residents, therefore the densely populated places tend to have higher quality infrastructure. Also, in densely population places, car parking supply tends to be limited, the road supply per capita is lower, also resulting in higher levels of biking and walking (Buehler, 2010). Basically, land use planning can determine whether or not biking will be convenient for the average person. This is a huge reason why cycling levels are higher in Europe. European countries don't have the freedom for sprawl like the US has. In concentrating their land uses, Europeans are able to reach all of their necessities by bike, unlike a majority of Americans. Assessing land uses in the case study cities will be crucial in examining what is successful and what needs to be improved. For each case study, this paper will report and analyze the land uses in each city and will analyze their applicability to bicycle planning.

## 2.3 Policy

National, regional and local governments influence cycling through policies, dedicated funding, and traffic/roadway standards. In Denmark and the Netherlands, national cycling policies enable local jurisdictions to develop and execute their own cycling plans. In the 1990s, the Dutch National Master Plan provided funds for bike infrastructure throughout the country. The United States does not have such a plan, but the US does however, fund the Safe Routes to School Program (Pucher & Buehler, 2010). The program gives underserved communities specific attention to attempt to make walking and biking a safe way to get to school. It also recently launched the Vision Zero for Youth Initiative, which will attempt to eliminate all traffic fatalities in youth in the US.

Overall, Europe has implemented more bike-friendly policies to not only encourage biking, but to also restrict car use. Their land use and design policies are also much stricter than the US, making low density sprawl more difficult. In order to evaluate a city's successes in bike friendliness, the policies in that city will need to be evaluated.

## 2.4 Infrastructure

Infrastructure is the most closely related to safety, which is typically the main concern when it comes to new cyclists. There are unique types of bike lanes that provide different levels of safety for the cyclist including: shared streets/lanes, bike lanes, separated paths, and standalone paths. The standalone paths will always be the safest as cars are no threat, but they also can be the most difficult to develop. As a standard, bike lanes are given different class names: Class I, II, or III. Standalone paths aren't included on this ranking since they don't involve cars.

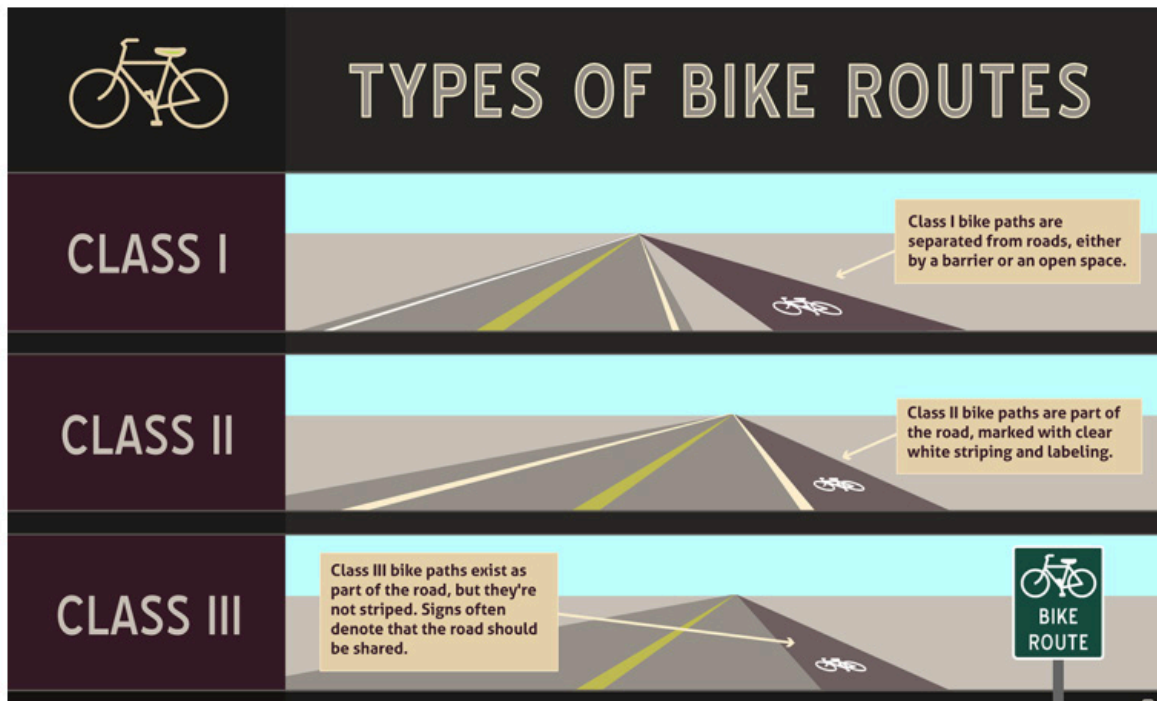


Figure 4: Bike Route Classifications from (Types of Bike Routes, n.d.).

Other bicycle infrastructure to be included would be traffic-calming devices. This can include speed bumps, bulb outs, traffic circles, roundabouts, and traffic diverters. In addition, when cars are in mixed traffic (Class II and III roads) the speed limit should ideally be 25mph or less. Any speed limit over 25mph can put a cyclist at risk of fatality. Lastly, bike infrastructure includes bike parking, whether that be in bike lockers, bike racks, bike stands or indoor storage. For each case study city, the infrastructure will be evaluated based on its' effectiveness to increasing cyclist safety.

## 2.5 Culture

Lastly, culture is probably the least considered factor in creating a bike friendly city, but it is arguably the most important. Having a culture that promotes the car as the societal norm will also have residents who are less likely to bike. A pro-environmental culture will always produce more cyclists. Through advocacy groups, government reinforcement, safety courses and community leaders, cycling can become the most highly regarded transportation method. In each case study city, the culture and societal norms will be addressed. Community organizations and advocacy groups will also be researched to conclude if the culture in the city is working to promote bike planning.

# 3. Case Studies

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## 3.1 Copenhagen

### *Introduction:*

Copenhagen, the beautiful capital of Denmark, was founded around 1160 and is the largest city in the country. One third of the population of Denmark resides in Copenhagen. Since the late 1800's, Copenhagen has held cycling and its livability as an important part of its identity. By 1910, the first separate bicycle paths were built. Since then, Copenhagen's population has grown to about 1.8 million, and the "City of Cyclists" has been rapidly expanding to accommodate more residents and more cyclists (City of Copenhagen, 2011).

As part of its rapid expansion, the City has set ambitious goals for their near and distance future. In 2015, the City of Copenhagen announced its goal of becoming a 'Greater Copenhagen', a hub for international investment and knowledge (City of Copenhagen, 2015). The City wants to become the world's best bicycle city, a goal firmly and unanimously by city council as part of the vision for Copenhagen to also become an Environmental Capital. Lastly, the City wants to become CO2 neutral by 2015 (City of Copenhagen, 2011).

Although the City presents ambitious goals, it has already accomplished much more than other cities of its size. Widely accepted as the most bicycle friendly city internationally, Copenhagen has 150,000 residents cycling each day to work or school. Every day, 1.2 million kilometers are cycled throughout the City and its earned the reputation for the example city for bicycle planning throughout the world (City of Copenhagen, 2011). Bicycle use is not limited to one group of people and all demographics are fairly equally represented in the cycling community. Cycling has been so prevalent for so long because it's so rooted in Copenhagen's history, it's been systematically executed and local authorities are deeply invested in its improvements (Bruekel, 2010).

### *Planning:*

Unlike other cities, cycling is implemented and incorporated into all levels of city planning. In 2002, Copenhagen published its first bike plan, that aligned with the City's budget for 2000-2003. The budget called for "an overall action plan for the improvement of cycling conditions shall be drawn up. The plan shall contain provisions for the extension of the cycle track network and proposals for new cycle routes and include proposals for the improvement of general passability, cyclist safety and comfort, including necessary maintenance" (City of Copenhagen, 2002). The 2002 bike plan, known as the "2002 Copenhagen Cycle Policy", laid out various goals for the proceeding 10 years. It called for \$10-15 million Euro to be dedicated to bicycle infrastructure/facilities. In addition, planned for 34,800 new bike parking spaces by 2009, a sharp decrease in bike theft, a greater focus on bike

planning at intersections, and a main focus on maintenance. This maintenance included a plan to sweep every weekend and for consistent snow-clearing, which would cost over \$1 million Euro a year. Lastly, it called for a removal of abandoned bicycles (Bruekel, 2010).

In 2011, the current bike plan, titled “Good, Better, Best- The City of Copenhagen’s Bicycle Strategy 2011” laid out the City’s goals for 2011-2025. With the slogan, “a better bicycle city, a more livable city”, planners identified that the way to accomplish their goals is through two principles: innovation and prioritizing. The plan has four main focus areas that it wanted to improve upon- sense of security, speed, comfort and lifestyle/image. In Figure 3.1.1.1 below, the 5-year interval goals are briefly identified (City of Copenhagen, 2011).

<b>GOALS:</b>			
<b>MODAL SPLIT FOR BICYCLES:</b>	2015	2020	2025
Share of all trips by bicycle to work and school in Copenhagen (2010: 35%)	50%	50%	50%
<b>QUALITY:</b>			
Share of the network that has three lanes (2010: 25%)	40%	60%	80%
Relative to 2010, cyclists’ travel time is reduced by	5%	10%	15%
Percentage of Copenhageners that feel safe cycling in traffic (2010: 67%)	80%	85%	90%
Relative to 2005, the number of seriously injured cyclists will fall by	50%	60%	70%
Percentage of Copenhagen cyclists who find the cycle tracks well maintained (2010: 50%)	70%	75%	80%
Share of Copenhageners who think that bicycle culture positively affects the city’s atmosphere (2010: 67%)	70%	75%	80%

Figure 5: Copenhagen’s Bicycle Strategy Goals from (City of Copenhagen, 2011).

Copenhagen’s goal to increase a sense of security for riders begins with the goal of having 90% of riders feeling safe riding through the City by 2025. In order to achieve this goal, new infrastructure is called among to be implemented, including: green bicycle routes, intersection redesign, wider cycle tracks, new cycle tracks, painting lines and streets dedicated to only bikes and buses. Infrastructure plans will be expanded upon in the ‘Infrastructure’ section for Copenhagen’s case study. In addition, safety will be increased with more public campaigns related to consideration and behavior, safer routes to schools, and traffic policies at schools (City of Copenhagen, 2011).

In order to increase cycling speed within the City, the plan calls for bicycle “super-highways”, small short cuts for cyclists (200-400 total: contraflow on one-way streets, shunts, etc.), large short cuts (5-8 bridges/underpasses), ITS (intelligent traffic systems), more E-Bike promotions, more signage and lower speed limits for cars. The City also plans to work out better partnerships between the metro/trains/buses and bicycles. Also, city officials plan to reevaluate land uses in the City and try to implement more population dense developments (City of Copenhagen, 2011).

These infrastructure improvements designed to increase riders’ speeds should also provide for the City’s goal of increasing comfort as well. For additional comfort, the plan calls for smoother asphalt on cycle tracks, improved snow clearance, effective bike parking and bike services throughout the City (air pumps, water fountains, weather reports, etc.) (City of Copenhagen, 2011).

To enhance the lifestyle and image for cycling in Copenhagen, the plan called for an increase in marketing to the public relating to image, lifestyle and advantages of cycling. It desires to create various campaigns aimed at specific target groups to promote behavioral habitats with regards to signaling, and campaigns to promote a sense of ownership. The strategy also plans to enhance the cooperation with local police regarding travels laws. The City wants to create partnerships between workplaces and educational institutions regarding bicycle facilities and information. Lastly, a one stop bicycle portal online will be implemented for more user-friendly community interaction (City of Copenhagen, 2011).

#### *Land Use:*

Copenhagen’s municipal city limits is about 33.4 square miles and has an estimated population of 601,448 residents as of 2016. The population density for within city limits is about 18,000 Copenhageners per square mile; very similar to US city, San Francisco’s population density. Copenhagen’s land use decisions are made with the ideal that “a dense city creates growth” (City of Copenhagen, 2015).

Development from the urban core outwards to its surrounding areas has been guided by the Finger Plan, first developed in 1947. The Finger Plan gives a general development plan for the Greater Copenhagen area where development is concentrated along transportation corridors leading to outside the City. There are designated green wedges between the “fingers” to remain undeveloped. These green wedges will prevent urban sprawl and will preserve valuable open spaces (Danish Ministry of the Environment, 2007).

