

Copenhagen,
Denmark

Mobility Planning Mattered in



“Why Mobility Planning Matters” Best Practice Case Study

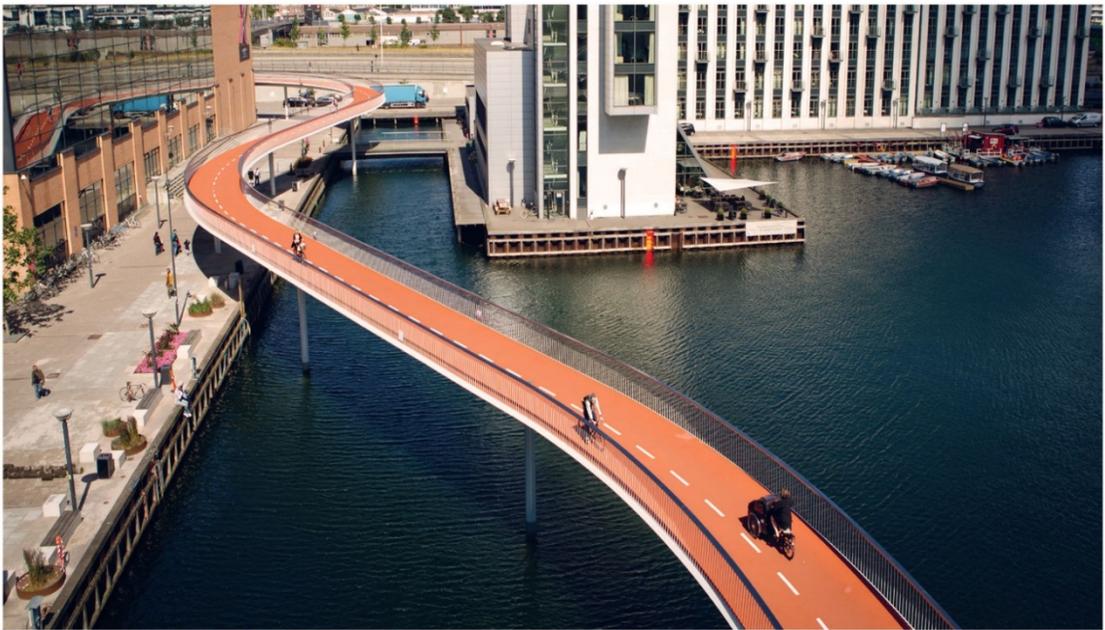


Photo: The Cycle Serpent

Source: 2014 Copenhagen Bicycle Account

Copenhagen, Denmark City of Cyclists

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Mobility Planning Best Practices Case Study: Copenhagen, Denmark

Abstract

From the 1880s until the 1950s, bicycling was the dominant mode of transportation in Copenhagen and throughout Denmark, representing 50-85% of all trips in some cities (Buehler, 2007). During the 1950s and '60s increased car use dramatically increased as a result of suburbanization and the lifting of wartime rationing of commodities such as oil, fuel, and rubber during World War II (Gossling, 2013). Copenhagen was able to direct this suburban growth along radial land use corridors fed by commuter rail thanks to an early effort in transit-oriented development (TOD) first conceived in the late 1940s and implemented in earnest in the 1960s. Despite the success of TOD plan, cycling rates fell by 50% or more by the latter decade (Buehler, 2007). During the worldwide energy crisis of the 1970s, Copenhagen saw its ambitious urban renewal schemes become financially unfeasible forcing it to turn more cost effective land use alternatives. As a part this transition, Copenhagen began increasingly targeting bicycle and pedestrian transportation as way to improve access to its mixed-use transit oriented developments, and improve livability overall. Today, as a result of a comprehensive suite of programs, plans and policies carried out by mostly by municipal government in service of this modal objective, 45% of all work or education trips in Copenhagen are made by bicycle (and 30% of all trips) - one of the highest bicycle commuting rates in the world (City of Copenhagen Technical and Environmental Administration, 2014). This has lead Copenhagen to become known as “the City of Cyclists”.

Background

Copenhagen; a medium sized city located in the Northern European country of Denmark, offers a unique case study in the field of transportation planning. At 1,246,611 (metro) and 562,379 (central city), Copenhagen is city of similar size to Memphis, Tennessee. The transportation and land use policies which have shaped the urban environment of these two cities however, are dramatically different, resulting in very different places for residents to live. Memphis, like many American cities, saw the combined and concurrent effects of decentralized land use; fostered by the rise in highway building and the use of personal motorized transportation, cause the central city's population density to steadily decline throughout the 20th century. These and other interrelated effects ultimately created a system in which residents are nearly beholden to automobile use and ownership as their sole means of accessing activity sites and opportunities throughout the city. Presently, only .3% of all work trips are made by bicycle in the city of Memphis (Wagenschutz, 2014).

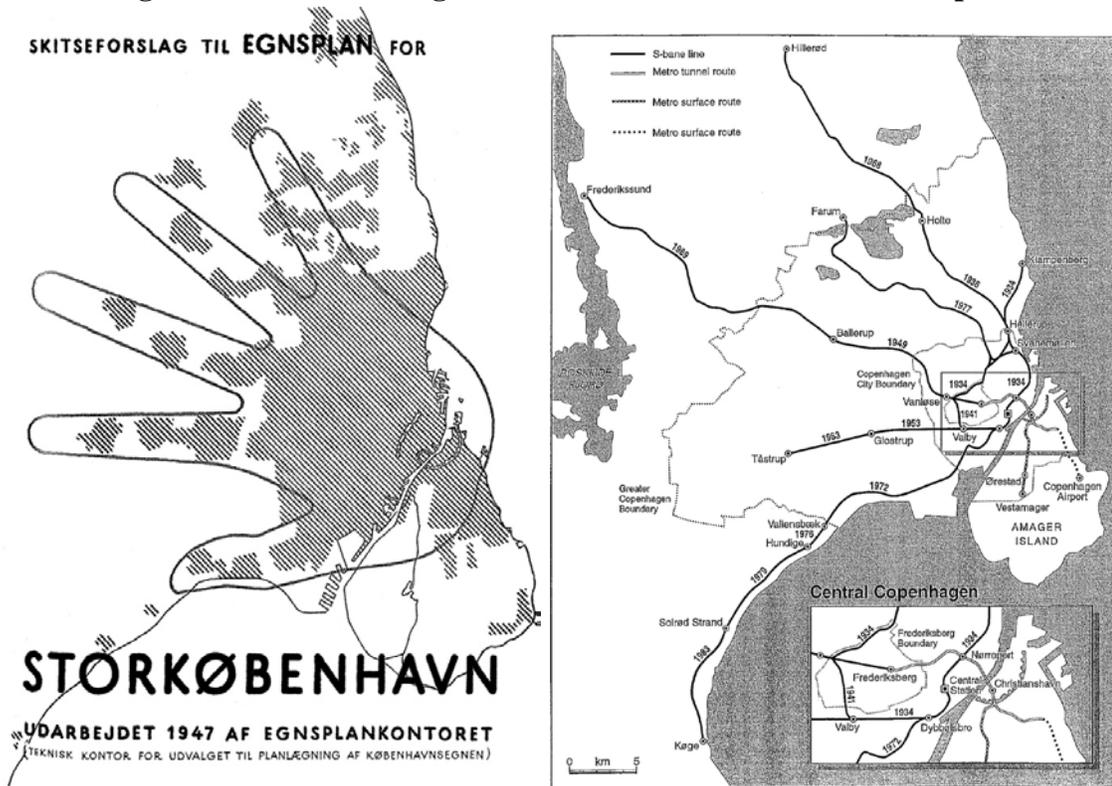
As alluded to in the abstract, Copenhagen responded to the worldwide energy crisis and economic recession caused by interruptions to the supply Middle Eastern oil exports in the 1970s in a very different manner from American cities like Memphis. From approximately 1880-1950,

between 50% -85% of all trips were made by bicycle in some Danish cities. By the 1950s and 1960s, Copenhagen had experienced similar trends towards suburbanization and automobile use as had occurred in the United States, resulting in the share of bicycle trips falling by nearly 2/3 to only 14-35% of all trips in some Denmark cities (Buehler, 2008). In a suddenly constrained economic climate Copenhagen was forced to abandon several automobile-dependent urban renewal projects and refocus its efforts on a different kind of transportation strategy and urban development scheme (Gossling, 2013). In light of the global oil shortage, Copenhagen decided to reembrace bicycle and pedestrian transportation, a method of mobility that remained popular among a core group of city residents even as use of the mode declined during the previous two decades. With car use into the central city significantly curtailed during certain periods of the day or week during that uncertain time period, bicycle and pedestrian transportation took on renewed importance to both citizens and leaders for good reason - it was one of the few options available to get around Copenhagen in an economical manner (The Fietzersbond (Dutch Cycling Union), 2009).

