

# Promoting Bicycling through Creative Design: Innovations for Bicycles and Cycling Facilities

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Guidance and support provided by the Helen and William Mazer Foundation  
League of American Bicyclists

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## Introduction

Bicycling is good for people's health, good for local economies, and good for reducing greenhouse gas emissions. The number of people who ride is rising across the United States, particularly in communities that are building facilities to safely accommodate people who bicycle. This suggests that the adoption of proven innovations and the encouragement of new innovations could help ensure that cycling and its benefits continue to increase.

Indeed, innovations continue to emerge in bicycle design and in the design and management of cycling facilities. Bicycling innovations and their adoption could be accelerated by increasing the level of resources available for evaluation of new designs. Federal funding for testing transportation-related innovations continues to be devoted primarily to motor vehicles and facilities to accommodate them. By focusing more on active, healthful transportation, including bicycling, federal resources for evaluation could become better aligned with national goals for improving public health and addressing climate change.

The new bicycle riders in the U.S. are all ages, ethnicities, income levels, and bike-abilities. The *Bicycling and Walking in the United States 2014 Benchmarking Report* shows that people across income groups walk and bicycle roughly proportionally to their distribution in the population. However the same is not true by gender. Seventy-five percent of bicycle trips in the United States are by males. Better understanding of who rides and better testing and adoption of innovations has the potential to increase bicycling among all groups of people, and reduce or eliminate gender, age, income, and ethnic disparities in riding.

The purpose of this document is to highlight some of these innovations so as to increase awareness of progress and encourage new improvements. This compilation is intended to be a living document, updated periodically to reflect emerging trends. Readers are welcomed to email Anne Lusk ([AnneLusk@hsph.harvard.edu](mailto:AnneLusk@hsph.harvard.edu)) if they have a bicycling innovation they would like to have considered for inclusion.

The working document will be posted on the *Research Initiative on Bicycling and Health at HSPH* web site <http://www.hsph.harvard.edu/bicycling/> with links also on the League of American Bicyclists web site. <http://www.bikeleague.org/> The innovations have been found through web searches or are from the creative thinking of the authors. Opinions expressed are those of the authors.

## **Anne Lusk, Ph.D. Harvard T. H. Chan School of Public Health**

Dr. Lusk holds a Ph.D. in Architecture with a specialization in Environment and Behavior. For 16 years before her degree, she was a practitioner building bicycle facilities and lecturing in the U.S., Canada, and Europe. For the 14 years after her degree, she has been conducting research about bicycle facilities at the Harvard T. H. Chan School of Public Health. Her studies have focused on comfortable and safe environments that will motivate women, children, seniors, parents with children on their bicycles, individuals of color, and lower income individuals to bicycle. Her design proposals have included Social Cycle Tracks, Climate Change Streets, rewarding destinations, MET Routes (Metabolic Equivalent of Task), and bicycle parking inside homes, offices, schools, and shops. She explores associations between bicycle environments and policy, behavior, health, pollution, injury, crashes, crime, preferences, Climate Change, sustainability, Alzheimer's, and joy. In addition to studying bicycle facilities for all populations, she has focused on China and lower income minority neighborhoods in the U.S. <http://www.hsph.harvard.edu/anne-lusk/>

## **Helen and William Mazer Foundation**

This document titled "Promoting Bicycling through Creative Design" was funded by a grant from the Helen and William Mazer Foundation (HWMF). HWMF, endowed in 1979, is a charitable foundation with a mission to improve human health and healing and promote sustainable urban environments. HWMF has supported numerous projects and initiatives relating to active mobility and urban transportation equity. For example, HWMF has funded research about bicycle guidelines and cycle track safety in the U.S. and preferences for cycle tracks, bike parking, and beautiful surroundings in Hangzhou, China. The foundation has additionally funded research about bike-related preferences of minority populations, bike parking standards, calorie-burning comparisons of different built environments, tree placement preferences on cycle tracks, and the economic impacts of bicycle facilities. The foundation provided funding for a bike counter in Kendall Square, Cambridge, MA; the costs for a delegation of Cambridge, MA city officials to participate in a People for Bikes study tour of the Netherlands; and the League of American Bicyclists National Bike Summit. Steven Bercu, a director of HWMF, leads many of its active-mobility-related efforts. An avid cyclist, he also serves as Board President for Ecocity Builders and the Boston Cyclists Union, on the Land Conservation and Boston Committees of The Trustees of Reservations, and on the Board of Overseers for the ICA-Boston.