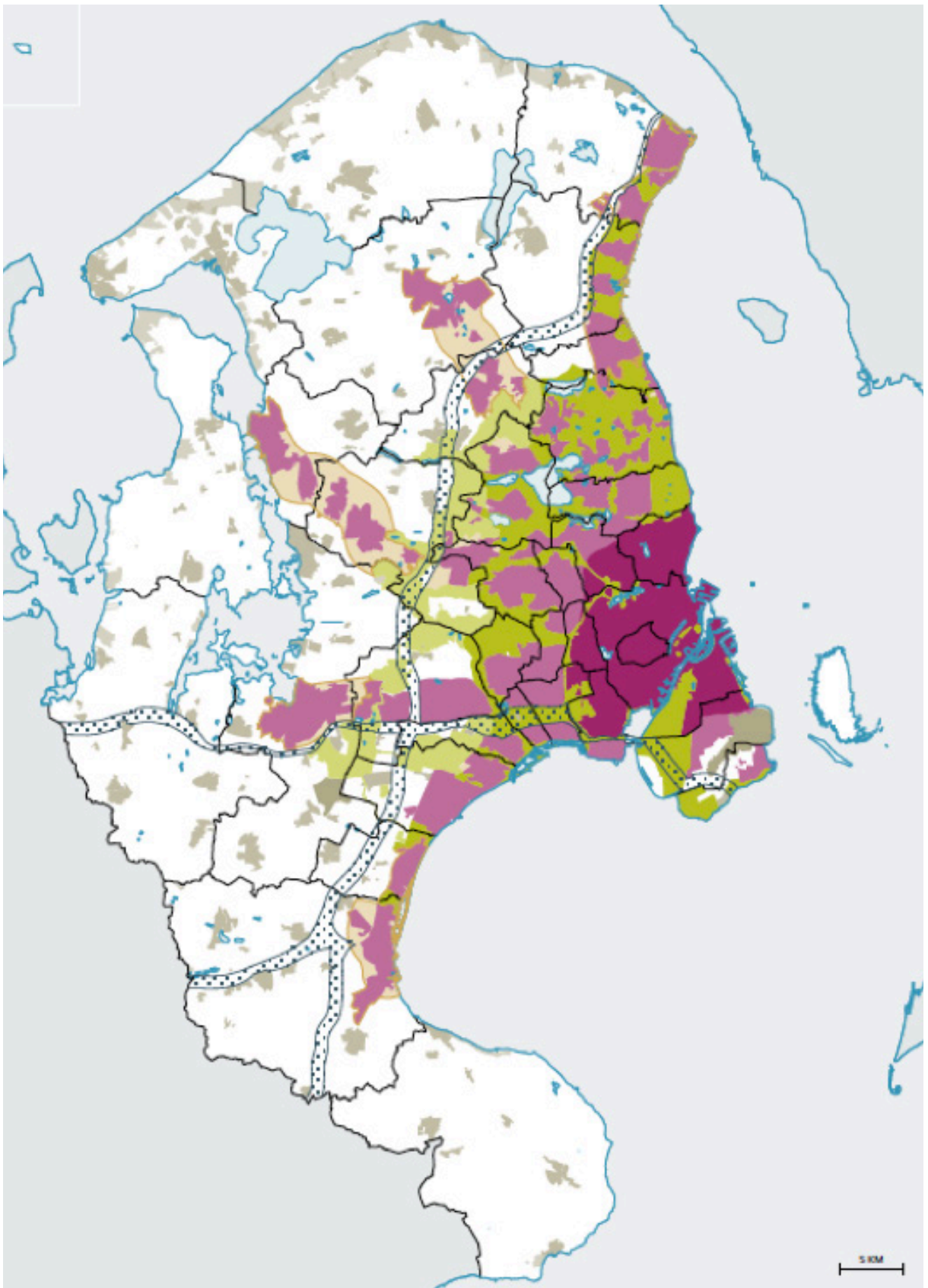


Figure 6: The Finger Plan 2007 from (Danish Ministry of the Environment, 2007).



Within the urban core, land is developed with the premise that mixed use development is the most efficient. In its most recent plan, the City gave its focal points for its urban development. The focal points being: new areas feature a mixture of function, short transport distances, focused urban development and completion of areas and neighborhoods, municipal investments in services that are optimized in line with growth, and new areas are only developed when absolutely needed (City of Copenhagen, 2015).

Denmark sees Copenhagen as the country's growth machine, so the country and the City have put significant efforts in making sure the development will best benefit the nation's growth needs. Again, with the idea that denser developments are more important, Copenhagen has decided to pursue its innovation and development in existing urban areas. The needs for more residential and commercial buildings will be met through developing areas more, not by expanding development into untouched land. This idea of co-location, or mixed-use developments create better utilization and increased urban life. In addition, no development is created far away from public transportation stations, which decrease the need for a car in the City. New municipal service functions are incorporated into already existing municipal buildings, reducing the need for new development (City of Copenhagen, 2015).

Lastly, in regard to land uses, Copenhagen maintains "green and blue spaces" with high priority. Green areas refer to open spaces or parks, while blue spaces refer to bodies of water; both of which are valued by the City and its residents. By maintaining these areas, the City can promote social communities across cultures and generations, improve air quality and provide animal habitats. 51% of Copenhagen residents are within a 0-5-minute walk from a park and/or a recreational space (City of Copenhagen, 2015).

Copenhagen's dedication to dense land use planning and its prioritization of green spaces is crucial to the success of bicycle planning in the City. Residents have access to all of their land use needs within a walkable or bikable distance. Without the constant consideration of travel times for residents, the City's development would not be so accommodating to riders.

**Policy:**

Transportation and bicycle policy in Copenhagen has been successful first and foremost because political leaders, policymakers, and decision makers are dedicated. But also, bicycle policies in Copenhagen are consistent, maintained, measurable, transparent and coherent. Government officials are dedicated to making sure that cycling needs are budgeted into the City’s expenditures. In 2002, the City budgeted 60 million for road construction, with 1/3 solely designated for improving cycling conditions (City of Copenhagen, 2002).

Bicycle policies are made with the City’s best interests in mind. While increasing ridership levels, they also want to improve the City’s health, environment, and equity. This has been expressed through various policies. First, cycling and proper cycling infrastructure is addressed throughout the City’s official health policy and health plans (City of Copenhagen, 2011).

All environmental policies that the City implements include efforts for cycling strategies, and at least ¾ of growth in traffic in the City must be green. The City also maintains policies to ensure that cycling remains equitable with requiring bike paths to be maintained in poor areas of the City. Also, no disadvantaged or low-income housing can be isolated from the City (City of Copenhagen, 2015).

Policy makers ensure that policies are transparent and receive the public’s feedback before being pursued. In addition, to check on their progress in bicycle planning, policymakers maintain the Bicycle Account, which is published every 2 years. The Bicycle Account allows for residents to give feedback on bicycle policy implemented in the past 2 years. An example of criteria is below (Bruekel, 2010).

***Scores awarded by cyclists on eight essential elements of Copenhagen bicycle policy, 1996-2008***

	1996	1998	2000	2002	2004	2006	2008
Copenhagen city for cycling	7	8	8	8	8	8	9
Cyclist sense of security in traffic	6	6	6	6	6	5	5
Amount of cycle paths	6	6	7	6	6	6	6
Cycle path width	7	7	6	5	5	5	4
Cycle track maintenance	5	5	4	5	5	5	5
Road maintenance	2	3	2	3	3	3	3
Feasibility of combining cycling and public transport	5	4	5	5	5	6	5
Bicycle parking in town	4	3	4	3	3	3	3

Figure 7: Scores (out of 10) by Cyclists on Elements of Bicycle Policy from (Bruekel, 2010).

**Infrastructure:**

Copenhagen, the “City of Cyclists”, has some of the world’s most innovative bike infrastructure. The first bike path to be constructed in the City was in 1920, by 2009 there was approximately 340 kilometers of bike paths (Bruekel, 2010). It currently has the largest

network of cycle tracks that are 2.2-3 meters wide, grade separated from motorized traffic and marked in blue color at intersections. It has traffic signals that are synchronized for cyclist speeds (Pucher & Buehler, 2012). It also has made great strides in lower car traffic in its urban core through transforming parking spaces into bike paths, making car parking more expensive and by reducing the amount of car traffic lanes (Bruekel, 2010).

Figure 8 is an example of one of the most iconic bicycle paths in Copenhagen, known as the “Cycle Serpent” (Cykelslangen in Danish). The overpass is a 230-meter-long sky bridge opened in 2014 which hosts more than 20,000 cyclists a day. It is very recognizable with its bright orange color and LED lights keeping it lit all night (City of Copenhagen, 2015).



Figure 8: The Cycle Serpent from (City of Copenhagen, 2015).

The 2011 Bicycle Strategy Plan provided the details of the new PLUSnet cycling system. PLUSnet is to be completed by 2025 and features some fairly innovative bicycle infrastructure developments. The goal for development is to have 3 bike lanes in each direction on 80% of the network with new routes over water, railways and town squares. The PLUSnet system is also known as a “Cycle Superhighway”. The superhighway will feature ITS, which stands for Intelligent Traffic System. ITS has LED lights in asphalt that signals which transportation form has the priority and when. This allows for multi-uses during different times of the day. This would, for example, make sidewalks widened during the middle of the day when there are more pedestrians and fewer cyclists, and then widened bike lanes in the same stop during high commuting hours.

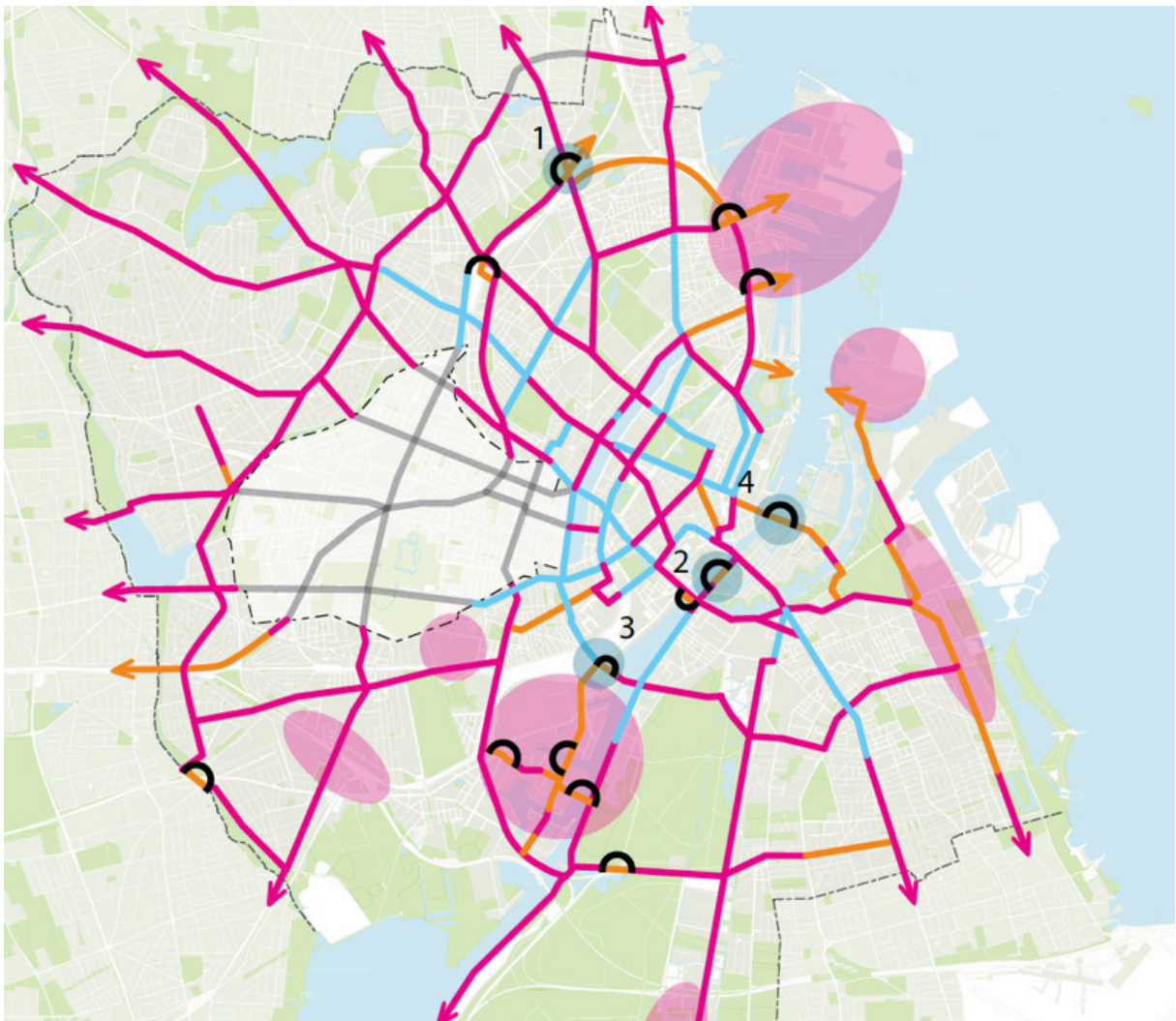


Figure 9: The PLUSnet Development Strategy Map from (City of Copenhagen, 2011).