Plans, Policies and Projects

Prior to the city's focus of bicycle and pedestrian travel, Copenhagen already became noteworthy in urban planning circles for its pioneering effort towards what later became known as transit-oriented development (TOD) with the 1947 "Five Fingers Plan." This plan was a transit focused effort which sought to control outward suburban growth along five commuter rail corridors. Suburbs were meant to sprout in a coordinated fashion along rail stops, with mixed-use, high-density development, including housing and retail, spreading outward from the stations within the narrow corridors. In between each "finger" land was reserved for agricultural and recreational uses in order to dissuade urban encroachment and give the public easy access to green space (Knowles, 2012). The plan; though never formally adopted by parliament, nevertheless became the basis for the Urban Regulation Act of 1949 (Møller, 2009). Conceptually, the Finger Plan was first implemented in earnest in the early 1960s, and has succeeded in controlling and channeling urban growth in this uniquely concentrated pattern ever since. The plan continues to be a guiding document in official municipal master plans fostering the linkage between land use and transportation. The conceptual image for the original 1947 "Five Fingers Plan" is shown below at left, as well as a map showing the early development of Copenhagen's commuter rail system, at right, in Figure 1.

Figure 1: The “Five Fingers Plan” and Commuter Rail Development



Source: *Transit Oriented Development in Copenhagen, Denmark: from the Finger Plan to Ørestad* by Richard Knowles

The “Five Fingers Plan” has become justifiably famous as a pioneering effort towards transit-oriented development which preserves urban green space while serving larger transportation and land use goals. What is less clear however, is what role bicycling had in servicing these aims. In terms of transportation, its major focus was certainly commuter rail servicing mixed-use development. Bicycle lanes are mentioned in passing in reviews of the plan by various sources, but it’s unclear how central bicycle use was as a feeder mechanism to serve the rail lines. A 2009 article published by the Dutch Cycling Union claims that the move to begin implementing widespread bicycle infrastructure did not unfold according to a grand, overarching plan. Instead, according to sources cited within the article that were a part of early bicycle planning in Copenhagen, the effort came together in an incremental fashion – a fact which, if accurate, should also give more hope to Memphis’ recent piecemeal efforts to promote bicycling as a viable form of transportation within an automobile dominated urban landscape. First, in 1962, an experiment by town planner Jan Gehl to close off an inner city street to all but pedestrian traffic resulted in a fivefold increase in the number of shoppers visiting stores within the targeted district, clearly demonstrating the success of the intervention (The Fietsersbond (Dutch Cycling Union), 2009). Throughout the late 20th century, municipal planners focused their attention on promoting bicycle transportation principally through the provision of extensive bicycle specific infrastructure. More than 300 km were completed by the millennium (Jensen, 2002). Bicycle lanes protected from automobile traffic by means of some physical barrier,

known presently as cycle tracks, were a key tool in a larger infrastructure kit that altered Copenhagen's streetscape, a process which continues to undergo significant refinement to the present day in order to maximize rider safety and comfort. According to the Cycling Embassy of Denmark, "from 1982 to 2001, every budget contained funds allocated to the construction of cycle paths and improvements of conditions for cyclists. The focus on bicyclists and the funding were minimized after 2001 at the national level. This has now changed, however. Reducing CO2 emissions and improving health conditions have once again placed cycling on the political agenda" (Cycling Embassy of Denmark, 2015).

Bicycle specific infrastructure, as well as Copenhagen's historic cycling tradition, helped normalize the activity among the general public who came to regard bicycle and pedestrian travel as a typical part of daily travel around the city. In 1995, Copenhagen introduced the world's first free bike-sharing program, aiming to remove the economic barriers of outright bike ownership which prevent some citizens from cycling (Gosling, 2013). In 2000, Denmark created its first National Bicycling Master Plan. This broad strategy document advocated for a modal shift from cars to bicycles, gathering better data on bicycle use and accidents, disseminating information to local governments about how to promote bicycle use, administering seminars on traffic safety, and offered economic support for research and development of bicycle projects (Krag, 2000). The report set a target of shifting 4% of vehicle kilometers traveled from cars to bicycles by 2005. This national strategy document was then crystallized into more concrete policies within the document *Collection of Cycle Concepts*. Included within the report was national data on the bicycle traffic in the year 2000; a process handbook for promoting bicycling; methods for designing bicycle promotion campaigns; a chapter on urban planning which linked land use patterns and the volume of bicycle traffic as well as how to plan, design, provide signage for and finance cycle networks. It also dealt with the provision of bike parking; road maintenance; offers best practice examples of bicycle projects and offers a vision of future traffic conditions within Denmark (Jensen, 2000). The present national plan; entitled *Denmark – On Your Bike!* focuses primarily on increasing mode share and improving rider safety and comfort through methods such as integrating cycling and public transport, regional infrastructure planning, promoting recreational cycling to residents and visitors alike, plus cyclist training and infrastructure design (Ministry of Transport, 2014).

Copenhagen produced its first comprehensive bicycle planning document in 2002. The goals of *Cycle Policy 2002-2012* were to increase the modal share of bicycle commuters, as well as to increase safety, security and comfort of riders. Specifically, the plan lists the following targets to be achieved by 2012:

- The proportion of people cycling to workplaces in Copenhagen shall increase from 34% to 40%.
- Cyclist risk of serious injury or death shall decrease by 50%.
- The proportion of Copenhagen cyclists who feel safe cycling in town shall increase from 57% to 80%.

- Cyclist travelling speed on trips of over 5 km shall increase by 10%.
- Cyclist comfort shall be improved so that cycle track surfaces deemed unsatisfactory shall not exceed 5%.

An important part of this plan is the linkage between so-called “soft” and “hard” policies. Gossling defines these terms in a 2013 *Journal of Transport Geography* article on bicycling in Copenhagen as follows:

Hard policies “set standards for products and services as well as behavior, affecting transport choices through urban design and land use planning, or investments in specific transport infrastructure. Soft policy measures have the objective to support decisions that are more socially desirable, generally relying on the distribution of information on more sustainable transport choices.”

Cycle Policy 2002-2012 lumps together hard policies with what Gossling calls “market-based” policies which he defines as “instruments include taxes, subsidies or duties, which affect behavior because of rising or declining costs for travel.” It is in these three elements – soft, hard, and market-based policies, combined with an average urban density three times greater than that of the typical American city (Dijkstra, 2000) that have helped to decrease trips lengths and increase rider safety and comfort all while normalizing bicycling as a viable method of daily utilitarian and recreational transportation.

Since the publication of *Cycle Policy 2002-2012*, Copenhagen has followed it up with strategy documents such as *Bicycle Track Priority Plan 2006–2016* which focuses on bicycle infrastructure priorities during the time period covered by the plan. An order to build 70 km of new cycle tracks or bicycle lanes was the overarching goal of the plan. The following objectives were mentioned as a part of this effort:

- Reinforced cycle lanes shall be established whenever possible
- Cycle tracks shall be built as quickly as possible in the most difficult sections
- Short sections which can form a link-up to the network shall be given high priority
- Sections with heavy bicycle traffic shall be given higher priority than sections with little bicycle traffic, under equal conditions

Eco-Metropolis – Our Vision for Copenhagen 2015 and *Good, Better, Best – The City of Copenhagen’s Bicycle Strategy 2011–2025* followed the 2006 plan as policy documents serving as visioning tools which set renewed goals for increasing modal share; improving cycling speed (through infrastructure design) in order to make it competitive with cars; reducing accidents and improving rider perception of comfort; expanding cycle track infrastructure and improving road maintenance as well as continuing promotional bicycle encouragement campaigns. Copenhagen

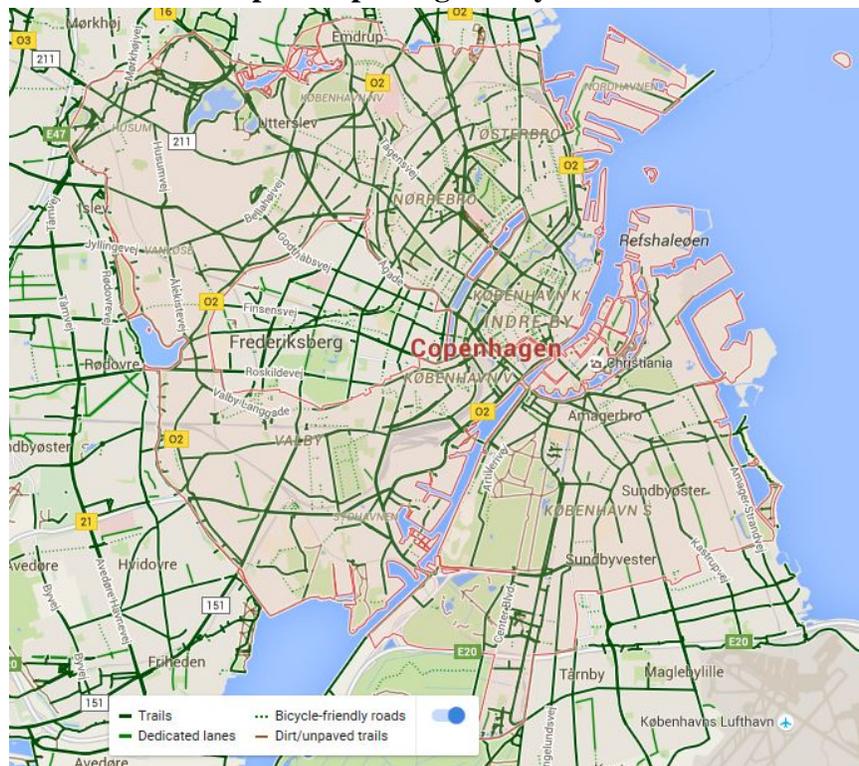
also relaunched its bike share system in 2013 after an international design competition to make it more accessible than the previous system as a part of these larger plans.