## **League of American Bicyclists**

The League of American Bicyclists, a member-supported organization founded in 1880, is working to create a Bicycle Friendly America for everyone. The League believes bicycling brings people together and when more people ride bikes, life is better for everyone, communities are safer, stronger and better connected, and our nation is healthier, economically stronger, environmentally cleaner and more energy-independent. The League has three main avenues:

The League's [Bicycle Friendly America](#) program provides a roadmap and hands-on assistance and recognition for states, communities, universities and businesses. The BFA program is a tool for states, communities, business and universities to make bicycling a real transportation and recreation option for all people.

[Smart Cycling Education](#) has been a core activity of the League since the 1970's. Virtually every state and local bicycling education program can trace its roots back to the League's program. The core content is designed to reach people of all ages and abilities and improve skills and build confidence.

The [advocacy](#) efforts span the spectrum, from lobbying Congress for bike's fair share of funding to giving local advocates tools to win campaigns for bike-friendly policies in their town. Through the National Bike Summit to National Bike Month, the League has been the hub of information to get wheels spinning in communities nationwide. At the federal, state and local level, the League unites the voices of bicyclists and bike advocates nationwide.

## **Ed Fendley, U.S. Environmental Protection Agency, Office of Sustainable Communities**

Ed Fendley works in the EPA's Office of Sustainable Communities, where he helps people build walkable, healthy and economically vibrant places. He has served in the Federal government for 30 years. His kids and his neighbors are not impressed with this. But Ed himself has had fun. He has worked as a Foreign Service Officer, a negotiator dealing with global climate change, and a White House staffer. In addition to his Federal career, Ed teaches a course on sustainability and environmental policy at the University of Maryland. What he really wants to do is ride his bike around the country sampling local food and drink. But that doesn't pay much.

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### **I. Definitions of Bicycle Facilities**

**Road** – A road for vehicles without any specific provision for bicyclists.

**Signed bike routes** – A road on which signs have been placed indicating to the bicyclist that this is the route to take that is, in most cases, safer than an alternate route.

**Shared-use paths** – A two way path shared by walkers, joggers, baby carriage pushers, dog walkers, in-line skaters, and bicyclists.

**Greenway** – A greenway could be a linear ecological nature preserve but often a greenway is a shared-use path in a linear park setting. Some communities have low-volume, low speed streets called greenways.

**Sharrows** – Shared lane markings (bicycle and double chevron) painted in the vehicular lane to indicate to car drivers that the road is to be shared with bicyclists. Some jurisdictions follow a policy or practice of placing sharrows where they believe bicyclists should place themselves in the vehicular lane.

**Painted bike lane between the sidewalk curb and moving traffic** – Lines painted on the asphalt to indicate to drivers that the lane is for bicyclists. Sometimes there are bike symbols and arrows painted in the bike lane. Cars can move into or double park in a bike lane.

**Painted bike lane between parallel parked cars and moving traffic** – Lines painted on the asphalt to indicate to drivers that the lane is for bicyclists. Because these lines are painted beside parallel parked cars, sometimes a driver or exiting vehicle passenger can “door” a passing bicyclist. The bicyclist then either hits the opened door or swerves to avoid the opened door and moves into the adjacent traffic.

**Buffered bike lane** – Either a curb-side painted bike lane or a parallel-parked car-side painted bike lane that has diagonal white lines between two lines of white paint. This painted buffer is intended to indicate to drivers to not encroach on the bike lane. The buffers might be painted beside moving traffic but sometimes the buffers are also painted beside parked cars to lessen “dooring.”

**Contra flow bike lane** – A painted bike lane in which the bicyclist can ride against the direction of the vehicular traffic. For example, on a one way street in which bicyclists are supposed to only ride in the same direction as the vehicles, with a contra flow lane the bicyclists can ride against the traffic in their lane.