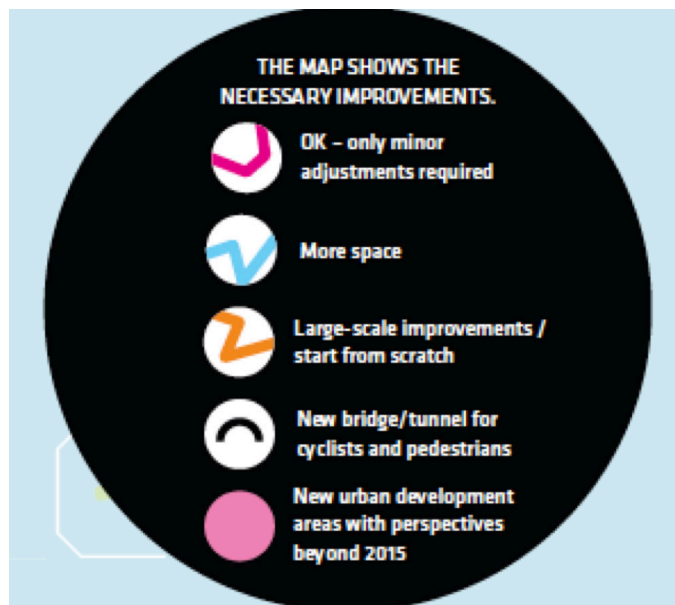


Figure 10: PLUSnet Development Strategy Map Key from (City of Copenhagen, 2011).

Another new innovation to the system is “green wave” technology. There are sensors embedded in the asphalt which register the number of cyclists so that traffic lights can time green lights to give to big groups of cyclists so they don’t have to continuously stop. The new PLUSnet cycling system will create higher quality space, intersections and maintenance throughout Copenhagen (City of Copenhagen, 2011).



Figure 11: LED Lights in Asphalt from (City of Copenhagen, 2011).



Figure 12: LED Green Wave Technology from (City of Copenhagen, 2011).

## Culture:

Bike-friendly culture in Copenhagen has been reinforced for decades. Jan Gehl has been a huge influence for decades in promote bike culture. Gehl is a Copenhagen native, international recognized, urban designer and architect. Gehl and his architecture firm are huge influences in Copenhagen, as well as all over the world. Gehl has written numerous books highly regarded in the urban planning world including *Cities for People*, *Life Between Buildings*, and *How to Study Public Life*. His career has been focused on re-orienting the City to accommodate pedestrians and cyclists first. Gehl has even coined the term “copenhagenization”, describing design strategies to make cities more accessible by bike (Project for Public Spaces, 2009).

Bike culture in Copenhagen is also influenced by advocacy groups that make sure riders have a voice in the City ’s decision making. The most prominent is the Cycling Embassy of Denmark. The Embassy is essentially a network of important private companies, governmental agencies, and non-governmental organizations who all want to promote cycling and development the most effective cycling strategies.

In response to the high interest in cycling, the City has expanded its bicycle planning team to 6 planners solely focused on bicycle planning implementation who make sure projects are widely implemented (Bruekel, 2010). These planners try to make sure the public is highly involved, with all plans and proposals for plans online with open access (Danish Ministry of the Environment, 2007).

Cycling is so embedded into the culture that most children are expected to know how to cycle safely before they even begin kindergarten. Cyclists are known to be well mannered in traffic, well-educated on traffic laws, and highly visible (Bruekel, 2010). Most residents share similar values on health and environmental sustainability. The City has a well-known goal of being carbon neutral by 2025. Copenhagen wants to make a green transition of energy production, lower the overall energy consumption, better utilize resources from waste and rely on green mobility. This goal is the City’s goal, but is also the goal of most residents. The idea is that taking care of the environment is a shared responsibility, and residents need to put in the effort to be as ecologically sustainable as possible. Since the City is so transparent about these goals, most immigrants to Copenhagen share the same values (City of Copenhagen, 2015).

*Summary:*

Table 3: Summary of Successes and Challenges to Bicycle Planning in Copenhagen

	<i>Successes:</i>	<i>Challenges:</i>
<i>Planning:</i>	<ol style="list-style-type: none"> <li>1. Cycling is incorporated in all levels of city planning.</li> <li>2. 5-year incremented clear goals are provided and are accomplished through innovation and prioritization.</li> <li>3. Main goals are to increase security, speed, comfort and lifestyle.</li> </ol>	<ol style="list-style-type: none"> <li>1. Coordinating bicycle planning in all levels of city planning takes a lot of time, effort and organization.</li> <li>2. It is difficult to create and track new goals for every five years.</li> <li>3. Having a multitude of goals is difficult to execute all at once.</li> </ol>
<i>Land Use:</i>	<ol style="list-style-type: none"> <li>1. Development is concentrated in transportation corridors.</li> <li>2. Mixed-use, high-density development is prioritized.</li> </ol>	<ol style="list-style-type: none"> <li>1. Development only pursued near transportation corridors can be difficult to execute and requires in depth planning.</li> <li>2. Mixed-use and/or high-density development is not always widely accepted.</li> </ol>
<i>Policy:</i>	<ol style="list-style-type: none"> <li>1. All policies are maintained, measurable, transparent and coherent.</li> <li>2. A Bicycle Account is maintained to track policy progress.</li> </ol>	<ol style="list-style-type: none"> <li>1. Policy that is maintained, measurable, transparent and coherent can be difficult to execute and keep up with.</li> <li>2. The Bicycle Account takes a significant amount of time and effort to maintain.</li> </ol>
<i>Infrastructure:</i>	<ol style="list-style-type: none"> <li>1. Has the world's largest network of cycle tracks.</li> <li>2. Car infrastructure like parking in the city center has been transformed into bike paths.</li> </ol>	<ol style="list-style-type: none"> <li>1. Expanding a bike network can be incredibly expensive.</li> <li>2. People are typically hesitant and defiant against the removal of car infrastructure.</li> </ol>
<i>Culture:</i>	<ol style="list-style-type: none"> <li>1. Cycling culture has been embedded into residents' lifestyle for decades.</li> <li>2. Many non-governmental organizations work to continuously promote cycling.</li> </ol>	<ol style="list-style-type: none"> <li>1. This wide acceptance of bike culture can't be easily or quickly implemented into a community.</li> <li>2. Bicycle advocacy groups can be difficult to start up and gain traction.</li> </ol>

## 3.2 Amsterdam

### *Introduction:*

Amsterdam and Copenhagen seem to take turns on which city is the cycling capital in the world. Although Copenhagen is currently on the top of most rankings, Amsterdam is a known cyclist haven. With its new plans for the next five years, Amsterdam could easily surpass Copenhagen in bike friendliness.

Amsterdam is the capital of the Netherlands located in western Europe. Through its high-density planning, strict government control and its historic urban tradition, Amsterdam is a well-known bicycle friendly city used as a model internationally for other cities developing their bicycle network. With a population of about 800,000 residents in 85 square miles, Amsterdam has a population density of about 9,500 people per square mile.

Amsterdam has the most bike parking internationally with 225,000 bike parking spots per 100,000 people. Biking in the City is accessible through the high amount of bicycle parking, the established car-free zones within the City's core, bike training beginning in elementary school and accessible, cheap and convenient public transportation that accommodates for bicycles. All of these factors contribute to a combined 2 million kilometers per day biked within the City (Pucher & Buehler, 2012).

### *Planning:*

The City of Amsterdam published its most recent bicycle plan (the Meerjarenplan Fiets) in 2017 which addressed its long-term goals for 2017- 2022. The plan was developed using various surveys, bicycle parking counts and input from the Dutch Cyclists' Union and Amsterdam residents. The plan's overall cost is an estimated 54 million dollars that features 53 measures for improving biking in Amsterdam. Planners have outlined the desire to create a healthy, accessible and attractive city through three objectives: smooth cycling, easy parking and better biking. (City of Amsterdam, 2017).

The idea of "smooth cycling" refers to better bike infrastructure within the City. Based on the plan there will be new bicycle connections throughout the City that overcome obstacles outlined by various surveys. There will be more space within other busy bike routes through the re-design of routes that also will utilize smart measures such as intelligent traffic lights and rush-hour bicycle routes. All routes will receive new smooth asphalt. Lastly, routes will be made more recognizable through a "Green Network" which features better signage within comfortable routes through pleasant, green surroundings from away from motorized traffic. Figure 11 below shows the trails the City has identified in this plan to have limited space that need expansion. Figure 12 below shows the City's busiest intersections that would benefit from "smart measures" to increase efficiency (City of Amsterdam, 2017).



In an effort to make easier parking, the City plans to create new forms of bike parking and provide guidance in order to make parking easier to find. There are also plans to create more accessible sidewalks, better utilize existing parking spaces and overall increase the number of parking facilities. Cyclists can expect an expansion of the number of pleasant and attractive public spaces in combination with bike parking facilities at beginning and end of walking routes. With regards to bike parking, the City wants a cyclist satisfaction rate of 7/10 by the year 2025, comparable to the rate of 5.8/10 in 2015 (City of Amsterdam, 2017).

The last main objective is for better biking. This objective is in regards with cycling culture and inclusion. The City wants cyclists in Amsterdam to cycle through responsible, respectful behavior. Most of the plans for encouraging bike culture include campaigns specifically aimed towards low cycling neighborhoods such as Nieuw-West, Noord and Zuidost. Its most concrete goal to raise overall cycling satisfaction ratings to 7.5/10 by 2015 comparable to the 7.1/10 rating in 2015. To raise this satisfaction rate, the City also intends to take measures that makes cycling more pleasant, such as with countdown signals at traffic lights. Figure 13 below shows various neighborhoods in the City with their respective transportation mode percentages. This data is used to help target where campaigns are most needed (City of Amsterdam, 2017).

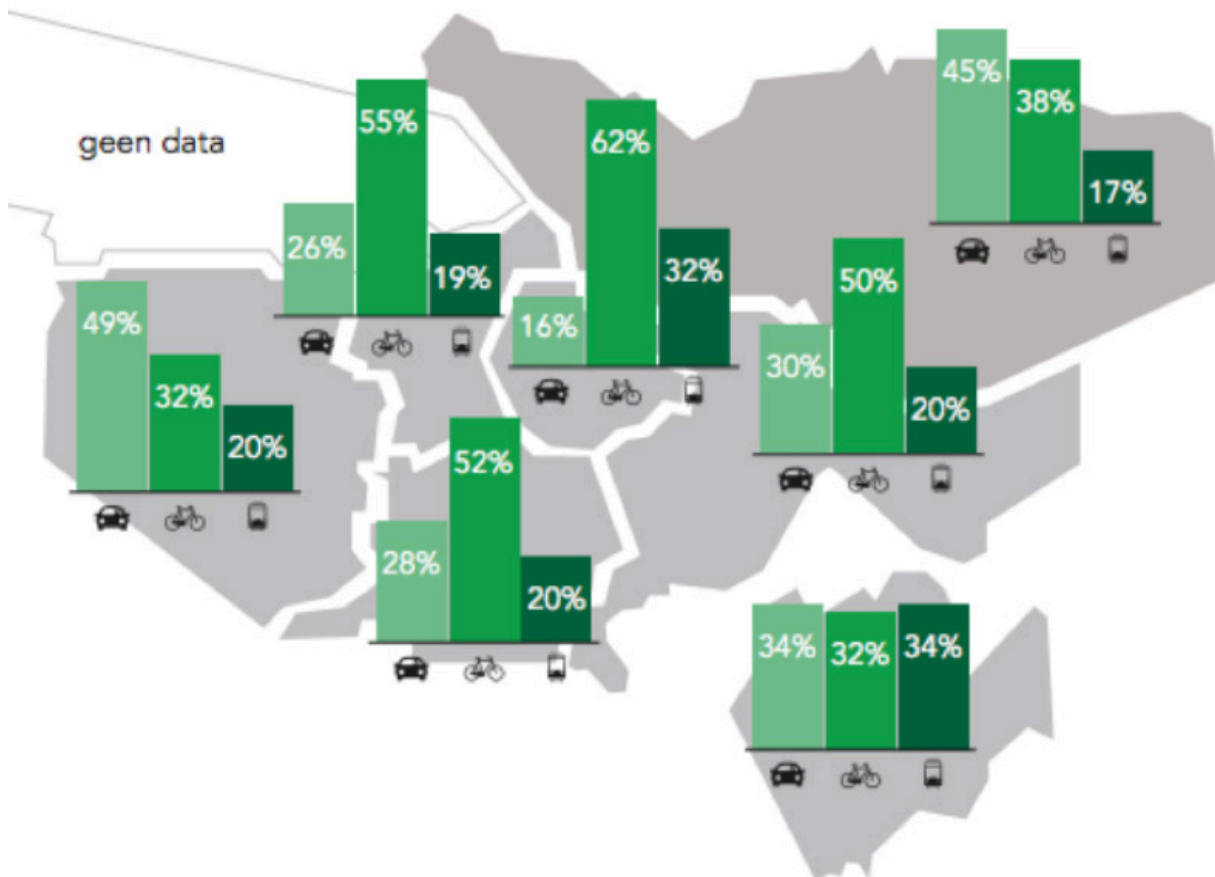


Figure 13: Transportation Modes by Neighborhood from (City of Amsterdam, 2017).