An important part Copenhagen’s bicycle planning efforts has been monitoring efforts to track the city’s progress towards its goals. The longest lived of these performance indicators is the *Bicycle Account*, which has been published bi-annually since 1995. The most recent edition of this report was published in 2014. It details Copenhagen’s progress towards the benchmarks set forth in *Good, Better, Best ...* and informs readers of further initiatives already underway, or planned in the near term future to continue working towards the goals of the current bicycle plan.

Location of Targeted Improvements

As a compact, medium-sized urban center, Copenhagen has implemented improvements throughout the metropolitan area of the city. Map 1, shown below, displays the extent of Copenhagen’s bicycle infrastructure network. Included within the map are bicycle trails in dark green, dedicated lanes in a lighter shade of green. The map’s legend also lists bicycle-friendly roads with a dotted green line and dirt/unpaved trails with a solid brown line, but neither are represented within the metropolitan area of the city which is lightly shaded and outlined in red. One can see that outside of some of the waterfront areas of the city, which are presumably reserved for industrial uses, bicycle lanes are linked throughout Copenhagen in an interconnected network.

Map 1: Copenhagen Bicycle Paths

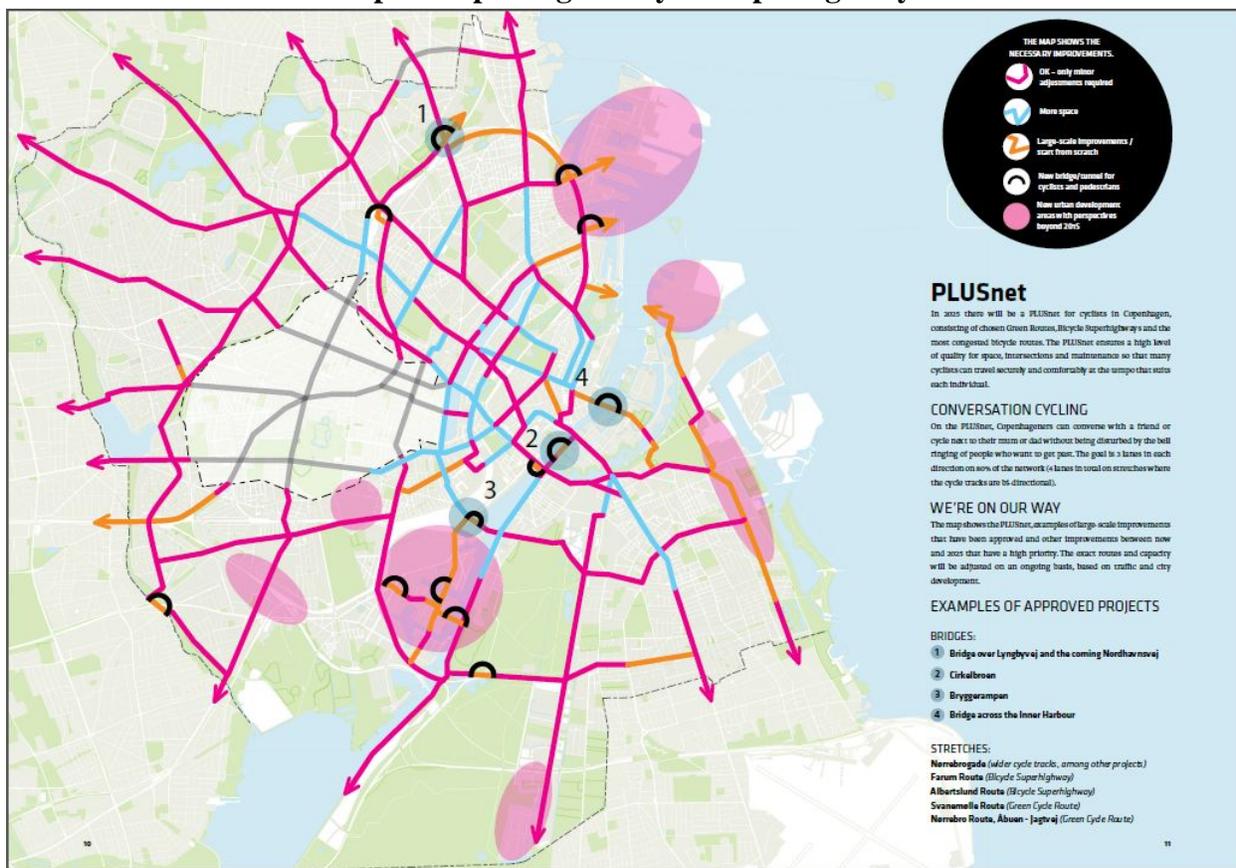


Source: Google Maps

A second map, Map 2, depicts the a planned network of “bicycle superhighways” that aim to connect Copenhagen with its surrounding suburbs as a part of the regional orientation included within the report *Good, Better, Best – The City of Copenhagen’s Bicycle Strategy 2011–2025*. The Cycling Embassy of Denmark; a cycling advocacy network of individuals representing the public, private and non-governmental sector, describes these “superhighways” as routes targeting suburban bicycle commuters that receive improvements such as new or wider bike paths, regulation of traffic lights, better signposting and automatic cycle pumps in order to provide a continuous and consistent ride throughout the length of the journey from the fringes of the metropolitan area into the city center (Madsen, 2011). Research has shown that trips by bicycle fall off significantly beyond 5 km, so the idea is to provide a swift, consistent, and easily navigable network of routes that can provide a viable alternative to car use from the urban fringe in order to relieve congestion in the city center. The website Plan Your City reports that “the network, consisting of Green Routes, Bicycle Superhighways, and the city’s most congested bicycle routes, will consist of at least three lanes in each direction on 80% of the network by 2025. Where there are bidirectional routes, there will be total of at least four lanes” (2014). In total, 28 routes covering 467 km are planned as a part of this regional planning effort (Zinck, 2014).

Map 2 uses a color grading system for individual pieces of the network in order to identify where further improvements can be made. Lines show in magenta represent areas that need only minor improvements. Blue is for areas that require more space to handle the volume of bicycle traffic. Orange denotes pieces where wholesale improvements are needed. Black horseshoe-shaped lines show where new bicycle bridges and tunnels are in the process of being constructed. Pink circles show areas where future urban development is planned which will necessitate consideration for bicycle facilities beyond the timeframe covered by the current plan.

Map 2: Copenhagen Bicycle Superhighways



Source: Good, Better, Best: Copenhagen's Bicycle Strategy 2011-2025

Time Frame of Intervention Impacts

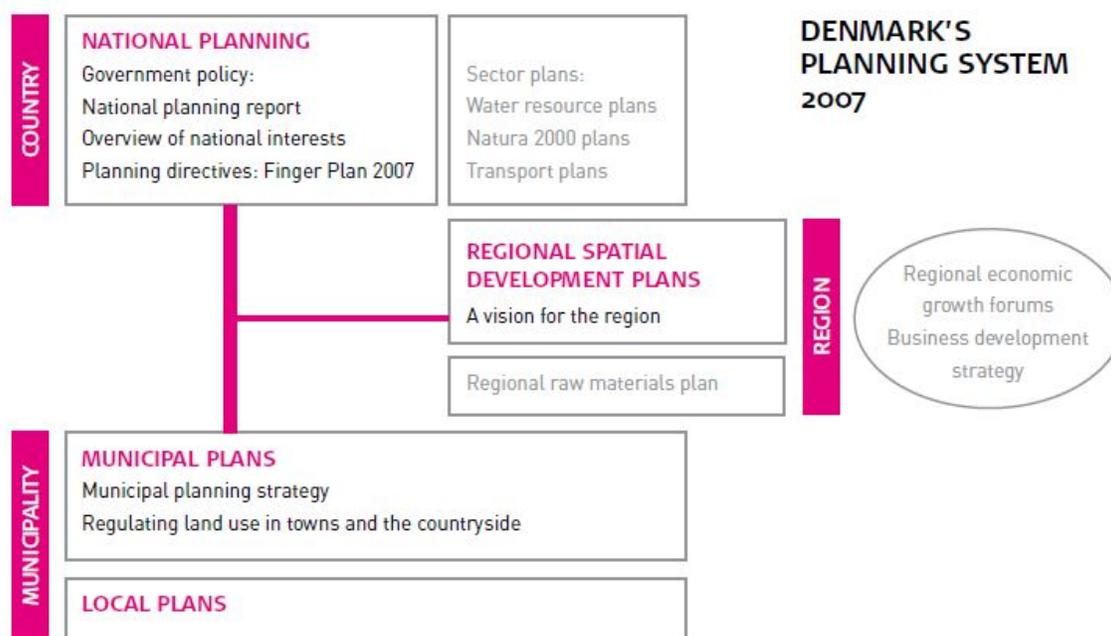
Copenhagen's eminently successful effort to remake itself in the image of the bicycle has much to do with the length of its commitment to this effort. The city began building its bicycle infrastructure network as early as the 1960s, even while car use was beginning to boom among residents as the process of suburbanization took hold within the region (Jensen, 2002). Construction of cycling facilities has essentially unabated in the 50 years since these measures first took place. While the pace has slowed considerably since the earlier periods of the network's construction, continual refinement of the design of these elements has occurred throughout their implementation in response to their performance. For clarification purposes, these design elements include things like intersections, traffic signals, lanes of a variety of types, bridges, tunnels, bike boxes, parking facilities, shelters, traffic calming devices, lighting, surface maintenance and more. The expansion of the network depicted in Map 2 above represents one of the largest recent periods of bicycle infrastructure construction, which makes sense given that it is regional in scale.