**Cycle tracks** (protected bike lanes) – A bicycle-exclusive path created with vertical separation from traffic or separated from traffic by being a higher level from the road. A cycle track can be between the sidewalk and moving cars or between the sidewalk and parked cars. Cycle tracks can be separated from the vehicular traffic by paint with delineator posts, raised islands, low curbs, mountable curbs, planting boxes, planting strips, or trees.

**Complete Street** – By definition Complete Streets “are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities.” Many Complete Streets include no bicycle provision or only painted bicycle lanes between the sidewalk and moving traffic or painted bike lanes between parallel parked cars and moving traffic. In these painted bike lanes, drivers drive their cars and trucks and double park. As all cars have a driver, bicyclists in painted bike lanes can be doored by exiting drivers. Thus, many Complete Streets do not provide safety to bicyclists of all ages and abilities.

## **II. Bicycle Guidelines for How to Build Bicycle Facilities**

American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of the Bicycle Facilities (2012)

National Association of City Transportation Officials-NACTO Urban Bikeway Design Guide (2013)

CROW Design Manual for Bicycle Traffic (2007)

Federal Highway Administration (FHWA) Separated Bike Lane Planning and Design Guide (2015)

Manual on Uniform Traffic Control Devices (MUTCD) Bicycle Facilities and the Manual on Uniform Traffic Control Devices (2009)

## **III. Innovations for the Bicycle**

### **A. *Bicycles***

#### **1. Copenhagen Wheel**



The Copenhagen Wheel has a rechargeable battery within the hub and a motor that is then operated by the battery. The wheel replaces the back wheel on a bike and is controlled by the bicyclist’s smart phone. As the bicyclist pedals and brakes, energy is saved that can be used if climbing a hill or carrying heavier loads. The wheel is also smart and patterns your pedaling revolutions, learning how you pedal to give you the most seamless boost when needed.

<http://copenhagenwheel.tumblr.com/image/143703290504>

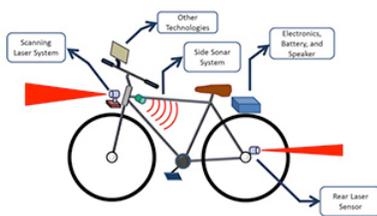
<https://www.superpedestrian.com/>

## 2. Road bicycle to power the home (Does not exist yet, perhaps)

If the Copenhagen wheel exists (link above) that generates and saves power to use later on hills and the stationary bicycle exists (link below) that can generate power to light up a home or charge cell phones during power outages, could a bicycle wheel be developed that stores the energy from pedaling or going downhill to provide power to a home? The bicyclists could opt to save the power in the Copenhagen wheel for use at home or to use the time spent bicycling (instead of sitting in one place on a stationary bike) to generate power for the house or office. Already, bicycle lights receive their power from a generator in the wheel hub or from the older bottle generator (link below). Though there is rolling resistance of the bicycle tires (lose energy) and developing nations have dirt roads and pot holes, the energy from the bicycle might power a small computer or smart phone.

<http://www.trueactivist.com/60-minutes-on-this-bicycle-can-power-your-home-for-24-hours/>  
<http://lovelybike.blogspot.com/2010/11/fondness-for-bottle.html>

## 3. Collision-warning sensor for bicycles



New cars have detectors that signal, sometimes with a sound or with a light blinking near a rear view mirror, when a bicyclist is close but at the University of Minnesota researchers have been testing a laser sensor on the bike to detect the likelihood of a collisions including rear end, right turn, or side. The bicycle attachment doesn't require that the car be equally equipped to avoid crashes.

<http://www.roadwaysafety.umn.edu/publications/news/2015/02/collision/index.html>

## 4. BSMART technology so bicycle police can warn drivers if passing closer than 3 feet



Chattanooga, Tennessee police have been testing a tool attached to the bike handlebars that indicates if a car driver has passed the bicycle closer than 3 feet. The bicycle police officer can catch up with the driver at the next light and give them a warning and information about the safe distance for passing bicyclists.