The Long-Term Bicycle Plan 2017-2022 contains a total of 53 measures. The City plans to work on these measures while also continue unfinished aspects of the 2012-2016 plan. The plan addresses how the City hopes to launch various studies and experiments through this process to explore new concepts and innovations. To track their progress, a bicycle monitor (fietsmonitor) is planned to be organized annually to present the results of that year. The City Council will use this information to possibly adjust plans for the next year (City of Amsterdam, 2017).

#### *Land Use:*

Amsterdam's government puts strict policies on developers in order to limit any sprawl. Ridership numbers in Amsterdam are very high in comparison to similar sized cities, and land use planning with an emphasis on concentrated development may be the reason. 70% of all journeys for residents are less than 7.5 km (The Netherlands Ministry of Transport, 2009). Since the 1980's, policies have been focused on concentration decentralization, which is a term describing developed designated growth centers and prohibited growth of small rural settlements. Policies like the one enacted in 1973 which prohibited out of town shopping malls forces developments to be put in the built environment, making development more sustainable and accessible (Wright, 2007).

With an anticipated population increase of 23% between 2016 and 2040, the City is anticipating an estimated 70,000 new residences needed by 2040. This growth represents how the City has already and will need to continue to be effective in its use of underused spaces. The City holds the idea that economic development and environmental sustainability are mutually reinforcing. Amsterdam currently works to increase housing density, to transform single-use buildings into mixed-used ones, improve regional transport and invest in green space. These aims have been defined through the 2016 Environment and Planning Act which merges 26 separate acts, including the former Spatial Planning Act (OECD, 2017).

Amsterdam's limited space for expansion, their strict government policies, mixed-use redevelopments and focus on growth centers have been effective in making the City bike friendly. The direction the City is going with their land use planning will continually make the City more accessible and rider friendly.

#### *Policy:*

Bicycle policy in Amsterdam is effective through its development, its budget, its integration and its execution. By the 1980's, bicycling issues returned to the mainstream government and policies were enacted to prioritize traffic safety of cyclists (Wright, 2007). Currently, national regulations work to prioritize the safety of all cyclists but there are a multitude of special protections for children and seniors. Policy is developed and executed based on five pillars; road safety, infrastructure, parking, education and promotion (Pucher & Buehler, 2008).

Cyclists are always in the minds of transportation policy makers. 10% of Amsterdam's transportation budget is dedicated to cycling (Wright, 2007). Bike policy execution is divided between the 14 city areas that each implement their own policy. Each has unique implementation processes and they have their own problems to address within their area (The Netherlands Ministry of Transport, 2009). However, most of Amsterdam's policies for cycling are not technically cycling instruments but instead they focus on car reduction. Some of these restrictions include: limited parking, no trucks in neighborhoods, no through traffic in neighborhoods and license requirements for parking in the city center (Wright, 2007).

### *Infrastructure:*

From 1978-1996, Amsterdam more than doubled their bicycle infrastructure from 5,764 miles to 11,767 miles (Wright, 2007). With a new bike plan costing the City \$54 million, the City will be able to continue to expand their bicycle infrastructure. Amsterdam's new bike plan calls for new bicycle connections throughout the City as well as widened bike lanes. In addition, bike routes will receive smart features including intelligent traffic lights and rush hour routes. Routes will be made more recognizable through a "Green Network" featuring better signage within more comfortable, green routes away from motorized traffic. (City of Amsterdam, 2017).

The Amsterdam Central Station in the City's core is the largest train station in the City and holds a bike garage with three levels to hold up to 3,000 bikes (Wright, 2007). The new bike plan will make an effort to make parking easier with new forms of bike parking and guidance to make finding parking easier. It also plans to put efforts in better utilization of existing parking spaces. A recent development at the Central Station is shown below; a tunnel underneath the station dedicated to cycling and walking (City of Amsterdam, 2017).



Figure 14: Tunnel Below Central Station from (City of Amsterdam, 2017).

Current policies in Amsterdam regarding bike infrastructure include various design requirements to make the bicycle network rider friendly. The bike network has as few intersections as possible, with priority given to cyclists at the necessary intersections. In addition, the average waiting time at traffic lights through an intersection are at most 30 seconds. Cyclists are also given priority in shopping streets. Bicycle lanes are mostly one-way paths that have requirements of being 1.8 meters wide, ideally 2.5 meters wide. There are restraints in constructing 2-way bike paths. Lastly, the radius of curve in bike paths is at least 4 meters, and the gradient is at most 1:10 (Bruekel, 2010). Other policies include traffic calming measures such as speed limits of 19 mph or less and physical barriers which include: raised intersections and crosswalks, traffic circles, road narrowing, zigzag routes, curves, speedbumps, and artificial closures (Wright, 2007).

### *Culture:*

Ridership levels in Amsterdam are impressive with 1.1 bikes owned per person (The Netherlands Ministry of Transport, 2009). Bike ownership among young people (24 and under) is 65%. Bike ownership among people over 24 is 83% (Breukel, 2010). Over 50% of all trips within the City limits are made by bike (City of Amsterdam, 2017). These statistics come from high levels of education, campaigns, unions, advocacy and a general widespread passion for cycling that comes from years of enforcement. In general, all citizens show support for intense policies against cars (Wright, 2007).

Much of Amsterdam's success in normalizing cycling is because of the Dutch Cyclists' Union, *Fietsersbond*, who campaign for better cycling conditions in the Netherlands. The union was founded in 1975 and has since had many successes. In the 1980s, they fought for lowered speed limits in residential areas. In the late 1990's they lobbied and fought for bicycle parking at train stations. In 2005, the *Fietsersbond* developed a bicycle route planner. And in 2007, they started training cycling teachers who in turn teach mostly school children. With their wide support and large voice in the transportation world, the *Fietsersbond* has been crucial in making Amsterdam as bike friendly as it is currently (*Fietsersbond*, n.d.).

All children in Amsterdam have received some kind of education on bike practices by the age of 10. Also, traffic education has intense driver training which always includes information about cyclist safety. The City also promotes a bike campaign every fall to encourage rides to use bike lights when it's dark. The campaign lasts one week to promote and educate, after that one week, riders are given tickets if they are caught riding in the dark with no lights (Wright, 2007).

With such high ridership numbers, comes Amsterdam's biggest problem regarding cycling- bike theft. It has become such a huge problem that city officials sentence offenders to jail for 3 months if they are caught. In addition, to combat this problem the City encourages people to always report bike theft and tries to get all riders to register their bikes. The City also brings in recovered abandoned and stolen bikes to centers designed to store homeless bikes. People are encouraged to come in to see if their bikes have been brought in (Wright, 2007).

*Summary:*

Table 4: Summary of Successes and Challenges to Bicycle Planning in Amsterdam

	<i>Successes:</i>	<i>Challenges:</i>
<i>Planning:</i>	<ol style="list-style-type: none"> <li>1. The new bicycle plan features 53 measures for improving cycling.</li> <li>2. Planners outlined three objectives: smooth cycling, easy parking, and better biking.</li> </ol>	<ol style="list-style-type: none"> <li>1. Bicycle plans with many features are incredibly expensive- this one \$54 million.</li> <li>2. Having more than one objective makes execution more difficult with multiple goals to be pursued at once.</li> </ol>
<i>Land Use:</i>	<ol style="list-style-type: none"> <li>1. Strict policies are placed so developers cannot contribute to urban sprawl.</li> <li>2. Single use buildings are being transitioned into mixed-used developments.</li> </ol>	<ol style="list-style-type: none"> <li>1. It is difficult to advance and expand a growing city without contributing to urban sprawl.</li> <li>2. Financing for mixed-use rather than single use can be much more difficult.</li> </ol>
<i>Policy:</i>	<ol style="list-style-type: none"> <li>1. Each of the 14 designated city areas implement their own policy.</li> <li>2. Most policies aren't focused on bike infrastructure, but rather on car reduction.</li> </ol>	<ol style="list-style-type: none"> <li>1. City areas must coordinate so their policies are coherent.</li> <li>2. Policies that limit cars can be difficult to implement as it will likely receive backlash.</li> </ol>
<i>Infrastructure:</i>	<ol style="list-style-type: none"> <li>1. Priority is given to cyclists at nearly every traffic intersection.</li> <li>2. Green routes are developed which are comfortable routes separate from car traffic.</li> </ol>	<ol style="list-style-type: none"> <li>1. There is less emphasis on ridesharing and public transit.</li> <li>2. Separated bike routes require their own designated land in the city.</li> </ol>
<i>Culture:</i>	<ol style="list-style-type: none"> <li>1. On average, there are 1.1 bicycles owned per person.</li> <li>2. Bike education is implemented for all elementary school students.</li> </ol>	<ol style="list-style-type: none"> <li>1. Bicycles can be marginalizing as not all groups of people can ride.</li> <li>2. Funding for bike education will likely raise tax prices.</li> </ol>

## 3.3 Minneapolis

### *Introduction:*

Minneapolis is the largest city in Minnesota with about 413,000 people, and is one of the “Twin Cities” along with the neighboring state capital, St. Paul. Minneapolis is known for its parks, lakes, extreme winter climate, cultural landmarks and now for its cycling-friendliness. Even with its average high temperature of 23.7 degrees Fahrenheit in the winter, Minneapolis has been recognized as a Gold Level Bicycle Friendly Community by the League of American Bicyclists. In addition, in 2015, Minneapolis was the only United States city included on the worldwide bike friendly list- the Copenhagenize Index (Pucher & Buehler, 2012).

This mid-western city has a federal pilot program to thank for much of their success. The Non-Motorized Transportation Pilot Program provided a grant for over 25 million dollars to four promising communities to help advance the bike network in that community. The three other communities chosen were Columbia, Missouri, Marin County and Sheboygan County, Wisconsin. Although, nobody else has seen as much success as Minneapolis since the grant in 2005 (Pucher & Buehler, 2012).

There are many things that make Minneapolis unique in their bike-friendliness. First, the City has the most bicycle parking per capita in the United States. Due to the extremely low winter temperatures, the City has to be quick to response to snow. The City plows all multi-use paths within 24 hours of snowfall. Next, the City relies heavily on off-street bike paths for their primary bikeway network. These off-street bike paths are safer for cyclists, and are probably why ridership levels are high in Minneapolis. Lastly, Mayor Rybak of Minneapolis (2002-2014) is a huge bicycle advocate and his energetic political advocacy did extensive work in helping to prioritize bike initiatives (Pucher & Buehler, 2012).

### *Planning:*

City of Minneapolis published its most recent bicycle plan in 2011. It was created to replace the 2001 5-year Bikeways Master Plan. The plan is over 200 in-depth pages and it took over a year to prepare. The plan provides a new bikeways master plan map showing the proposed facilities. That map is pictured below as Figure 15. The plan also gives the vision statement for this plan. The vision, “All bicyclists enjoy a welcoming environment, riding safely, efficiently, and conveniently within the City of Minneapolis year-round”, also provides a list of guiding principles: improve safety, improve mobility, increase the numbers of bicyclists, increase mode share, ensure community support, and ensure wise investments (City of Minneapolis, 2011).



Figure 15: Proposed New Bikeways Master Plan (City of Minneapolis, 2011).

The plan starts a look at the past with a history of biking in Minneapolis with a look at how Minneapolis maintains a commitment to bicycling. It then examines the current bicycle policies in the City, which have been derived from various other local plans including: City of Minneapolis Bikeways Master Plan (2001), Access Minneapolis: Citywide Transportation Action Plan (2009), The Minneapolis Park and Recreation Bike Walk and Roll Plan (2009), and other various citywide and small area plans. The plan then provides an existing condition analysis where it evaluates what is already been accomplished throughout the City and where an accurate baseline can be established. It also designates the City's strengths and challenges (City of Minneapolis, 2011).

Next, the plan establishes a needs analysis. The needs have been broken down into the 6 "E"s: education, encouragement, enforcement, engineering, equity and evaluation. With regards to education, the plan calls for better bicycle education for children, education for adult drivers, education for professional drivers, and education for senior citizens. For encouragement, the plan provides the groups of people who need the most encouragement to pursue cycling including seniors, minorities, and youth. When talking about enforcement, the plan defines the biggest needs for enforcement including more speed management, reduced bike theft and better constancy. The engineering needs of the City are the infrastructure improvements that are needed including: corridor improvements, system-wide needs and spot improvement needs. With regards to equity, the City has defined that geographical areas within the City are not equitable and infrastructure should be equally allocated. Lastly, the City addresses how they need better evaluation statuses such as better count data, better ways to engage the public, and better participation in research initiatives (City of Minneapolis, 2011).

The plan prioritizes the most significant goals that it wants to accomplish in increasing cycling ridership numbers. The City wants to reduce bike injuries by 10% every year while also cutting fatalities in half every five years. It wants to pursue and develop dozens of infrastructure projects that will equally serve all residents. This includes the addition of 183 miles of bikeways in the next 30 years and an additional 300 parking spaces each year. The City wants to be able to ensure that all residents are within 1 mile of a trail, ½ mile of a bike lane or ¼ mile of a signed bike route by 2020. The City wants to encourage biking through adding bike education, expanding bike share to all parts of the City, strengthen existing bicycle policies and reduce bicycle theft through more police enforcement (City of Minneapolis, 2011).