As indicated within the timeline of significant plans noted earlier in this report, while modern bicycle infrastructure elements have been built going back half a century, strategic

planning efforts have occurred mostly since the start of the 21st century. Copenhagen’s first bike share program was inaugurated in 1995, as was the first *Bicycle Account* tracking cycling trends in the city. Denmark created its first national plan for biking in 2000, while Copenhagen’s first comprehensive bike transportation plan in 2002. In the time since, Copenhagen has continually, refined, updated, and monitored its progress towards goals like modal shifting, improved safety and comfort, and reduced environmental impact resulting from the use of more sustainable forms of transportation.

Lead Entities, Stakeholders and Impacted Populations

Chart 1: Flow Chart of Denmark’s Planning System



Source: Spatial Planning in Denmark 2007

Pucher describes the roles of various levels of government in bicycle planning in Denmark in a 2008 article published in the journal *Transport Reviews*. He notes that municipal governments are the primary entities involved in promoting and implementing bicycle policies and programs because of the majority of the trips made by this mode are short, and local. Pucher continues by saying that “municipalities are responsible for making the specific plans that reflect the particular conditions and needs of the local context” (Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany). Bicycle training, safety and promotional programs are mandated and funded by higher levels of government but under the control of local governments. County and regional level governments assist with mostly policy guidance, project coordination, funding, but also get involved in some aspects of planning and construction in order to connect metropolitan areas or neighboring towns and cities together.

Similar to function of intermediate level government assistance with bicycle transportation planning, the national government is mostly involved with broad policy development, technical assistance, and financial support while leaving project implementation to local governments. The primary concern of national cycling policy is in encouraging modal shift and improving safety while moving Denmark towards methods of transportation that reduce congestion and improve environmental quality indicators (Buehler, 2008) (City of Copenhagen Technical and Environmental Administration, 2011). Accordingly, upper levels of government in Denmark contribute towards the creation of “overall goals, design guidelines, research support, model projects, coordination and funding” (Buehler, 2008). The national government is also responsible for the cost of bicycling facilities along national highways and those that cross state boundaries. The European Union has also become involved in bicycle promotion, funding long-distance bike routes across sovereign borders, funding research, and disseminating best practice information.

While it is true that the planning and implementation of bicycle infrastructure in Denmark is a primarily state led effort, Danish citizens are invited into the bicycle planning process in few of key ways. One way is in the frequent distribution of surveys by central authorities to gauge citizen satisfaction of bicycle facilities and programs, and to elicit feedback on how the current system can be improved. For example, the *2014 Bicycle Account* asks Copenhagen residents about their satisfaction with a variety of metrics including the integration of bicycle facilities and public transit, the width and maintenance of cycle tracks, and the adequacy of bicycle parking, amongst other measures. It also sets targets to improve satisfaction by the time of the next report is published in connection with Copenhagen’s larger bicycle strategy. Suggestions for improvement are gathered through online tools such as an interactive online map where one can comment on specific pieces of the infrastructure network need work, or see in real time where work is underway to fix problematic areas (Gossling, 2013). This process can also be accomplished on a mobile phone by downloading an app which triangulates a cyclist’s geographical position and allows that person to suggest improvements.

Another way the public can participate in bicycle planning is to become involved with informal planning networks. Entities like the previously mentioned Cycling Embassy of Denmark bring together stakeholders from public, private and academic realms, as well as advocacy groups and average citizens in a forum in which they can exchange ideas both in person and in virtual space as well. These informal networks are important aspect of Danish bicycle planning because there are few employees at any level of government whose sole responsibility is to be responsible for that task. The Municipal Cycle Network; another informal bicycle network, acts as a professional platform for municipal practitioners working with bicycle promotion projects. Members exchange ideas, experiences and build a base of knowledge and best practices through twice annual meetings and study trips as well as through the ongoing testing of ideas (Andersen, 2012).

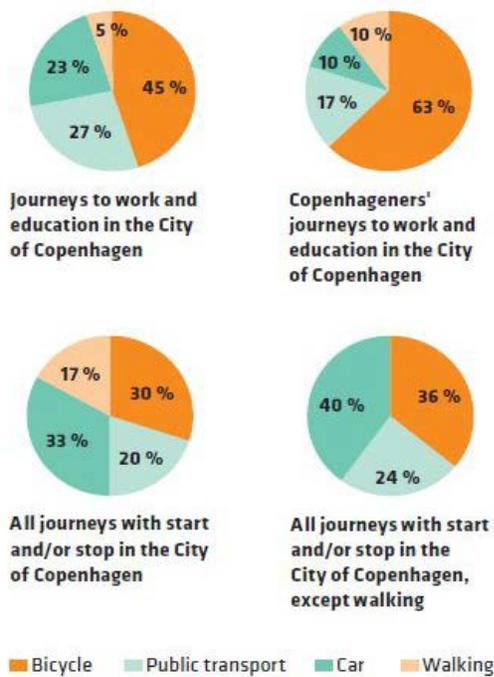
Results

Pucher and Buehler extensively review the outcomes of this widespread intentional effort to promote bicycle and travel in a case study review of measures implemented in Denmark, the Netherlands, and Germany published in 2008 (*Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany*). Their results are presented in a series of graphics which help to illustrate the success which these programs, policies and plans have affected a wide range of the populace according to a number of measures. These findings are supplemented by the monitoring efforts of Copenhagen's 2014 *Bicycling Account*, which provide the most up to date figures on a variety of bicycle related metrics. Accordingly, it allows us to examine the effect of these policies on larger issues such as social justice, public health, economic development, the environment and more.

Modal Share

Figure 2 the current modal share of the most prevalent forms of transportation in the city of Copenhagen. From the top row of this graphic, we can understand that the bicycle is the most common form of commuter transportation within the city of Copenhagen, for both city residents and non-residents. The 2014 *Bicycling Account* that these figures have improved by 9% and 10%, respectively, since 2012. The bottom row demonstrates that bicycle travel is still the number two mode of transportation even in trips that travel outside of the core city. In all cases, the modal share for bicycle transportation represents one of the highest in the world, as will be proven in later graphics. Next to this graphic is a chart with the targets for bicycle transportation included as a part of Copenhagen's most recent bicycle strategy document. Overall, these first figures show an increase in transportation equity according to the modal share, and an improvement in cyclist safety and satisfaction.

Figure 2: 2014 Copenhagen Modal Share with Planning Targets



TARGETS STATED IN GOOD, BETTER, BEST. THE CITY OF COPENHAGEN'S BICYCLE STRATEGY 2011-2025

	'04	'06	'08	'10	'12	'14	'15	'25	
	36	36	37	35	36	45	50	50	Proportion of people who cycle to work/education (%) *
	58	53	51	67	76	74	80	90	Proportion of cycling Copenhagens who feel secure (%)*
	125	97	121	92	102	91	56	34	Cycling casualties (number per year)*
					17	19	40	80	Proportion of PLUS network that has 3 lanes (%)
					0	7	5	15	Reduction in cycling travel time (%)
	50	48	54	50	61	63	70	80	Satisfaction with state of cycle tracks (%)
				67	73	70	70	80	Satisfaction with cycling culture's impact on urban life (%)

*Targets included in the City of Copenhagen's publication Eco-Metropolis. Our Vision for Copenhagen 2015.

OTHER KEY FIGURES

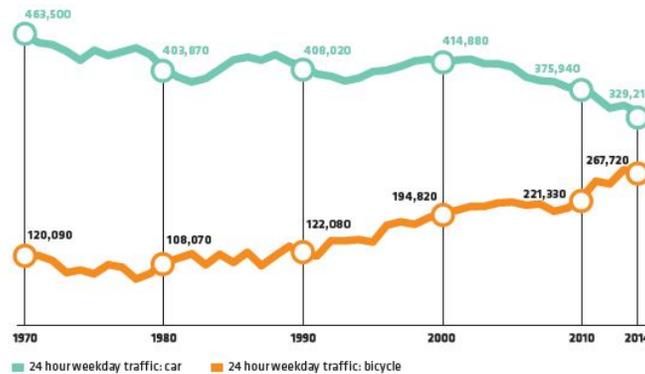
	'04	'06	'08	'10	'12	'14	
	1.13	1.15	1.17	1.21	1.27	1.34	Kilometres cycled (million km per weekday)
	3	4	3.2	4.4	4.2	4.9	Kilometres cycled between each casualty (million km)
	15.3	16	16.2	15.8	15.5	16.4	Average cycling speed (km/h)
	329	332	338	346	359	368	Cycle tracks (km)*
	14	17	18	23	24	28	Cycle lanes (km)
	37	39	41	42	43	58	Green Cycle Routes (km)
					17.5	38.5	Cycle Super Highways (km)**
		42	47	48	49	51	Bicycle parking facilities on roads and pavements (1,000)