“This image shows a driver passing a police officer on a bike closer than Tennessee's three-foot law allows. New technology from BSMART shows the distance between the car and the bike in inches.timesfreepress.com”

<http://www.businessinsider.com/bmart-technology-prevents-drivers-from-hitting-cyclists-3-foot-rule-2015-6>

## 5. Button activated electronic shifting system



This may be a tool primarily for the racer but Shimano has introduced a gear shifting mechanism that is electronic. Activated with only the push of a button, the gears shift more smoothly, allowing the rider savings in energy and time. The shifting mechanism is additionally light weight.

<http://www.sporttechie.com/2014/07/24/the-many-technological-advancements-at-the-tour-de-france/>  
<http://www.trisports.com/shimano-dura-ace-di2-groupset.html>

6. Bike share bikes for children to ride, for seating children on the adult bike, or for carrying cargo



The Velib bike share in Paris now offers four sizes of bikes for children including the pedal-less scooter bike. Hangzhou, China, has one of the largest bike share programs in the world and, along with traditional shared bikes, bikes with child seats on the back and also cargo bikes are in the stalls waiting to be used.

Children using P'tit Vélib. © blog.velib.paris.fr

<http://www.lifegate.com/people/lifestyle/ptit-velib-bike-sharing-children>

<http://www.cnn.com/2014/06/18/travel/paris-bike-hire-kids/>

<http://www.irishexaminer.com/viewpoints/analysis/copenhagen--leading-the-green-city-revolution-291173.html>

7. Bicycle seat that can be raised and lowered for seniors to put down a foot



While many bike innovations have been created for the younger bicyclists, few have focused on seniors. Instead of having to pedal a three wheeled tricycle, which self-balances, or ride a regular bicycle and worry about hopping off the saddle to put down a foot at an intersection, this bicycle has a shift lever to raise and lower the seat. A bicyclist approaching an intersection could lower the seat and have her feet flat on the ground. After leaving the intersection, she could raise the seat and achieve a good seat/pedal distance for knee comfort and pedal power. This eliminates the fear of having to dismount quickly though the senior would have to learn the additional mechanism for lowering and raising the seat.

<http://www.core77.com/posts/22048/innovative-moveable-seat-design-keeps-bicycles-elderly-friendly-22048>

8. Bicycles made of bamboo to provide jobs in developing nations



Though individuals have made high end and artful bikes out of bamboo as a hobby, the bamboo bike, as promoted by Craig Calfee through his Bamboosera, has provided jobs for people in Africa. The resulting bike is high in quality and also high end and artful.

<http://calfeedesign.com/products/bamboo/>

<https://www.youtube.com/watch?v=ICwZEgkNnAY&feature=youtu.be>

## 9. “Self-filling” bicycle bottle that generates water from moist air



In locations where humidity is high, air temperature is high, pollution is low, and water is scarce, the “self-filling” bicycle bottle attached to the bike pulls moisture out of the air, resulting in drinkable water as the bicyclist rides. In about one of hour of riding, the invention produces 0.5 liters (2 cups) of water.

© Kristof Retezár

<http://www.treehugger.com/gadgets/fontus-solar-powered-bike-gadget-creates-water-out-of-air.html>

## ***B. Bicycle environment***

### 1. Bicycle roads built in developing nations using the dirt and soil stabilizers (Does not exist yet)

Bicyclists in developing nations have to bicycle on pavement or dirt with the vehicles or over an uneven footpath. Bicycling over dirt means the bicyclist has to work harder against the rolling resistance of the tires against dirt. Often, the dirt routes have pot holes so deep the post of the donated bike breaks. Bicycle roads could be created locally by combining the existing soils with soil stabilizers (including natural resins and clays). The result would be a durable, harder-surface, smooth bicycling road that could be built in rural areas between a clinic and a village. These routes could then be used for children going to school, nurses pedaling cargo bikes with supplies to a rural village, a bicycle ambulance transporting a pregnant woman to a clinic, or men and women taking goods to market. The bicycle roads could be built locally using the soil stabilizer, a road milling apparatus, and a compactor. The use of indigenous soil stabilizers, local labor, and local machinery could also be tested for maintaining and expanding the bicycle roads.

Roads for vehicles have been built in rural areas by putting soil in bags that, when placed close together, serve as the subbase. This solution might work with the heavy vehicle and fatter vehicle tires but bicycles are light and bicycle tires narrow.