This bike plan was especially significant for the City of Minneapolis since it was not only the first plan in ten years, but it also was the first bike plan after the grant provided by the Non-Motorized Transportation Pilot Program. To make sure this plan was as effective as possible, planners relied heavily on community involvement. The plan was shaped by comments from the public through public open houses and various surveys. Most of the input from this plan came from bike advocates elected officials, businesses, neighborhood groups, and the general public. The City tries to utilize community input as part of all citywide plans and capital projects (City of Minneapolis, 2011).

In 2015, planners decided to update the bicycle plan from 2011 in order to explore



the need for more protected bikeways. They also wanted to update the plan because the 2013 Climate Action Plan recommended 30 miles of on-street protected bike facilities. The plan update focused solely on near-term priorities, not long-term visions. The update is a result of a year-long planning process beginning with public open houses, online surveys to identify where protected bikeways were needed. The new planned bicycle network is pictured below (City of Minneapolis, 2015).

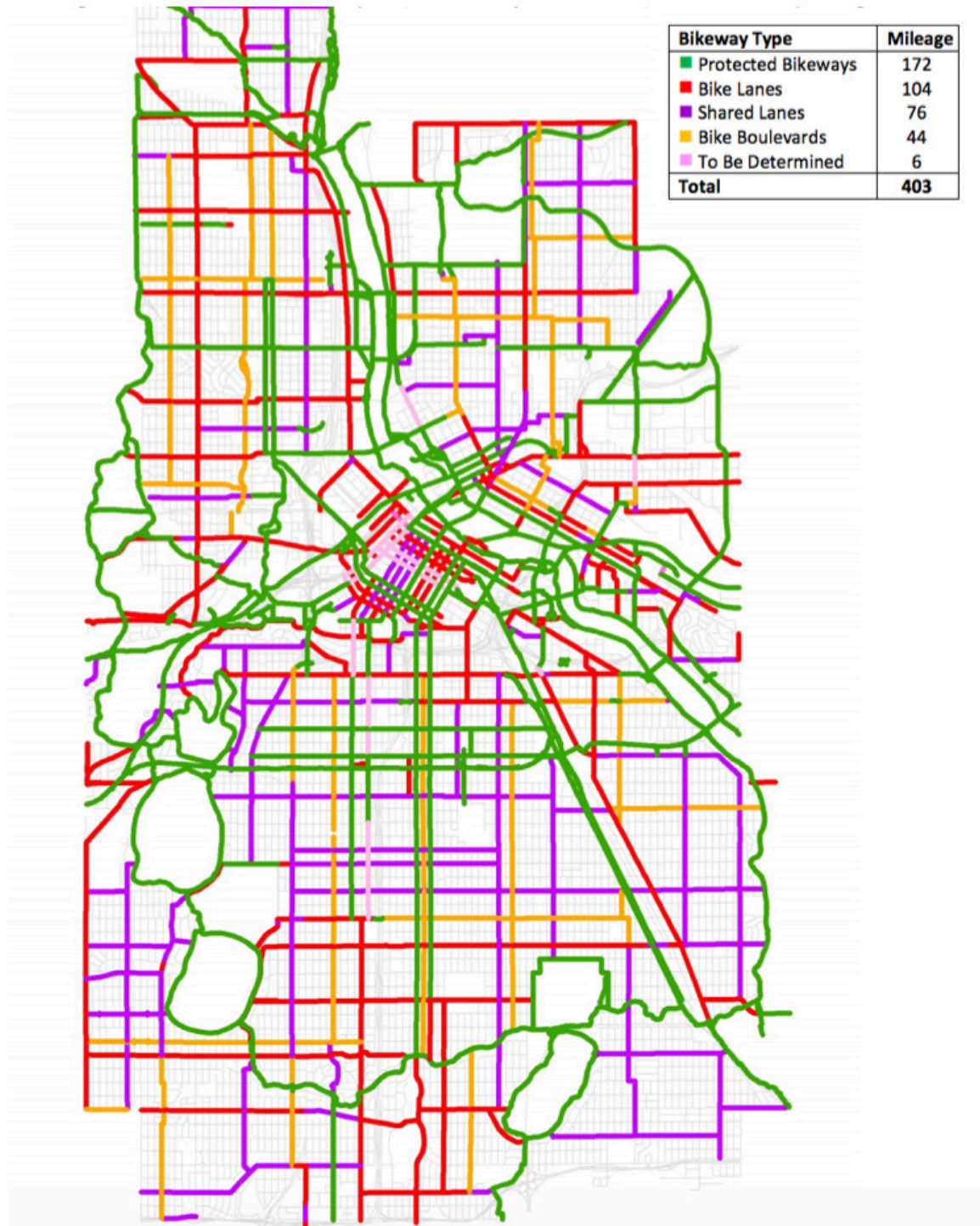


Figure 16: 2015 Updated Bicycle Network Plan (City of Minneapolis, 2015).

*Land Use:*

Downtown Minneapolis was platted in a grid before the era of cars. Its first ring of suburbs was constructed in the interstate era. Then, the rest of development sprawled out, resulting in a spread-out city. Almost all of the bicycle accommodations have been the result of redevelopment. Existing land uses are shown in figure 17. The City of Minneapolis however, is addressing its sprawl issue. Within the City's new bike plan and its new land use plan, the City has addressed how it will prioritize high-density land use (City of Minneapolis, 2011).

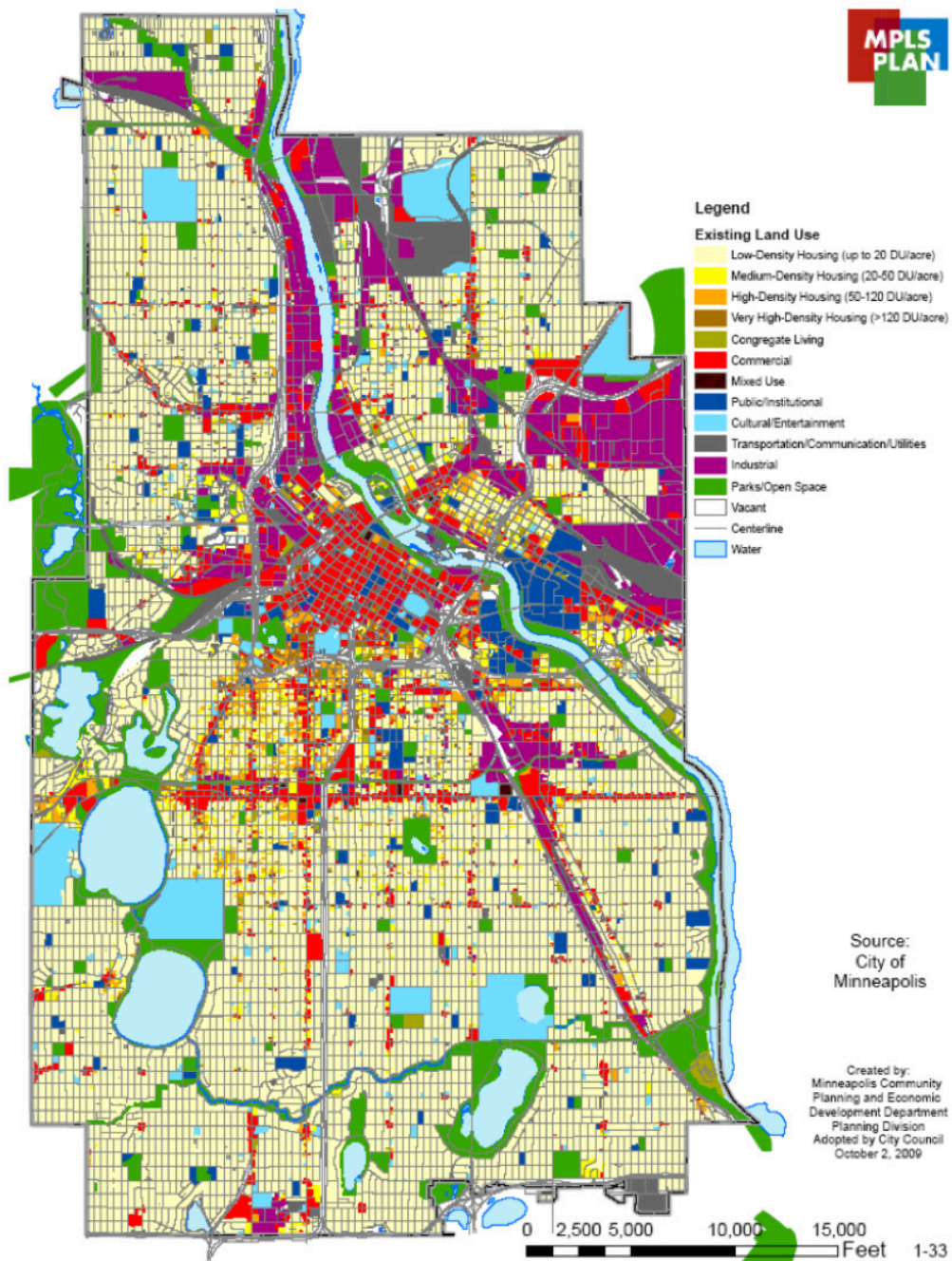


Figure 17: Existing Land Uses (City of Minneapolis, 2016).

In the City's Minneapolis Plan for Sustainable Growth, planners outlined many new techniques for more sustainable land use planning. First, the City wants to build upon and enhance already existing community assets, instead of developing new ones. All new commercial and mixed-use development will only be pursued in designated corridors and districts that have been selected as sustainable development sites. The City wants to preserve and enhance a system of Neighborhood Commercial Nodes that include a mix of housing, neighborhood-serving retail and community uses. This is intended to make neighborhoods more accommodating and hopefully all walkable and bikable (City of Minneapolis, 2016).

The City also has plans to enhance their "activity centers". Minneapolis was developed historically with some districts as hubs for activities. These activity centers have a diversity of uses and have a city-wide and regional draw to them. They're complimented by medium and high-density residential uses and are not meant to support cars. The City wants to make them more accommodating with more commercial services, entertainment uses and educational campuses (City of Minneapolis, 2016).

Lastly, the City is prioritizing their development in areas in the City designated as "growth centers" where there is a significant concentration of employment activity. Current designated growth centers are: The Downtown Minneapolis area, the University of Minnesota area, the Bassett Creek Valley, and areas around hospitals. These areas should be complimented by high density housing (City of Minneapolis, 2016).

To accommodate alternative transportation, the City wants to ensure that all development incorporates appropriate transportation access and facilities, particularly for bikes and pedestrians. The City also wants to ensure that there's high quality bike and pedestrian access to and within designated land use features. The City has strategically plans bike infrastructure to be accessible to everyone throughout the City. Bike trails have been spaced approximately 2 miles apart, bike lanes 1 mile apart and local signed routes ½ miles apart; this has been made so that no resident is more than 1 mile from a trail, ½ mile from a bike lane and ¼ mile from a signed route (City of Minneapolis, 2011).

*Policy:*

Bikes have become a huge part of Minneapolis's transportation policy in recent years. Bicycle policy in Minneapolis has been derived from a variety of sources. The City's bike policy has been developed through a variety of policy sources like: recreation and parks plans, climate action plans, land use plans, health plans, local plans, citywide plans and, of course, the bike plan. Minneapolis bike policy is effective because it is comprehensive and seen in almost all of the general plan's elements including the Public Services and Facilities Element, the Land Use Element, the Transportation Element, the Economic Development Element, the Open Space and Parks Element, and the Urban Design Element. The policies have been made to achieve the following bike-friendly goals: improve safety, improve mobility, increase the number of bicyclists, increase mode share, ensure community support and ensure wise investments (City of Minneapolis, 2011).

Current transportation policies are most focused on completing a network of on and off street primary bicycle corridors. Policy has designated a large amount of transportation money to go towards bicycle infrastructure. \$3 million per mile has been designated for off-street trails. Between \$100,000-500,000 per mile has been designated for bicycle boulevards and between \$30,000-50,000 per mile for bike lanes. Other policies have been made to see improvements in culture with the aim to expand the bike share program beyond just the university and downtown areas, and with the aim to create equity in targeted area with low cycling levels (City of Minneapolis, 2011).

### *Infrastructure:*

The City of Minneapolis provides incentives the integration of bike friendly designs and amenities in new developments. As of 2011, the City had 84 miles of off-street paved trails, which are open 24/7 and plowed in the winter. The most prominent trails are the Minneapolis Grand Rounds, The Midtown Greenway, the Cedar Lake Trail and the Minneapolis Diagonal Trail. In 2011, there was also 44 miles of on-street bike lanes throughout the City. Most of these bike lanes are colored, and some feature bike boxes which allow cyclists to make a transition at an intersection when the light is red for vehicles. There are also currently over 5,000 bike racks and 17,026 bike parking spaces within city limits (City of Minneapolis, 2011).