*Includes cycle tracks in Nordhavn **Entire Capital Region of Denmark

Source: 2014 Copenhagen Bicycle Account

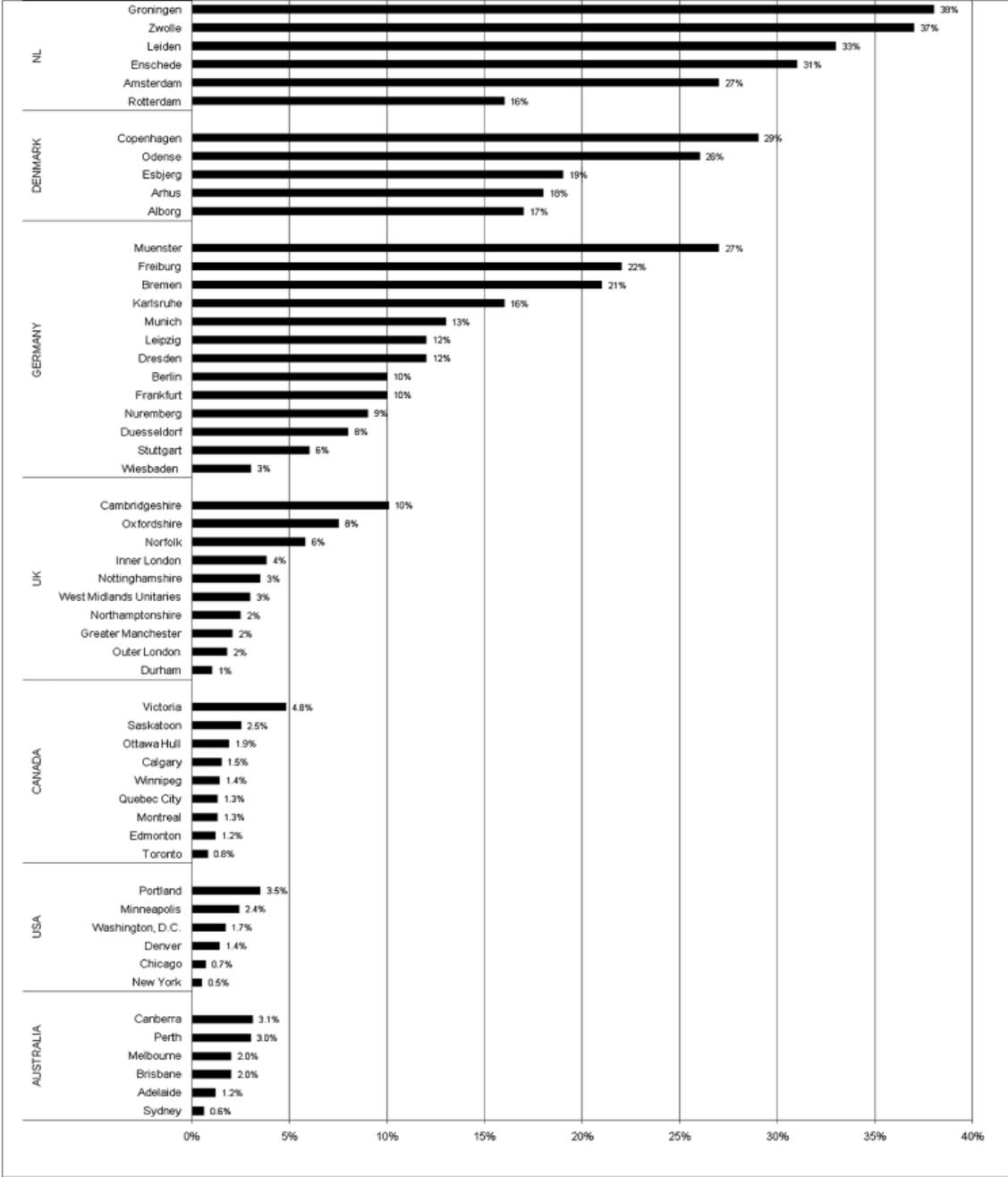
Figure 3, also taken from the most recent *Bicycle Account* demonstrates that the increase in bicycle travel in Copenhagen has come at the expense of automobile travel since 1970 as a result of the efforts made by the city to encourage this use. More than 1.34 million km are cycled per day in Copenhagen.

Figure 3: Traffic entering in and out of the city center (24 hour weekday traffic 1970-2014)



For comparison purposes, Figure 4 shows modal share of all trips by bicycles in selected cities in the Netherlands, Denmark, Germany, the UK, Canada, the USA and Australia from 2000-2005. The numbers for Denmark are not as accurate as those provided above in the bicycle account, but can still see the demonstrable success that bicycle-specific infrastructure, policy and programming have had on this metric. It also highlights how far ahead world-leading cities like Copenhagen are in successfully promoting bicycle use in comparison to domestic cities.

Figure 4: Modal Share in Selected International Selected International and Domestic Cities



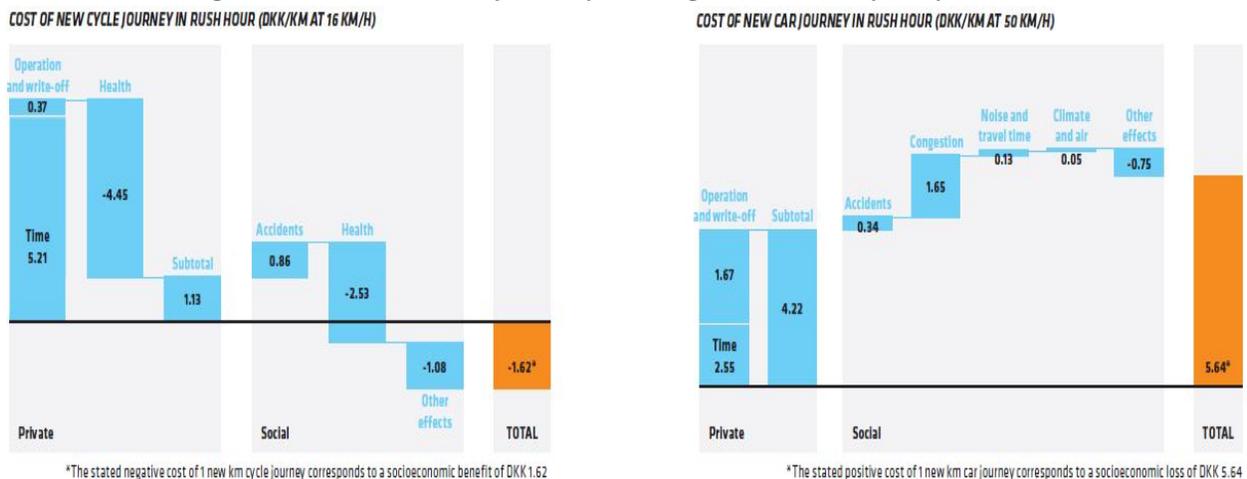
Source: Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany

Public Health

The 2014 *Bicycle Account* takes stock of the public health benefits of increased bicycle travel mostly through the lens of improved safety and reduced accidents. Figure 3, shown previously, makes an obvious case for public health benefits resulting from the increased number of bicycle trips in the last thirty five years, as it has doubled while car use has fallen in

Copenhagen. Each person cycles about 3.3 km per day on average in Copenhagen (Ministry of Transport, 2014). The first bicycle “superhighway” to the busy suburb of Albertslund, opened in 2009, is estimated to have saved Copenhagen's health care system some \$60 million a year (Beardsley, 2012). The *Bicycle Account* illuminates other positive statistics for public health. It notes a 30% reduction in the fatality rate for adults who cycle daily to work or education. Three out of four cyclists cycle year round, obtaining consistent benefits. Also, in a cost-benefit analysis within this document, the authors found that a new bicycle journey of 1 km during rush hour saved Copenhagen 1.62/km Danish kroner (the national currency) in time, health, and environmental effects; while the cost was a loss of 5.63/km when the journey was made by car instead. These figures were used to illustrate the significant diverse benefits of building extensive bicycle-infrastructure. Figure 5 shows these calculations below.

Figure 5: Cost of 1 km journey during rush hour by bicycle v. car



Source: Copenhagen 2014 Bicycle Account

Reinforcing the argument of Danish public health improvements resulting increased attention to bicycle planning, data shown by Pucher and Buehler within their journal article also show a continuous downward trend in bicycle fatalities between 1970 and 2005 in Denmark corresponding with a period of intensive bicycle-infrastructure construction. One can see from the comparative countries included, that Denmark has seen one of the greatest decreases in bicycle fatalities since that time. These improvements have occurred even as substantially more people are cycling, at greater cumulative distances than in the past (Jensen, 2002).