[http://velafrica.ch/media/archive1/PDF\\_Deutsch/Wirkungsstudie/Measuring\\_the\\_impact\\_of\\_bicycles.pdf](http://velafrica.ch/media/archive1/PDF_Deutsch/Wirkungsstudie/Measuring_the_impact_of_bicycles.pdf)

[http://ac.els-cdn.com/S0038080613001285/1-s2.0-S0038080613001285-main.pdf?\\_tid=d759e5dc-2cde-11e6-9861-00000aab0f6c&acdnat=1465324808\\_c254dd223557fe559fcb9b975e921e1a](http://ac.els-cdn.com/S0038080613001285/1-s2.0-S0038080613001285-main.pdf?_tid=d759e5dc-2cde-11e6-9861-00000aab0f6c&acdnat=1465324808_c254dd223557fe559fcb9b975e921e1a)

### 2. Drainage ditch under a cycle track



While water can percolate into soil beside and under a cycle track, in a sudden storm or after repeated storms rain water might remain on or by the cycle track. The hardscape surface of a cycle track could be permeable but if the pores of permeable surface have filled or the subbase soil underneath has become dense, less water can be absorbed. In the Netherlands, a drainage ditch has been designed that is a V channel under the cycle track. It can be installed in long sections of a cycle track where water is a problem or near an area where water concentrates.

<http://www.fietsberaad.nl/index.cfm?lang=en&repository=Fietspad+in+de+sloot>

### 3. Colored road pavement for bicyclists



To designate a road or cycle track area as being for bicyclists, sometimes the pavement is of a different color. One option is to put a pigment into the pavement, as in the red pavement in the Netherlands. Another option is to paint the surface of the asphalt but this can wear off or be slippery. A new option is the product by Transpo Industries. The material is applied to the surface of the asphalt and comes in a variety of colors.

<http://www.transpo.com/roads-highways/safety-products/pavement-marking-material>

### 4. Antifreeze asphalt/concrete on a bicycle bridge or cycle track to melt snow

Antifreeze that is incorporated into asphalt concrete offers the capabilities of melting snow more quickly and not allowing the snow to adhere as strongly to the road surface. This antifreeze asphalt, a quick setting cement, was used on a bicycle bridge in the Netherlands. Application of the antifreeze asphalt means there is no icing if the temperatures go down to -5 degrees Celsius (23 degrees Fahrenheit). The study on the bicycle bridge in the Netherlands suggested that over a 20 year period maintenance would be lower by 11%.

<http://www.fietsberaad.nl/?section=Nieuws&lang=nl&mode=newsArticle&newsYear=2015&repositor y=Antivries+asfalt+voor+fietsbrug>

[http://en.cnki.com.cn/Article\\_en/CJFDTOTAL-XAGL201102005.htm](http://en.cnki.com.cn/Article_en/CJFDTOTAL-XAGL201102005.htm)

### 5. Solar-panel cycle track to generate power



Solar panels have been embedded into a cycle path in the Netherlands for a length of 230 feet. Though viewed pessimistically because the panels on the flat surface were not pitched toward the sun and shadows from bicyclists and trees would lessen the energy generated, the solar panel cycle track has generated power. Time will tell if maintenance issues are complex and costly.

<http://cleantechnica.com/2015/05/29/dutch-solar-bike-path-pleases-many/>

A system of solar panels has also been installed over a cycle track in the middle of a highway in Korea. The solar panels there are tilted toward the sun and would give a modicum of shade but a three lane highway is on both sides, encompassing the bicyclists in mobile source air pollution and vehicle noise.



In locations where rain is constant or sun unrelenting, perhaps the solar panels could be elevated like a carport, tilted toward the sun but also with a continuous roof to protect from rain and snow. This would resemble the full sidewalk-width storefront canopies in early American small towns and in Australia to shade patrons. This solar covered cycle track could be in a location that is not in the middle of a major highway.

<http://www.treehugger.com/bikes/bike-lane-down-center-korean-highway-covered-solar-panels.htm>

## 6. Ice and snow melted from cycle tracks using solar panel-generated power

Snow and ice on cycle tracks can be melted by solar power generated from either solar panels in the cycle track or solar panels over the cycle track. An inventor in Idaho has developed interlocking solar panels for highways but also parking lots and bicycle facilities. These solar panels could generate the power to melt snow and ice, light up the outer line of a cycle track, and power display messages. Though it would be expensive to put in solar panels the entire length cycle tracks, perhaps enough panels could exist to generate power. These panels could be connected to underground wires to heat the other sections of cycle track and melt snow.