Since most of the City's bike trails are off-road, there have been safety measures put in place to put cyclist's minds at ease. There are code blue emergency phones on all trails that are linked to 911 dispatchers, as well as good lighting and regular patrolling through the trails. Commuter trails are also designed for emergency vehicles to be able to drive through for easy rescue (City of Minneapolis, 2011).

Some infrastructure improvements have been designated by the City to be addressed in the future. First, the City has recognized that there needs to be more community connectors. There needs to be on as well as off-street connections to surrounding communities. They also have stated that there needs to be bicycle curb cuts added to all existing cul-de-sacs and diverters. The manhole covers and storm sewer grates also need to be replaced to be bicycle friendly. Lastly, the 2011 bike plan discussed the possibility of installing "green wave" corridors where signals along major bike routes are timed based on the speed of a bike (City of Minneapolis, 2011).

The 2015 update to the 2011 Minneapolis Bicycle Master Plan was mostly focused on the City's need for more protected bikeways which are bike facilities that are physically separated from motor vehicle traffic. The figure below shows the 2015 Protected Bikeway Update to the Minneapolis Bikeway Master Plan's goals for bikeway network development (City of Minneapolis, 2015).

## Minneapolis Bikeway Network Development

Bikeway Type	Centerline Miles by Year				
	1997	2010	2014	This Plan	Long-Term*
■ Protected Bikeways	62	89	96	144	174
■ Bike Lanes	19	44	82	50	104
■ Shared Lanes	1	5	15	11	74
■ Bike Boulevards			20	20	44
■ To Be Determined				6	6
<b>Total</b>	<b>82</b>	<b>138</b>	<b>213</b>	<b>232</b>	<b>403</b>

*\* Based on existing network, this plan, 2011 Bicycle Master Plan, and other recent planning activities.*

Figure 18: Minneapolis Bikeway Network Development (City of Minneapolis, 2015).

### Culture:

In a “frozen” city like Minneapolis, high ridership levels are surprising. Minneapolis’s climate is comparable to Moscow’s climate, so there have been some steps made to make biking in the cold possible. There are winter bicycling seminars taught every year so that cyclists learn safety measures for cycling in the winter. Local bike shops also sell winter clothes and biking gear like studded tires so riders can be prepared. The City also keeps trails and lanes plowed, sanded, salted and swept for cyclists. As of 2011, only 20% of daily cyclists were biking in the extreme winter conditions, but the City is trying to increase that number (City of Minneapolis, 2011).

Much of Minneapolis’s success has been through various advocacy groups and committees who work to ensure that biking is possible in Minneapolis. First, the Minneapolis Bicycle Advisory Committee (BAC) has been around since 1990 encouraging more people to bike. The BAC was created to advise the mayor, city council and Park and Rec about bike issues. They serve as a mediator for bike users to make sure bike infrastructure is being advanced. They also educate the public on bike safety and try to strengthen community support for non-motorized transportation (City of Minneapolis, 2011).

Another organization is Move Minneapolis TMO that works to promote alternative transportation modes. They attend commuter fairs and work with downtown employers to reach out and distribute things like bike maps and bus schedules. They have a program called the Bike 2 Benefits Program which awards prizes to those who bike once a week for 8 weeks. Other bicycle organizations in Minneapolis are: The Bicycle Alliance of Minnesota, the Minneapolis Bicycle Coalition, the Midtown Greenway Coalition, the Minneapolis Off-Road Cycling Advocates, the Twin Cities Bicycle Club, Major Taylor Bike Club, Hiawatha Bike Club and the Minnesota Cycling Federation (City of Minneapolis, 2011).

Minneapolis is also a part of the US program, Safe Routes to School. This program is focused on getting as many children to bike or walk to school in a safe manner. The Minnesota Department of Transportation administers it in Minneapolis with funding to schools within the City. In Minneapolis, every single elementary and middle school has been evaluated by a professional engineer to identify all needed infrastructure and safety improvements within the immediate vicinity of the school. Approximately half of all students in Minneapolis live within a 20-minute bike ride to their school. Also, most schools in Minneapolis teach bike safety in the classroom. The City has also given ½ of public school's new bike parking within the last 5 years (City of Minneapolis, 2011).

Minneapolis also has a few bicycle oriented events each year including the Great River Energy Bicycle Festival, Bike-In at the Bell and the Minneapolis Bicycle Tour (City of Minneapolis, 2011). The Minneapolis bike-friendly culture will definitely enhance biking and increase ridership levels in years to come.

*Summary:*

Table 5: Summary of Successes and Challenges to Bicycle Planning in Minneapolis

	<i>Successes:</i>	<i>Challenges:</i>
<i>Planning:</i>	<ol style="list-style-type: none"> <li>1. The new bike master plan has extensive information and is over 200 in-depth pages.</li> <li>2. Input for the plan came from various community groups.</li> </ol>	<ol style="list-style-type: none"> <li>1. A bike master plan that is this long takes many years (10) to write and is expensive.</li> <li>2. Gathering information from various groups in the community is time consuming.</li> </ol>
<i>Land Use:</i>	<ol style="list-style-type: none"> <li>1. Sustainable development corridors have been designated for future mixed-use developments.</li> <li>2. High density housing is to be coordinated with development in “growth centers” where there is a significant concentration of activity.</li> </ol>	<ol style="list-style-type: none"> <li>1. The city has already experienced significant urban sprawl, which is difficult to mitigate.</li> <li>2. Although these housing units will be high density, they will likely be expensive to live in due to their close proximity to job sites.</li> </ol>
<i>Policy:</i>	<ol style="list-style-type: none"> <li>1. Policy is focused on a completing a network of on and off street primary bicycle corridors.</li> <li>2. Policy is comprehensive and consistent throughout various city plans and elements.</li> </ol>	<ol style="list-style-type: none"> <li>1. Completing the bike network will be expensive (\$3 million per mile for off street trails).</li> <li>2. Policy must be well coordinated and thought-out to maintain consistent throughout so many different plans and elements.</li> </ol>
<i>Infrastructure:</i>	<ol style="list-style-type: none"> <li>1. Off-road trails have various safety measures to ensure cyclists safety.</li> <li>2. Protected bikeways are emphasized in the recent bike plan and will be executed more than other bikeway types.</li> </ol>	<ol style="list-style-type: none"> <li>1. Providing effective security measures for miles of trails can be expensive.</li> <li>2. Protected bikeways can alter transportation routes, traffic lanes and parking infrastructure which can be controversial.</li> </ol>
<i>Culture:</i>	<ol style="list-style-type: none"> <li>1. Despite extremely cold temperatures, riders stay on their bikes in the winter time.</li> <li>2. The City receives significant funding from the state to execute an effective and all serving Safe Routes to School program.</li> </ol>	<ol style="list-style-type: none"> <li>1. The City must go to great lengths to ensure that bikeways are safe for cyclists all winter.</li> <li>2. Even though most cities in the US have a Safe Routes to School program, it’s unusual for all schools in the system to receive attention.</li> </ol>

## 3.4 Portland

### *Introduction:*

Portland is Oregon's largest city, well known for its eco-friendliness, parks, bridges, microbreweries, coffeehouses, and recently, its bike-friendliness. The City has recently dedicated significant efforts into making Portland an internationally known bicycle city. Former Mayor Sam Adams was quoted, "Our intentions are to be as sustainable a city as possible. That means socially, that means environmentally and that means economically. The bike is great on all three of those factors. You just can't get a better transportation return on your investment than you get promoting bicycling". Adams has reported looking to the European cities of Amsterdam, Groningen and Copenhagen as an inspiration (City of Portland, 2010).

In 2008, Portland was recognized by the League of American Bicyclists as a platinum-level bicycle friendly community. With its tightly connected bike network with access to bike facilities within 3-6 blocks from anywhere in the City, it's easy to see why the City has been recognized. Portland also is known for its lively bike culture which includes bike education, promotion and fun events. In 2012, it held 10 times the national average for bike commuters, with 70% of residents owning or having reliable access to a bike (Pucher & Buehler, 2012).

Especially in recent years, Portland has become an extremely popular city, especially among the millennial population. In 2010, the population was 2 million, and by 2030 the population is expected to rise to 3 million. With its growing population, bike ridership levels have sky rocketed as well. Between 1990 and 2005, the US Census reported a 190% increase in bike commuting in Portland. Bike traffic across the four bike-friendly Willamette River bridges increased by 321% since 1990 (City of Portland, 2007). Portland's biggest challenge in coming years will be accommodating the growing population.

### *Planning:*

Portland's first bicycle plan was adopted in 1996 as a cost-effective blueprint for developing an interconnected bicycle network which was supported by innovative policies and programs for enhancing bicycling in the City. Since then, Portland has expanded its bike network by more than 300 miles. The City published its most recent bike plan in 2010, "The Portland Bike Plan for 2030". This new plan set out plans, goals, strategies, objectives and policies for advancing bicycling in the next twenty years. The plan is divided into five sections, each to cover a different aspect of bicycle planning: background/history, policy, bicycle network, programs and implementation (City of Portland, 2010).

This plan recommends expanding the network of bikeways from 630 to 962 miles based on three main strategies. First, introduce safe, comfortable and attractive bikeways that carry more bicyclists and serve all types of riders by building on the best design practices of great cities around the world. Next, construct a dense network of bikeways so that all



Portland residents can easily find and access a bike route near them. And lastly, create a cohesive network with direct routes that take people where they want and need to go (City of Portland, 2010).

This plan was developed in two phases. The first phase took place in 2007 when a project team assessed the City’s existing conditions. They led regular rides, gathered opinions from the community, held open houses, pursued extensive fieldwork, and researched other cities’ policies. They utilized this information to create an extensive existing conditions report that was published in the same year. In the second phase, the project team identified the most desired elements of the plan and formed working groups in order to address each element. The five elements they decided to address are: broad policy context, bicycle policy recommendations, street classifications for bicycle travel, bicycle facility design and engineering, bike parking, integrating bicycling and other travel modes, a green network, encouraging bicycling, safety education and enforcement, an overall approach to implementation, and evaluation and measuring (City of Portland, 2010).

The plan’s overall approach to implementation combines all of the previous elements and identifies its overall plan for implementing them before 2030. An implementation strategy identified was to amend the transportation system plan to adopt recommended policies and classifications for bicycle transportation. The City also wants to identify and pursue multiple strategies to increase funding for green transportation. Also, the City wants to develop a complete streets design guide that include bicycle design guidelines. They also want to build as much of the bicycle transportation system as possible, as quickly as possible. Lastly, the City wants to develop strategies to ensure a successful delivery of bicycle projects. To track their progress, the City wants to expand the means of evaluating how well the public is being served by Portland’s bikeways network and the programs that support bicycling. Some tangible goals they have for 2020 are to have at least 15% of all trips taken by residents be by bicycle and to reduce the risk of a fatal bike crash by 50%.

The figures below exhibit the planned facilities and programs and the potential costs outlined by the bike plan.

COSTS of citywide bicycle facilities:								
FACILITY	FUNDED*		IMMEDIATE / 80 PERCENT		WORLD-CLASS		TOTALS	
	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost
Trails	2.9	\$9,871,000	40.7	\$77,311,000	35.0	\$35,379,000	78.6	\$122,561,000
Separated in-roadway bikeways (bike lanes, buffered bike lanes, cycle tracks)	14.6	\$4,921,000	92.7	\$105,269,000	278.4	\$279,051,000	385.7	\$389,241,000
Bicycle boulevards and advisory bike lanes	26.0	\$7,975,000	155.3	\$38,820,000	74.9	\$18,733,000	256.2	\$65,528,000
Enhanced shared roadways	0.7	\$123,000	38.8	\$3,536,000	7.1	\$782,000	46.6	\$4,441,000
<b>Total</b>	<b>44.2</b>	<b>\$22,890,000</b>	<b>327.5</b>	<b>\$224,936,000</b>	<b>395.5</b>	<b>\$333,945,000</b>	<b>767.1</b>	<b>\$581,771,000</b>

Figure 19: Potential Costs of Citywide Bicycle Facilities (City of Portland, 2010).

Program scenarios <b>COSTS:</b>			
Scenario Cost	Moderate \$1.56 million	High \$3.9million	World-class \$5.9 million
<b>PROGRAM LEVELS</b>			
Maps and trip planning	150,000 maps distributed \$150,000	200,000 maps \$200,000	200,000 maps \$200,000
Customer service	Continue at current service levels. \$20,000	Increased support for visitors and residents \$40,000	Increased support for visitors and residents with new website \$80,000
SmartTrips residential and business	Every eight years \$800,000	Every five years \$1.4 million	Every five years with new resident and expanded programs \$1.7 million
Outreach & events	70 events per year \$50,000	100 events per year \$80,000	150 events per year \$120,000
Organized rides	30 per year \$15,000	50 per year \$50,000	50 per year \$50,000
Visibility campaigns	One per year with limited media exposure \$20,000	Two per year with expanded media exposure \$60,000	Four per year with expanded media exposure \$160,000
Summits & conferences	None N/A	One per year \$75,000	One per year \$75,000

Figure 20: Potential Costs of Bicycle Programs (City of Portland, 2010).