Figure 6: Trend in cycling fatalities in the USA, the UK, Denmark, Germany and the Netherlands (relative to 1970 levels)



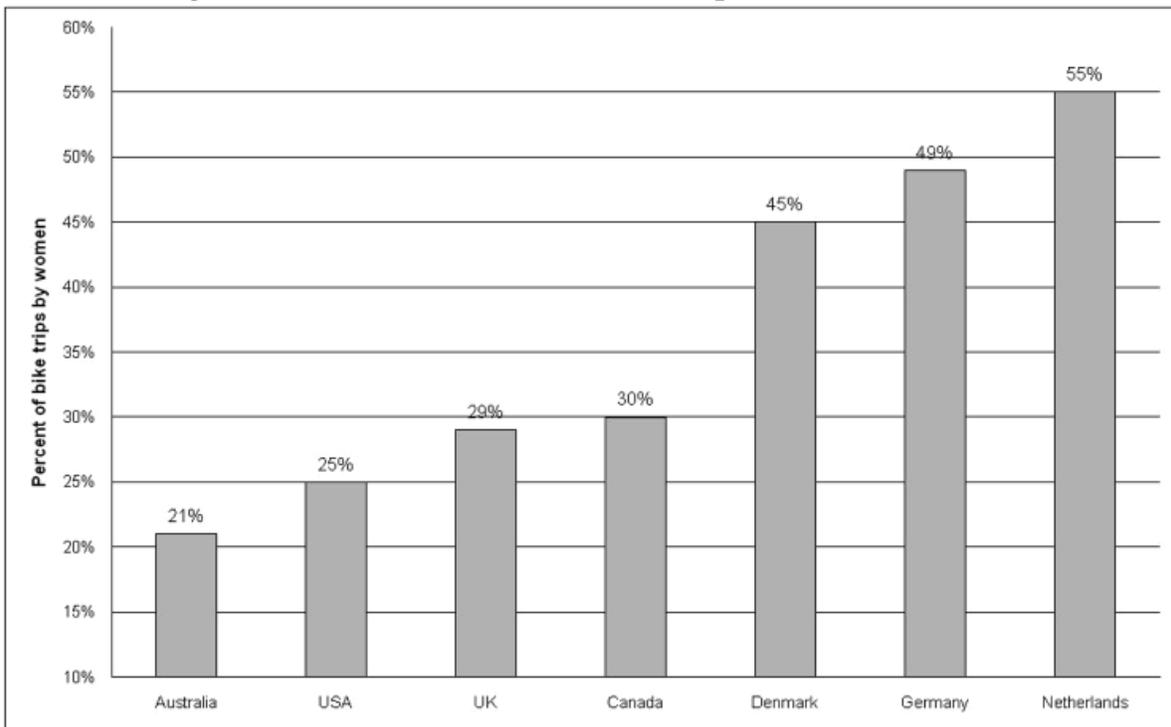
Sources: Danish Ministry of Transport (2007); Department for Transport (2007); German Federal Ministry of Transport (2007); Netherlands Ministry of Transport (2007); U.S. Department of Transportation (2007)

Equity/Social Justice

There are a few important indicators of equity noted within the two sources that we have been drawing from in the results section of this report. First, the 2014 *Bicycle Account* cites that “26% of all families with two or more children have a cargo bike or a bicycle trailer,” which makes clear that families are among the demographic groups benefiting from the extensive bicycle infrastructure built in Copenhagen. Four out of five households also have access to a bicycle, according to the report. The relaunch of the city’s bike share program in 2013 may aid in further improving access to bicycles as well. The City of Copenhagen’s health aid center has lent tricycles to over 500 citizens who are no longer physical able to ride a two-wheeled bike. Volunteers have also visited 39 different old-age care facilities to take people out on rickshaw bicycle rides since they can no longer make the journey under their own power. Some libraries in Copenhagen also lend out cargo-bikes for free in collaboration with local environmental organizations in order to conduct these routine trips without a car.

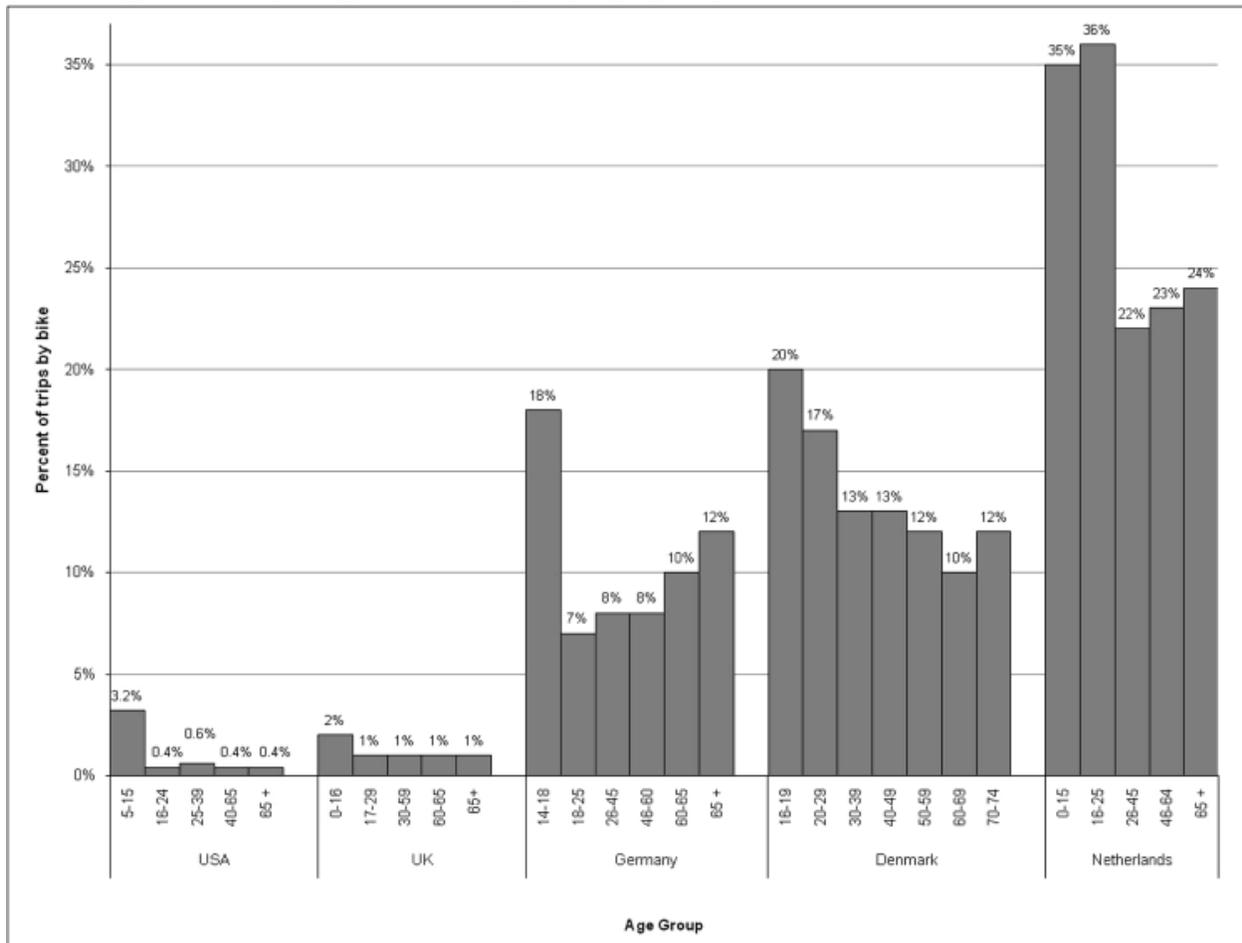
In terms of age and gender distribution of riders, Pucher and Buehler have found in their research that measures taken within Denmark have encouraged virtually all segments of society to bicycle. Figure 7 shows the share of women’s total bike trips in the countries surveyed from 2000-2005, while Figure 8 shows the breakdown of age groups between 2000 and 2002. The authors note that 45% of women cycle in Denmark, compared to 76% in the United States. Biking makes up 12% of all trips among Danish people aged 70-74, compared to less than .5% in America (2008). 20% of trips made by Danish teens aged 18-19 come by bicycle, while that number is .4% in our country. Though not cited graphically, Pucher and Buehler also found that cycling was equally distributed among income classes in Denmark in a 2007 article, a fact which was seconded by the *Copenhagen 2002-2012 Cycle Policy* (Cycling for Everyone: Lessons from Europe). Bicycle usage statistics according to race were unavailable for the 12% other racial or ethnic groups who make up the total population besides native Danes.

Figure 7: Women’s share of total bike trips in selected countries



Sources: German Federal Ministry of Transport (2003); U.S. Department of Transportation (2003); Danish Ministry of Transport (2005); Statistics Netherlands (2005); Australian Bureau of Statistics (2007); Department for Transport (2007) and information provided directly by bike planners in Canadian provinces and cities

Figure 8: Bicycling share of trips by age group in selected countries 2000-2002



Sources: German Federal Ministry of Transport (2003); U.S. Department of Transportation (2003); Danish Ministry of Transport (2005); Statistics Netherlands (2005); Department for Transport (2007)