<http://www.dailyfinance.com/2014/07/11/solar-roadways/>

<http://www.cnn.com/2014/05/12/tech/solar-powered-roads-coming-highway/>

## 7. Bicycle countdown signal with red and green numbers in the middle

Cities in China have overhead bicycle signals that include a red bicycle on the top, a green bicycle on the bottom, and a red or green countdown number in the middle. Drivers and bicyclists can then watch this bicycle signal and understand that the bicyclists have to wait (red countdown numbers in the middle). As the numbers approach 4,3...bicyclists know to get ready to pedal through the intersection. As soon as the bicycle on the bottom is green, the numbers again start with a countdown in green in the middle, alerting the bicyclists for how much time they have to pedal through. Car drivers can also use this information to know how long they have to wait before it is their turn to cross the intersection.



## 8. Protected intersection designs to lessen crashes



Conflicts between vehicles and bicycles happen most often at intersections and the protected intersection does a good job at keeping them separate and providing good visibility by drivers of bicyclists crossing. This intersection can fit within existing intersections and is affordable.

Image: City of Davis.

<http://www.peopleforbikes.org/blog/entry/americas-first-protected-intersection-is-open-in-davis-and-working-like-a-c>

## 9. Roundabouts incorporated into urban and suburban communities with perimeter cycle tracks or different levels for cars and bikes (Do not exist in quantity in the U.S.)

In the Netherlands, roundabouts have perimeter sidewalks and perimeter cycle tracks. Bicyclists who cross the roadway with exiting and entering vehicles are then seen at right angles. If bicyclists have to navigate a roundabout with the vehicles, the drivers can only see the bicyclist at an angle, greatly increasing the chance of a crash. The roundabouts with perimeter sidewalks and cycle tracks take up more right-of-way than a standard roundabout but the safety and diversity of users should warrant finding the right-of-way. A different roundabout was built in 1940 in Utrecht, Netherlands. Instead of drivers, bicyclists, and pedestrians being on the same grade, drivers are on roads above the bicyclists and bicyclist pedal through tunnels under the roads. This roundabout road and cycle track system is still heavily used. A new roundabout for cyclists was built in Eindhoven, Netherlands. Called the

Hovenring, a suspended circle hovers over the roads below, providing safe and separate passage for bicyclists separate from the cars.



(Photo Ronald Otten)

<https://bicycledutch.wordpress.com/2009/11/22/multi-level-cycle-roundabout-in-utrecht/>  
<https://bicycledutch.wordpress.com/2012/08/23/spectacular-new-floating-cycle-roundabout/>

#### 10. Canopy tent over cycle track in China to provide shade lessens red light running



A tent canopy with a sponsor's logo was placed over the end of a wide cycle track in Hangzhou, China to provide shade to waiting bicyclists at the intersection. Observations of bicyclists revealed that fewer ran red lights, even on days when it was cloudy (when they wouldn't prefer to stay in the shade).

<http://www.ncbi.nlm.nih.gov/pubmed/23348101>

#### 11. Bicyclist foot rests and Love Handles might also lessen red light running



In Copenhagen, bicyclists on cycle tracks have resting enabled and encouraged through bicyclist foot rests that allow a bicyclist to stay seated but put out one foot for balance. In Copenhagen, they have also been testing Love Handles or hand holds for bicyclists on poles beside cycle tracks. Though not studied, having these foot rests and hand holds might lessen red light running, as does the canopy in China over the cycle track.



<http://www.copenhagenize.com/2010/01/holding-on-to-cyclists-in-copenhagen.html>  
<http://copenhagenize.eu/portfolio/project38.html>

#### 12. Green intersection light activated more often and for longer for bicyclists if raining

Waiting in the rain for a bicyclist traffic light to turn and then pedaling fast through before the bicycle light changes is uncomfortable for a bicyclist compared with someone inside a vehicle. The Dutch



have installed a rain sensor on their bicycle traffic lights that, if it is raining, gives bicyclists a green light more often and also keeps the light green longer for the bicyclists to pass through the intersection. The sensors are so sensitive they can detect the difference between drizzle and snow. These sensors are installed primarily on bicycle traffic signals where a cycle track has to cross a road and there typically are many waiting bicyclists.