### Land Use:

The in early 20th century, Portland was redeveloped to accommodate cars. This meant widened streets, increased urban growth in the once rural areas, and landscapes that were designed specifically for cars and without amenities for other transportation modes. The commercial districts were developed as multi-lane car oriented corridors with acres of parking lots. Through this develop progression, Portland was very inaccessible without a vehicle. A 2008 assessment found that the existing bikeway network failed to provide access to almost all commercial areas in Portland. In response, the city wants to develop a concept called a “20-minute neighborhood” where residents can live within a maximum 20-minute walk or bike ride to any sort of daily destinations such as stores, schools, etc. This concept

is based on European cities that have enacted supporting land use policies (City of Portland, 2010).

Land uses decide if a community has opportunities for alternative transportation. In order to have better serving land uses, the City’s Adopted 2035 Comprehensive Plan features an Urban Design element with guidelines for to foster an equitable system of compact mixed use and commercial centers across the city to increase access to community service and businesses. Housing and services need to be built together so people can meet their daily needs locally (City of Portland, 2016).

The City’s land use goal is for 80% of Portlanders to live in complete neighborhoods by 2035. The goal is for travel solely by walking, transit or bike. To do this, the City wants to focus growth near transit stations and in the central city areas and other “centers” with a high level of service and amenities. These “centers” are meant to be the primary area of growth over the next 20 years. They are meant to be compact and pedestrian-oriented places that anchor complete neighborhoods with retail stores, businesses, housing, amenities and public gathering spaces. This type of development will achieve the goal to make Portlanders live in complete neighborhoods and utilize active transportation. The designated centers are the City’s downtown area, the Gateway Regional Center, which is near the airport, Town Centers which are located throughout Portland where existing commercial centers are, and Neighborhood Centers which are village-like centers in neighborhoods where development will be more low-rise. Below is the urban design map showing where development is planned (City of Portland, 2016).

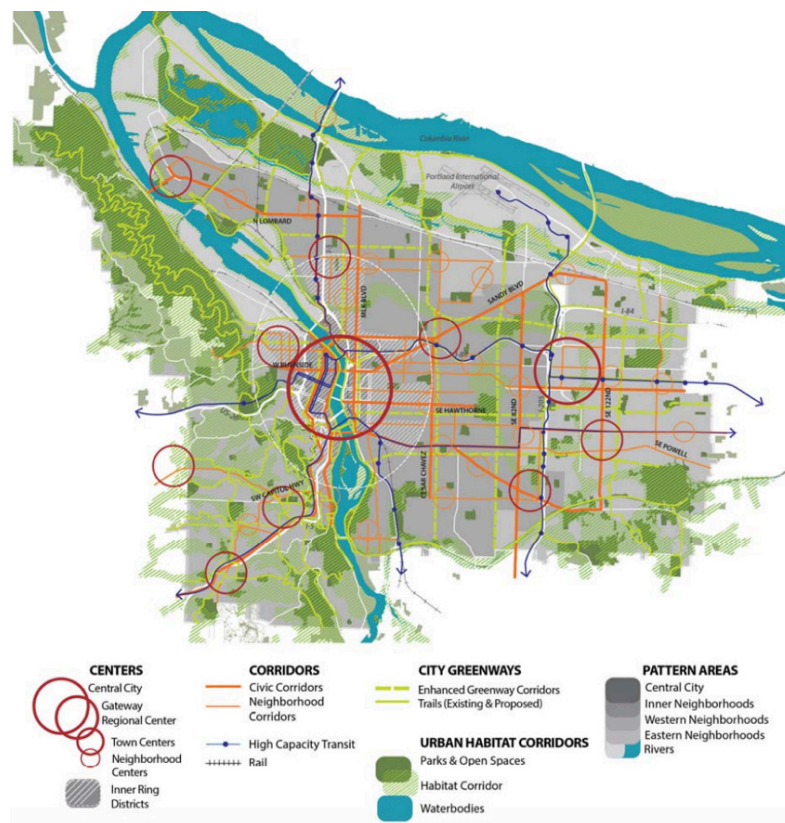


Figure 21: Urban Design Framework (City of Portland, 2016).

### *Policy:*

The City of Portland's main bicycle policy in 1996 had the aim to "make bicycling a part of daily life in Portland." In 2010, the City recreated the slogan to "create conditions that make bicycling more attractive than driving for trips of three miles or less." This new stronger policy language shows that the City recognizes that the main competition to bicycle transportation is the car. The 2030 Bike Plan's new policies will be implemented throughout the City others plan such as: The Climate Action Plan, the Freight System Master Plan, the Integrated Mobility Strategy, the Regional High Capacity Transit Plan, the Regional Trails Strategy, the Regional Transportation Plan Update, and the Transportation System Plan Update (City of Portland, 2010).

The plan provides broad policy context recommendations: put green zones first, fully integrate bicycling into the Portland Plan project and further integrate support for bicycling into existing city policies. To put green zones first, the plan recommends identifying 'home zones' or similar where cars can be limited. Then, collaborating with regional state and federal partners to reform system performance measures and mobility standards to reflect the movement of people instead of vehicles. Lastly, developing transportation models and forecasting tools to accurately predict bicycle travel demand (City of Portland, 2010).

In order to integrate bicycling into the Portland Plan project, there are seven policies given as recommendations. First, the plan recommends designating set of 20-minute neighborhood centers and a set of continuous multi-modal mobility corridors interconnecting these neighborhood centers. The City also wants to analyze the space that is devoted to car parking and bicycle parking in commercial parking locations and give policies based on how much space has been allocated between vehicle types. Next, they plan to conduct research to evaluate the impact of bike infrastructure and mode share on property values. Then, identify opportunities for zoning changes to support retail centers that are located along bikeways and provide the opportunities for high-density mixed-use development along those bikeways. Lastly, the City wants to establish 'eco-districts' as neighborhood developments that emphasize sustainability and ensure that all these neighborhoods have adequate low-stress bike facilities throughout the development (City of Portland, 2010).

In order to further integrate support for bicycling into existing city policy, the City wants to identify opportunities for revisions to existing city policies. The City also wants to adopt a bike transportation policy that is able to create conditions that make bicycling more attractive for trips that are three miles or less. Lastly, the City wants to revise the already existing parking policies so that new policy will include bicycle parking (City of Portland, 2010).

### *Infrastructure:*

Portland is well known for its innovations in signal treatments, roadway markings and civil designs. Besides the immediate need for more biking parking, the City and its residents seem satisfied with the bicycle infrastructure they currently have. The main concern appears to be completing the bikeway network to have better connectivity throughout the City. Between the early 1990's to 2009, there was a direct correlation between the expansion

of Portland's bikeway network (122 miles added) and the number of resident cyclists. By 2006, the City recognized that the bikeway network was approximately 45% complete (City of Portland, 2007). The City holds the notion that, "build it and they will come". Figure 22 below shows the type of bicycle network expansions planned by the City. In order to expand their bikeway into a more complete network, the City has addressed three strategies: form a finer-grained network, emphasize low-stress bike routes (identified as trails and bikeways with physical separations), and ensure access to all common destinations. Figure 23 below shows the current bikeway network, as well as planned infrastructure additions (City of Portland, 2010).

**Bicycle network EXPANSION by facility type:**

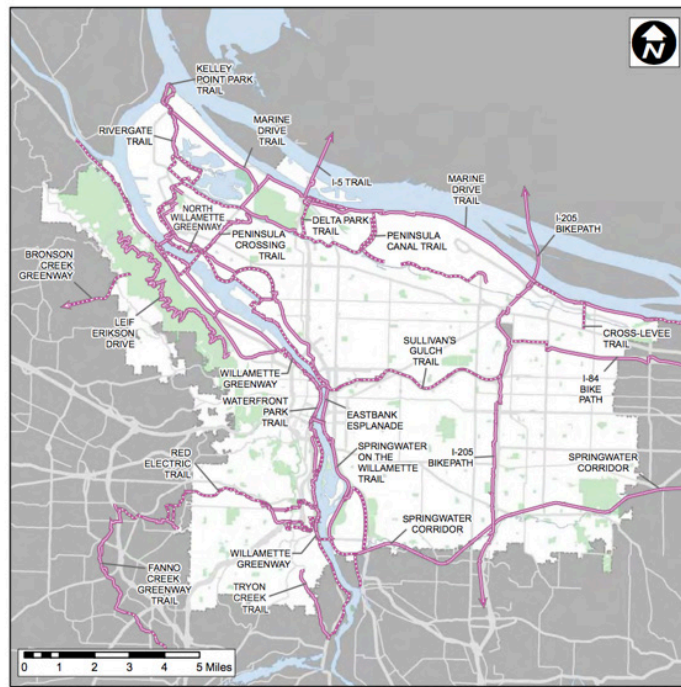
Bicycle facility type	Existing developed miles	Miles added by this plan	Total miles at plan completion	Facility proportion of total system
Trails	75 miles	64 miles	139 miles	14%
Separated in-roadways (bike lanes, buffered bike lanes, cycle tracks)	176 miles	314 miles	490 miles	51%
Bicycle boulevards / advisory bike lanes	30 miles	256 miles	286 miles	30%
Enhanced shared roadways	-	47 miles	47 miles	5%
Signed connections	28 miles	0 miles	0 miles*	0%
<b>TOTAL</b>	<b>309 miles</b>	<b>681 miles</b>	<b>962 miles</b>	<b>100%</b>

\* Routes previously identified as signed connections will be developed as another bicycle facility type in the *Portland Bicycle Plan for 2030*.

Figure 22: Bicycle Network Expansion by Facility Type (City of Portland, 2010).

**Portland regional trail network**

-  Existing
-  Proposed
-  Highway/Arterial Street
-  Parks and Open Spaces
-  Waterways



*This map shows the network of regional trails open to bicycles, and includes off-street and some on-street trail segments. This map is adapted from the Portland Parks & Recreation's Multi-use Regional Trail System map.*

Figure 23: Proposed Portland Regional Trail Network (City of Portland, 2010).

The City also has decided to pursue developing a green network. This network would feature corridors that would connect neighborhoods, parks, commercial districts, schools, natural areas and transit. A green network would utilize green streets, which are street that manage storm water on site through vegetation. They create attractive streetscapes that will enhance their respective neighborhoods through enhanced livability, traffic calming and increased connectivity. Green streets are highly compatible existing bike boulevards and other shared roadways. Figure 24 shows a current example of a green street treatment. with The City would also connect with the public transit systems and other partners to create the most effective coordinated regional network. Figure 25 shows the where the City intends to develop green infrastructure.

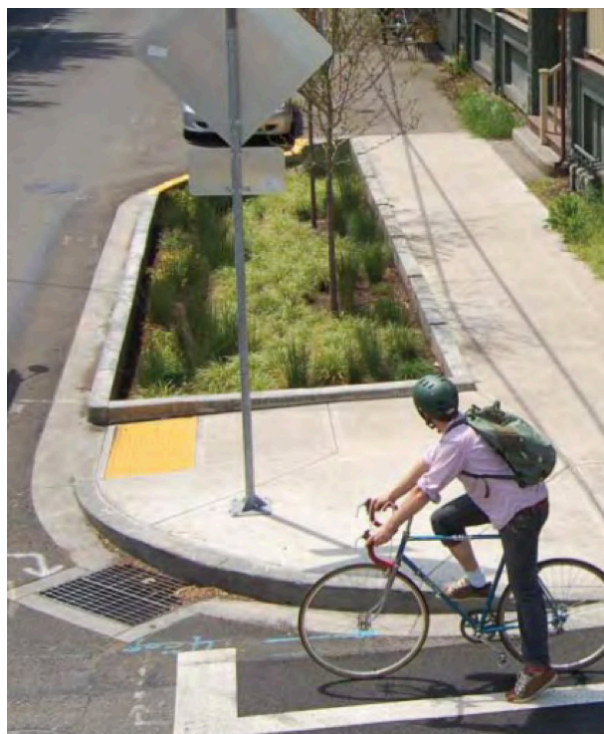


Figure 24: Green Street Treatment in Portland (City of Portland, 2010).