Economic Development

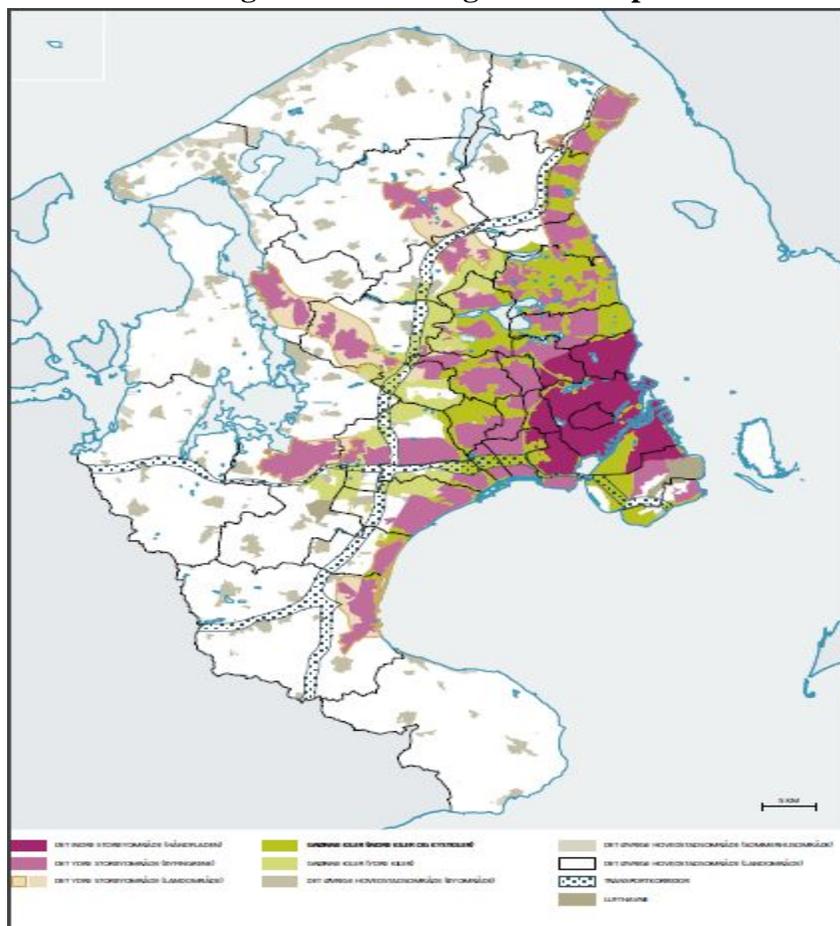
The 2014 *Bicycle Account* notes some of the economic benefits related to the provision of bicycle planning and infrastructure. These include:

- 32% of supermarket and street level shop turnover is made by bike providing an economic benefit of \$15.4 billion Danish Kroner (DKK)
- DKK 5 million recouped through time savings to users with the opening of the new bicycle bridge The Bicycle allowing the bridge to pay itself off within 7 years
- A total of DKK 1 billion has been invested in the bicycle system since 2005
- Wonderful Copenhagen's most recent analysis of tourists in Copenhagen shows that 52% of the respondent tourists give cycling culture as one of the three main reasons for having chosen Copenhagen as a destination
- The average 1km bike journey made during rush hour saves the city DKK 1.62/km while a car trip made in place of the bicycle trip costs DKK 5.63/km

Environment

Copenhagen has a plan (CPH Climate Plan 2025) to be climate neutral within 10 years. Among many other pieces of this plan, transportation initiatives - including investments in bicycling and public transportation, are integral to reducing its output of carbon dioxide and other greenhouse gases. Specifically, it has declared a goal that “Copenhagengers will take 75 percent of trips by bicycle, on foot or by public transport and 50 percent of trips to work or school will be by bike” (C40 Cities, 2013). Copenhagen has reached a 45% bike commute rate currently, according to the 2014 *Bicycle Account*, making it more than feasible to reach their goal. This will save 10,000 – 20,000 tons of carbon dioxide per year, according to that report. The bicycle “superhighway” noted within the climate and bicycle plans are a key piece in this effort to continue increasing modal share. There will be 28 of these corridors which will capture more medium to long distance commuters in the Copenhagen metro area traveling for work or other activities into the city center.

Figure 9: 2007 Finger Plan Map



Source: Spatial Planning in Denmark 2007

Of further evidence of the utility of transportation and land use policy in Copenhagen is the most recent iteration of the Finger Plan. In 2007, Copenhagen updated this plan to “establish

a framework for development in Greater Copenhagen and promote appropriate urban development in close connection with the development of transport infrastructure and transport services” (Ministry of the Environment, 2007). Figure 9, demonstrates that the original vision of the 1947 Finger Plan to concentrate suburban development along radial corridors, tying land use and transportation together through a multi-modal effort, has still be remarkably successful in preserving Copenhagen’s urban form. This plan will continue to delineate clear division between urban and rural zones, focus on providing excellent public transportation, and mixed-use development in a regional planning vision. A new feature of this plan is to mandate that “large office workplaces exceeding 1500 square meters of floor space will generally have to be located within 600 meters by foot from the closest station. Surveys show that location near stations induces many more people to choose public transport instead of car transport” (Ministry of the Environment, 2007).

Conclusion

Copenhagen offers a useful case study for transportation planning in Memphis for a few key reasons. Memphis’ recent “bicycling boom” allows us to examine how other places have successfully encouraged substantial modal shifting towards bicycles. The lessons learned throughout this document offer affirmative and repudiating wisdom towards how Memphis is implementing its bicycle network. On the positive side, the act of simply building an extensive, interconnected bicycle infrastructure network has been hugely instrumental to Copenhagen’s success in this regard. The fact that these efforts may not necessarily have always followed a plan that was specific to bicycle travel versus being a part of a larger transportation plan, offers a bit of hope that Memphis piecemeal approach can have some success. And while various scales of government are involved in bicycle planning in Denmark, few entities are responsible solely for bicycle planning as their major work objective, as the work is spread between many agencies. Informal networks that bring together diverse coalitions from the public, private and non-profit sectors are important to Denmark’s bicycle planning, as are the coalitions of bicycle advocacy groups in Memphis. Overall though, building bicycle infrastructure even during periods when the public clamored for cars, was and continues to be a critical part of Copenhagen’s success.

The most important lesson that Memphis might learn from Copenhagen on the repudiating side however, is the runaway success of the city’s long term commitment to tie together transportation and land use. The Finger Plan originally established this objected more than sixty years ago at this point, and the plan has been incredibly successful in containing growth to planned corridors which in turn allow for the preservation of valuable green space and farmland within the metro area. This has made for planned, concentrated growth that is well served by transit, which allows people to carry out nearly all daily activities in an efficient manner without a car if one so desires. Memphis on the other hand, long ago abandoned this linkage between land use and transportation. In the pattern of many American cities, it allowed the myriad forces of highway building, suburbanization through the provision of low-interest

home loans, all served solely by a rising automobile industry, to decentralize the core city. The result for citizens has been segregation by race and class as a result of a transportation system that serves those who can afford a car, while leaving those who cannot behind. Memphis and Copenhagen are nearly identical in size inside and outside the core city, but their spatial pattern could not be more different as a result of the differing treatment of land use. It is an entirely inefficient system that we are now slowly trying to undo, but this objective will remain elusive as long as we refuse to make the clear linkage between transportation and land use.

A final note on Copenhagen's transportation policy that is worth mentioning. As is made especially clear in the appendix, a critical element in the control of land use and transportation is the provision of both incentives and disincentives. What this means is that for a policy to work effectively, it has to be incentivized in various ways, while a competing alternative must be disincentivized. In Memphis as in the rest of America, every incentive that a citizen has in most places points to using an automobile to meet their daily transportation needs. In our best bicycling cities, such as Portland, Oregon, bicycle commuting rates are less than 1/5 what they are in Copenhagen. This is true for multiple reasons, including the length of time that Copenhagen has been pursuing its transportation goals, but also due to policies such as the exceedingly high cost of owning a car in the city. This is true throughout much of Europe, and it should therefore come as no surprise that these strong deterrents dissuade many from purchasing a car in favor of walking, bicycling or using public transit. For us to ever be successful in Memphis or in America, it seems clear that we will have to address this "elephant in the room." In the aftermath of the 1970s Middle East energy crisis unfolded, Europe went one way on and America went the other when it came to the energy choices that are inherent in every transportation and land use system. It is clear in hindsight who is now better prepared for the uncertain future portended by climate change. Accordingly, there is no better time than the present to learn from other nations in plotting a new course for transportation in Memphis.

Appendix

Comprehensive List of Program, Policies and Other Measures to Increase Bicycle Usage in Netherlands, Germany, and Denmark from *Making Cycling Irresistible* (2008)

Table 1. Key policies and innovative measures used in Dutch, Danish and German cities to promote safe and convenient cycling

Extensive systems of separate cycling facilities

- Well-maintained, fully integrated paths, lanes and special bicycle streets in cities and surrounding regions
- Fully coordinated system of color-coded directional signs for bicyclists
- Off-street short-cuts, such as mid-block connections and passages through dead-ends for cars

Intersection modifications and priority traffic signals

- Advance green lights for cyclists at most intersections
- Advanced cyclist waiting positions (ahead of cars) fed by special bike lanes facilitate safer and quicker crossings and turns
- Cyclist short-cuts to make right-hand turns before intersections and exemption from red traffic signals at T-intersections, thus increasing cyclist speed and safety
- Bike paths turn into brightly colored bike lanes when crossing intersections
- Traffic signals are synchronized at cyclist speeds assuring consecutive green lights for cyclists (green wave)
- Bollards with flashing lights along bike routes signal cyclists the right speed to reach the next intersection at a green light

Traffic calming

- Traffic calming of all residential neighborhoods via speed limit (30 km/hr) and physical infrastructure deterrents for cars
- Bicycle streets, narrow roads where bikes have absolute priority over cars
- ‘Home Zones’ with 7 km/hr speed limit, where cars must yield to pedestrians and cyclists using the road

Bike parking

- Large supply of good bike parking throughout the city
- Improved lighting and security of bike parking facilities often featuring guards, video-surveillance and priority parking for women