<http://www.eltis.org/discover/news/groningen-installs-rain-sensors-cyclists-traffic-lights-netherlands-0>

These traffic signals are costly. If at intersections it is proven that vehicle drivers don't have longer to wait while cyclists have a longer time to get through (rain or shine), then perhaps the money should be saved and the timing kept in the bicyclists favor at all times.

<http://www.aviewfromthecyclepath.com/2013/04/the-netherlands-sets-best-example-but.html>

### 13. Signals activated in Copenhagen to speed buses and bicyclists through intersections



Drivers and bicyclists would have their smart phones sensed (anonymously) and this information would inform intelligent traffic signals of traffic conditions. The result would be lights turned green and kept green longer to move buses and bicyclists along faster.

<http://citiscopes.org/citisignals/2015/copenhagen-install-intelligent-traffic-system>

### 14. Green wave or Light Companion to indicate to bicyclists to pedal a certain speed and have green traffic signals

The green wave involves small posts on the sidewalk edge in which a light can be green. If green, the bicyclists know that if they maintain their biking speed they



will arrive at the intersection and have a green light. This allows for the bicyclists to keep up their momentum. The green wave has also been tested in an LED tube that parallels the cycle track. If the bicyclist can pedal at the speed of the green light within the tube, they will arrive at a green light. These parallel-to-the cycle track light tubes also show the outline of the cycle track at night. If there is snow, the green wave small posts would better inform the bicyclist than a tube

that is covered in snow.

<https://bicycledutch.wordpress.com/2015/11/10/your-personal-guide-to-catch-the-green-light/>

<http://www.streetsblog.org/2007/11/12/in-amsterdam-cyclists-always-get-the-green-light/>

<http://www.irishexaminer.com/viewpoints/analysis/copenhagen--leading-the-green-city-revolution-291173.html>

### 15. Heated cycle tracks and a heated cycle track bridge



Roads have a variety of ways to be heated to melt snow and ice including through: a. collection of summer heat on the asphalt surface that is stored underground in thermal banks and used in winter to warm the road; b. insulated pipes under the road surface into which hot air is pumped that is leftover heat from factories or generating plants; or c. warm air, as in Stockholm on a bridge that has warm air pushed into a hollow beam under the bridge.

<http://www.dezeen.com/2013/03/01/snow-free-heated-bridge-opens-in-sweden/>

[http://www.icax.co.uk/Solar\\_Roads.html](http://www.icax.co.uk/Solar_Roads.html)

<http://www.theguardian.com/cities/2015/jul/29/how-groningen-invented-a-cycling-template-for-cities-all-over-the-world>

<http://www.aviewfromthecyclepath.com/2013/04/the-netherlands-sets-best-example-but.html>

## 16. Glow in the dark cycle track influenced by Van Gogh or glow in the dark edge lines

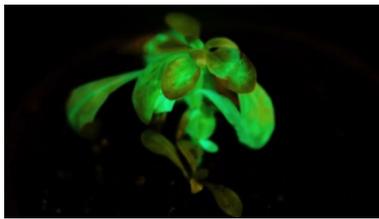
An artful surface on a cycle track in the Netherlands, as created by Daan Roosegaarde, glows in the dark with stones to which a smart coating has been applied. The polished stones are charged with daylight but also with solar lighting if there was little sunshine. While surreal, having this surface the lengths of cycle tracks would be expensive. An alternative might be using the same smart coating as lines along the edge of a right-of-way, as also designed by Roosegaarde. Currently three parallel lines along the edge of highways have been created that glow in the dark but perhaps the lines could be applied to both sides of a cycle track to keep out drivers and forewarn pedestrians that this is a bicycle space. The drivers all have headlights and the pedestrians, while they benefit from having street lights, are, by comparison not moving as fast as bicyclists.