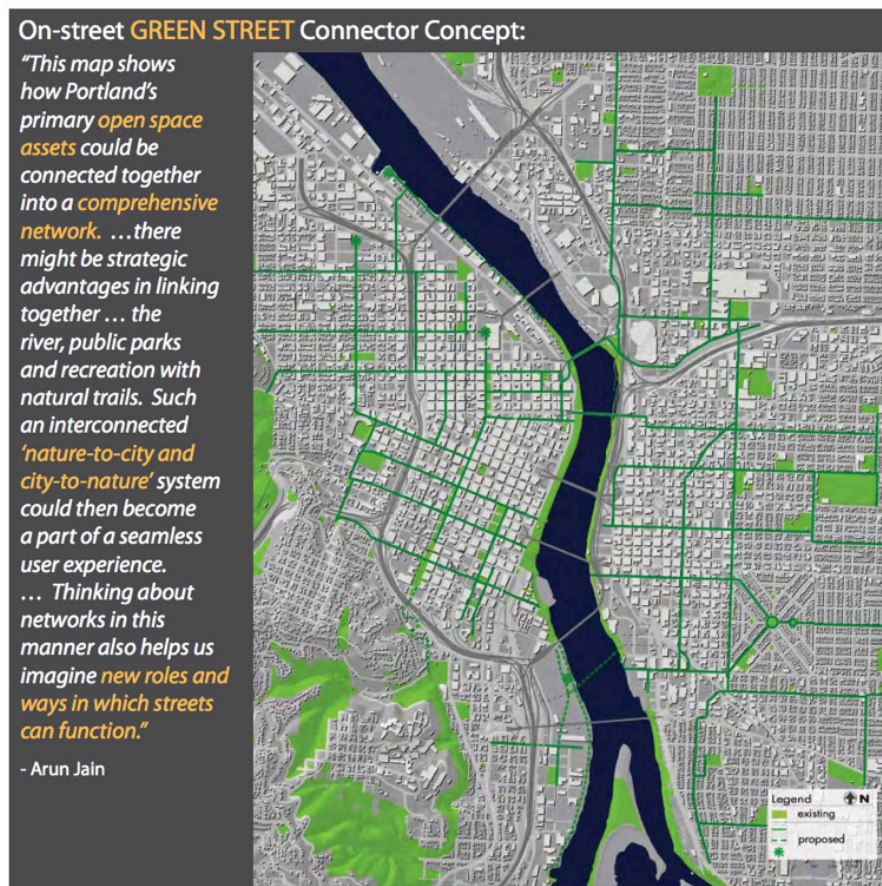


Figure 25: Green Street Concept Map (City of Portland, 2010).

## Culture:

Portland's success in gaining high levels of support for bikeway expansion stems from the fact that Portland residents seem to independently understand that bicycling can play a large role in addressing some critical challenges that the City faces. In addition, there are significant lobbying efforts towards expanding bikeways, as well as intensive media coverage and mass political support (City of Portland, 2010). In 2006, a survey showed that 43% of residents feel biking is an important aspect of their lifestyle. The survey also showed that 81% of school age children have received some kind of bicycle safety education over the past 8 years (City of Portland, 2007).

Bicycle education in Portland has been implemented by a variety of organizations: The Bicycle Transportation Alliance, City Fleet, Community Cycling Center, Exchange Cycle Touring Club, the Oregon Department of Transportation, the Portland Planning Bureau and TriMet. Women on Bikes is an organization that provides annual urban bicycle training designed for women. Portland by Cycle is another free annual educational and encouragement program for beginning cyclists. Bike Champions is a program that provides incentives for downtown commuters who encourage their co-workers to bike to work as well. Biking is Back is a program with the aim of getting seniors to try 3-wheeled bicycling, which is a more comfortable and stable option. Portland does not, however, have any bike safety clubs or programs sponsored by the City that is aimed for kids. This is something the City has addressed as an immediate need (City of Portland, 2010).

Besides developing a safety education program for kids, the City has developed a series of practices to implement in order to further encourage bicycle culture in Portland. Although the City has a Safe Routes to School program, only 25/70 of the public schools receive this program. The City hopes to expand their program to all schools so that more students travel to school by bike (City of Portland, 2010).

In order to make bicycling more accessible and attractive, the City also wants to expand their offering of maps and trip planning tools. Currently, the City distributes a guide to Oregon Laws pertaining to cycling, a brochure to proper bike helmet fitting, instructions for children on safe riding skills and techniques, and a calendar of biking events and group rides. The City currently has an online tool, 'bicycle.org' which provides online route info, as well as a smart phone app, SmartTrips, which allows the user to make a personalized bike trip plan remotely. But, the City wants to expand their resources by developing a 24/7 phone automated trip planning service with emergency roadside assistance for bike repair and maintenance (City of Portland, 2010).

Although Portland already has a broad bike-culture established, the City wants to further promote long-term changes in transportation habits of residents by raising awareness of the benefits of bicycling and providing more incentives for those who choose their bike over a car (City of Portland, 2010).

Summary:

Table 6: Summary of Successes and Challenges to Bicycle Planning in Portland

	Successes:	Challenges:
<i>Planning:</i>	<ol style="list-style-type: none"> <li>1. The new bike plan focuses on both bicycle infrastructure plans and community programs.</li> <li>2. The new bike plan was developed using various community outreach methods.</li> </ol>	<ol style="list-style-type: none"> <li>1. Plans for new bike infrastructure and new community programming are costly.</li> <li>2. Extensive community outreach can be difficult to arrange and administer.</li> </ol>
<i>Land Use:</i>	<ol style="list-style-type: none"> <li>1. The City will develop guidelines for an equitable system of compact mixed use and commercial centers.</li> <li>2. The City wants 80% of Portlanders to live in complete neighborhood where travel is solely through walking, transit or bike.</li> </ol>	<ol style="list-style-type: none"> <li>1. Redeveloping a city built for cars will take a significant amount of time, money and convincing.</li> <li>2. The new complete neighborhoods might not be equitable with some neighborhoods not receiving any modifications.</li> </ol>
<i>Policy:</i>	<ol style="list-style-type: none"> <li>1. The 2030 Bike Plan's policies will be implemented throughout a multitude of other city plans.</li> <li>2. The City plans to revise many existing policies to better designate the City's current goals and objectives.</li> </ol>	<ol style="list-style-type: none"> <li>1. In order to make policies comprehensive, different departments within the City must be cooperative and communicative.</li> <li>2. It can be difficult to identify which policies need to be adjusted and how they can be changed to serve new goals.</li> </ol>
<i>Infrastructure:</i>	<ol style="list-style-type: none"> <li>1. A total of 681 miles of bikeways are planned to be added to the current bicycle network by 2030.</li> <li>2. A green network will be developed with green streets that manage storm water on site through vegetation.</li> </ol>	<ol style="list-style-type: none"> <li>1. Installing this many miles of bikeways will cost the City millions of dollars.</li> <li>2. It can be difficult to find space to install vegetation in some land uses where space is limited.</li> </ol>
<i>Culture:</i>	<ol style="list-style-type: none"> <li>1. Portland holds a well-established bike culture.</li> <li>2. There is a multitude of educational and encouragement programs in Portland to serve cyclists.</li> </ol>	<ol style="list-style-type: none"> <li>1. It's difficult to force bike culture onto residents.</li> <li>2. Bicycle advocacy groups who administer these programs can be difficult to start up due to a lack of funding and support.</li> </ol>



# 4. Conclusions

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## 4.1 Comparing European and American Cities

As the Netherlands and Denmark cyclist levels are 10 times higher than in the United States, there are many differences between Europe and America to look to as the source (Pucher & Buehler, 2008). The US has long promoted the car, despite its economic, social and environmental costs. Meanwhile, in Dutch and Danish cities, instead of catering to more cars, governments have focused on serving the people. In order for American cities to catch up to European cities, they need to put people first.

Frankly, European cities have had significantly more time to develop a cycling culture that is complimented by effective bicycle infrastructure. In addition, the development and make-up of the European cities, Copenhagen and Amsterdam, is more complementary for active transportation. The United States, which is about 4 million square miles, has 9 cities with populations over 1 million. The US was developed after Europe, with much more land to accommodate ever growing populations with low-density and single-use developments.

US cities, Portland and Minneapolis, have been put at a disadvantage when compared to their Europe counterparts, Copenhagen and Amsterdam. However, besides the inherent advantage European cities have, Copenhagen and Amsterdam have developed practices that have advanced their cycling networks.

Unlike the studied American cities, Copenhagen and Amsterdam both develop new bike plans every five years with many measures utilized to track progress being made. In comparison, Minneapolis's last bike plan took 10 years to write. While Portland's bike plan set goals for the next 20 years. These longer increments diminish a sense of urgency and can be more difficult to monitor. In addition, Copenhagen and Amsterdam have designated city staff specifically employed to plan and execute bicycle planning. Minneapolis does not even have a transportation department; their public works department is responsible for any transportation planning. Dedicated staff members are crucial to make sure projects are being executed in a timely manner.

As for land uses, Copenhagen and Amsterdam are ahead of combatting urban sprawl when compared to the American cities. Portland and Minneapolis were developed for the automobile and, until recently, the cities have been sprawling out with low-density uses stemming out of the urban core. Copenhagen and Amsterdam have strict policies to enforce mixed-use and high-density land uses which new development only allows in designated growth centers. Although Minneapolis and Portland have new policies, plans and practices in place to discourage sprawl, it will take a significant amount of time for the American cities to have a higher population density like Copenhagen and Amsterdam.

The bikeway network in Copenhagen has been executed so that it is continuous throughout the City. The City has enough riders however to further expand bike lanes with the hopes of having most high populated city streets be equipped with three lanes in each direction. Similarly, Amsterdam's infrastructure is sophisticated with priority given to cyclists at all intersections. Both cities are in the process of executing green wave technology to better serve their cyclists. Both cities have also converted car infrastructure, like parking spaces, into bike infrastructure.

Portland currently has plans to develop approximately 681 miles of bikeways before 2030 to close gaps in bike infrastructure throughout the City. Meanwhile, Minneapolis is concerned with developing about 200 miles of bikeways, most of which are protected lanes. After the American cities have filled in the gaps of their lacking bicycle infrastructure, they will likely work to convert car infrastructure much like Copenhagen and Amsterdam.

As for culture, all four cities have supportive residents who are passionate about making the transition into a more healthy, complete, and people oriented city. Although the European cities, Copenhagen in particular, have embedded cycling cultures, the American cities have recent support through governmental officials, advocacy groups and non-profits that will likely push their respective cities to catch up to Europe. There are ever-growing incentive programs like tax-benefitted reimbursements provided to Americans through various organizations, such as the League of American Bicyclists, which encourage bicycle commuting. The rapid changes that the United States is experiencing with support for bike culture, will quickly revolutionize transportation in major cities all across the country. The following section will cover some recommendations gathered through research and careful consideration that should further help get American cities cycling.

## 4.2 Recommendations

As both Portland and Minneapolis already have plans in place to increase the number of bikeways through their cities, diminish urban sprawl, make policies comprehensive and trackable, and overall increase ridership levels, recommendations will be more focused on increasing safety, accessibility and changing attitudes with regards to bicycling.

To increase safety in these cities, traffic calming measures should be implemented in high-risk corridors. Some proven traffic calming measures that have been executed in Europe and other US cities include: reduced legal speed limits, road narrowing, raised crosswalks, traffic circles, artificial dead ends, and car-free zones. Intersections can be modified with advance stop lights for cyclists, advanced green traffic signals for cyclists, the insertion of traffic islands or bollards to sharpen the turning radius of cars, or cyclist-activated traffic lights (Pucher & Buehler, 2008).

In order to increase accessibility for Americans and make bicycling the most sensible transportation mode, there are multiple infrastructure and program installments to be executed that will make bicycling justified. Separate bike lanes and paths are obvious choices for ensuring cyclist safety. In addition, directional signs for cyclists that are color-coded to correspond to different types of routes and internet route planning services can make bicycling more accessible.

The integration of bicycles with public transit is a priority in Europe that would be valuable to make a priority in America as well. Urban transportation should allow all bikes on buses or trains for free. Also, the provision of bike rentals at major transit stations would be useful (Pucher & Buehler, 2008). City governments should also help make bicycles a priority by requiring private developments to provide bicycle parking. Designated bike parking in city centers would also be beneficial.

In order to progress culture in American cities to hold bicycling to the high standard that Danish and Dutch residents do, there are European practices that Americans can implement. First, all Danish and Dutch children receive training in cycling techniques as part of their regular school curriculum. In addition, automobile drivers need to be trained to know how to handle cyclists on the road. Expanding education efforts in America would help embed cycling into the culture while also expanding safety measures (Pucher & Buehler, 2008).

During the planning process, American cities can learn from Europe in ensuring that citizens participate at all levels of planning and implementation. American cities can also hire more planners who are to solely focus on bicycle planning. It would also be beneficial for the US cities to more regularly update their long-term bicycle plans and develop a more accountable way to measure progress. American bicycle planning could also gain significant support with more coordination with national organizations so that bicycle culture is not as segregated (Pucher & Buehler, 2008).

As bicycling is highly prioritized and accepted by the European community, it's easier for officials to implement policies that would be controversial in America. For instance, in Amsterdam, car infrastructure is being redesigned for the bike. In order for American policy makers to make these types of radical changes, such as traffic calming, car-free zones, and less car parking, it'll be beneficial to implement the controversial policies in stages. Governmental officials could also provide incentives for cycling while also pursuing disincentives for car users (Pucher & Buehler, 2008).

Copenhagen and Amsterdam are two amazing, internationally known bicycle-friendly cities. Through examining their planning processes, land uses, policies, bicycle infrastructure and bicycle cultures, many ideas have stemmed for better equipping American cities to make the transition into a more active transportation model. Recommendations from this paper are applicable to Portland and Minneapolis in the United States, and if executed properly could make these two cities international leaders in active transportation as well.

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