Coordination with public transport

- Extensive bike parking at all metro, suburban and regional train stations
- ‘Call a Bike’ programs: bikes can be rented by cell phone at transit stops, paid for by the minute and left at any busy intersection in the city
- Bike rentals at most train stations
- Deluxe bike parking garages at some train stations, with video-surveillance, special lighting, music, repair services and bike rentals

Traffic education and training

- Comprehensive cycling training courses for virtually all school children with test by traffic police
- Special cycling training test tracks for children
- Stringent training of motorists to respect pedestrians and cyclists and avoid hitting them

Traffic laws

- Special legal protection for children and elderly cyclists

- Motorists assumed by law to be responsible for almost all crashes with cyclists
- Strict enforcement of cyclist rights by police and courts

Source: Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany by John Pucher and Ralph Buehler

Table 2. Cycling promotion in the Netherlands, Denmark and Germany

Access to bikes

- Free use of distinctive, simple City Bikes parked throughout the city, as in Copenhagen
- Easy, convenient and inexpensive bike rentals at train stations and throughout the city, such as the ‘OV-Fiets’ and ‘Call a Bike’ programs in the Netherlands and Germany, respectively
- Company bikes loaned for free to employees who can use them during the day for short business trips
- Tax breaks to purchase a bike in the Netherlands
- Convenient air pumps for bikes in city center
- ‘Park and Bike’: discount bike rentals for motorists who park their cars and bike for the rest of the journey

Bike trip planning

- Bicycling websites with extensive information for cyclists on bicycling routes, activities, special programs, health benefits of cycling, bikes and bike accessories, etc.
- Flexible Internet bike trip planning tool allows finding the most comfortable or quickest route by bike tailored to the specific preferences and needs of each person
- Comprehensive bike maps for most cities as well as most regions and states

Public awareness campaigns

- Focus on health benefits of cycling, such as the ‘Get Rid of the Sack’ program in Odense targeted at overweight middle-aged men with pot-bellies who need more exercise
- Special fun programs for young children, such as the ‘Cycling Duckie’ in Odense, which distributes candy, balloons, free bike accessories and other gifts to children learning to cycle
- Cycling ambassador programs that send well-trained cyclists to residential neighborhoods to serve as role models of safe cycling and help with cycling promotion, distributing newsletters and information
- Annual bicycling festivals and car-free days that promote the environmental advantages of bicycling, display the latest bike models and accessories, and disseminate various other relevant information for bike enthusiasts
- Wide range of cycling competitions for different ages and skill levels
- Special guided bike tours for seniors

Public participation in bike planning

- Regular surveys of cyclists to assess their satisfaction with cycling facilities and programs and to gather specific suggestions for improvement
- Bike councils that provide a platform for opinion exchange among stakeholders from businesses, the bike industry, the city administration, research institutes, universities, bike experts and citizen advocacy groups, such as the ‘Fahrrat’ in Berlin

Source: Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany by John Pucher and Ralph Buehler

Table 3. Taxation, parking and land-use policies that encourage cycling indirectly

Automobile speed limitations in cities

- Traffic calming of residential neighborhoods limits cars to speeds of 30 km/hr or less
- ‘Home Zones’ in many neighborhoods give cyclists and pedestrians equal rights to road use and limit cars to *walking speed* (about 7 km/hr)
- Car-free zones, one-way streets and artificial dead-ends make car travel through the city center slow and inconvenient
- Turn restrictions for cars but not for cyclists
- Almost no limited access highways (motorways) in city centers
- Strictly enforced speed limits and traffic rules in cities (such as police cameras at intersections)
- Frequent random speed limit enforcement checks by the police
- Advance stop lines and traffic signal priority for cyclists

Road and parking capacity limitations

- Limited number of car parking places in city centers
- Parking management schemes limit easy car access to urban neighborhoods, often with resident only parking or strict time limits
- Replacing car parking facilities with bike parking instead
- Combined bus-bike lanes that permit bike use but prohibit car use
- Deliberately narrowed roads in city centers force cars to drive slowly
- Special bicycle streets that sharply limit car speeds and give cyclists priority in roadway use over the entire width of the road

Taxation of automobile ownership and use

- High taxes and fees on car purchase, ownership and use
- Especially high excise and sales taxes on petrol
- High hourly parking rates in city center, even in medium-size cities
- High fees and strict training requirements for obtaining a driver’s license (over €1500 in Germany)

Strict land use planning policies

- Most land beyond already built-up areas is off-limits for new development
- Most new development occurs adjacent to already built-up areas, which keeps overall population densities high compared to the USA
- Transport and land-use planning are integrated at several levels of government, with regional coordination that fosters cooperation between adjacent communities
- Many local governments specifically require cycling and walking facilities for new suburban developments, thus reducing the need for car use
- Mixed-use zoning keeps trip distances short and feasible by bicycle and on foot
- Less strict separation of land uses than in the USA, thus enabling natural development of mixed use neighborhoods

Sources: Pucher (1995); Nivola (1999); Bratzel (1999); Alterman (2001); Transportation Research Board (2001); Pucher and Dijkstra (2003); European Conference of the Ministers of Transport (2004); Banister (2005); Dutch Bicycling Council (2006); Netherlands Ministry of Transport (2006); Schmidt and Buehler (2007)

Bibliography

- Andersen, T. (2012). *Collection of Cycle Concepts 2012*. Copenhagen, Denmark: Cycling Embassy of Denmark.
- Beardsley, E. (2012, September 1). *In Bike-Friendly Copenhagen, Highways For Cyclists* . Retrieved September 18, 2015, from National Public Radio:
<http://www.npr.org/2012/09/01/160386904/in-bike-friendly-copenhagen-highways-for-cyclists>
- Buehler, J. P. (2007). *Cycling for Everyone: Lessons from Europe*. New Brunswick, NJ: Rutgers University.
- Buehler, J. P. (2008). Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany. *Transport Reviews*, 495-528.
- C40 Cities. (2013). *Copenhagen: CPH Climate Plan 2025* . Retrieved September 19, 2015, from C40 Cities:
<http://www.c40.org/profiles/2013-copenhagen>
- City of Copenhagen Technical and Environmental Administration. (2011). *Good, Better, Best: The City of Copenhagen's Bicycle Strategy 2011-2025*. Copenhagen, Denmark: City of Copenhagen Technical and Environmental Administration.
- City of Copenhagen Technical and Environmental Administration. (2014). *Copenhagen City of Cyclists: The Bicycle Account 2014*. Copenhagen, Denmark: City of Copenhagen .

- Cycling Embassy of Denmark. (2015). *Bicycling History*. Retrieved September 18, 2015, from Cycling Embassy of Denmark: <http://www.cycling-embassy.dk/facts-about-cycling-in-denmark/cycling-history/>
- Dijkstra, J. P. (2000). Making Walking and Cycling Safer: Lessons from Europe. *Transportation Quarterly*, Vol. 54, No. 3, 1-33.
- Gossling, S. (2013). Urban Transport Transitions: Copenhagen, City of Cyclists. *Journal of Transport Geography*, 196-206.
- Jensen, N. (2002). *Cycle Policy 2002-2012*. Copenhagen, Denmark: City of Copenhagen, Building and Construction Administration, Roads and Parks Department.
- Jensen, S. U. (2000). *Collection of Cycle Concepts*. Copenhagen, Denmark: Road Directorate.
- Knowles, R. (2012). Transit Oriented Development in Copenhagen, Denmark: from the Finger Plan to Orestad. *Journal of Transport Geography*, 251-261.
- Krag, T. (2000). *Bicycle promotion strategies in Denmark*. Copenhagen, Denmark: Thomas Krag.
- Madsen, J. S. (2011, February 2). *Cycle Super Highways in Greater Copenhagen area*. Retrieved September 11, 2015, from Cycling Embassy of Denmark: <http://www.cycling-embassy.dk/2011/02/02/super-cycle-highways-in-greater-copenhagen-area-2/>
- Ministry of the Environment. (2007). *Spatial planning in Denmark*. Copenhagen, Denmark: Ministry of the Environment.
- Ministry of Transport. (2014). *Denmark - on your bike! The National Bike Strategy*. Copenhagen, Denmark: Ministry of Transport.
- Møller, V. A. (2009). *The Finger Plan, Greater Copenhagen*. Retrieved September 18, 2015, from 1001 Stories of Denmark: http://www.kulturarv.dk/1001fortaellinger/en_GB/the-finger-plan-greater-copenhagen
- Plan Your City. (2014, February). *Becoming the Cycling Capital of the 21st Century*. Retrieved September 11, 2015, from Plan Your City: <http://planyourcity.net/2014/01/31/becoming-the-cycling-capital-of-the-21st-century/>
- The Fietsersbond (Dutch Cycling Union). (2009, December). Copenhagen 'the Ultimate Cycling City'. *Cycling Cities*, pp. 4-7.
- Wagenschutz, K. (2014). *2014 State of Bicycling: Memphis, TN*. Memphis, TN: City of Memphis.
- Zinck, A. (2014, November 19). *Copenhagen bicycle "super highways" push regional cooperation to a new level*. Retrieved September 11, 2015, from Citiscope: <http://citiscope.org/story/2014/copenhagen-bicycle-super-highways-push-regional-cooperation-new-level>