Studio Roosegaarde

<http://abcnews.go.com/Travel/glow-dark-bike-path-inspired-van-goghs-starry/story?id=26924214>  
<http://www.dezeen.com/2014/11/12/daan-roosegaarde-van-gogh-bicycle-path-glowing-patterns-nunen-netherlands/>

## 17. Glow in the dark street trees



Daan Roosegaarde also is exploring glow-in-the-dark street trees by genetically modifying plants. Alternatively, mature trees could receive a coating of a paint that allowed the tree to glow at night. These trees could be alongside cycle tracks but, just as light pollution blocks the view of the sky, perhaps these lit-at-night trees would alter the perception of night. The trees might also have their pollution absorption capabilities altered.

<http://www.dezeen.com/2014/03/24/movie-sxsw-daan-roosegarde-glow-in-dark-trees/>

## 18. Pollution eating vacuum cleaner towers beside cycle tracks in polluted cities

Daan Roosegaarde is also exploring a tower that would pull pollution out of the air, similar to hospital purification systems. A tall tower is proposed to clean the area in a park but imagine in cities, such as Beijing or Delhi, having smaller towers line both sides of a cycle track. While drivers in vehicles are amidst mobile source air pollution, they have the advantage of being inside a car with filters. While pedestrians are also amidst mobile source air pollution, they are more removed from the tail pipe plume and their breathing rate is slower, especially in a park setting where they are at rest. Bicyclists, whose breathing rate is faster, are taking ultra-fine particles deep into their lungs. The location for these towers could, therefore, be alongside cycle tracks where, of all populations, bicyclists have the highest breathing rates. Reducing the initial production of pollution is the ultimate solution but this might extend the health of the population while sun, wind, and water energy sources are refined.



<http://www.dezeen.com/2015/09/07/daan-roosegaarde-smog-free-tower-opens-rotterdam-netherlands/>

### 19. Italian Piazza strings of lights on the edge of cycle tracks (Does not exist yet)

A street light on a pole that receives its power from a tilted solar panel has been around for a while. Placed on a cycle track, these typical sidewalk and highway lights provide pools of light. These lights could also be activated when a bicyclist is approaching and then be turned off after the bicyclist has passed. The power from the sun is free but perhaps some aesthetics are lacking. Solar panels on each light post might not work if the goal is to also have mature trees beside bicycle environments. With individual lights on poles, the dark spaces between the pools of light provide little security to someone riding alone. Italian piazzas used to have strings of lights to invite revelers to stay outside in the cool air. These strings of warm lights could be over a cycle track, guiding the way for bicyclists while universally signaling to car drivers and pedestrians that the space below is for bicyclists. These lights could also be powered by solar but the solar panels could be on the roofs of adjacent buildings, revealing only the lights that might also be strung by trees that line the cycle track.

<https://www.restorationhardware.com/catalog/product/product.jsp?productId=prod1677169>

### 20. Small light diodes along the outer edge of a cycle track in rural setting

Lighting cycle tracks especially in rural areas is complex because, like car drivers, bicyclists are supposed to have their own lights but, unlike car drivers, the lights on a bike are not as all encompassing. In rural areas, few want to pollute the sky with more street lighting. Roads for cars have reflective white paint on the outside edge of a road that can always be followed during a rain



storm. Roads also have reflective tape on guard rails that can be followed. Overhead power lines that parallel a rural road can be watched to see if the lines show the headlights from an approaching vehicle. In Copenhagen, residents who used a bicycle superhighway near a forest requested and had small diodes installed in the outside edge of the path that light the outer perimeter.

Peter Hovmand, Plot Foto

<http://citiscopes.org/story/2014/copenhagen-bicycle-super-highways-push-regional-cooperation-new-level>

### 21. Cycle Snake (bridge in Copenhagen for bicyclists) that is a work of art



Copenhagen built the orange-surfaced Cycle Snake bridge to carry bicyclists in both directions. While the bridge could have been utilitarian and transportation-inspired, the serpentine curve is a work of art. It is a joy to view from adjacent buildings and to ride.

Photo Dissing + Weitling

<http://www.dac.dk/en/dac-life/copenhagen-x-gallery/cases/the-bicycle-snake/>

## 22. Drawbridge in London only for bicyclists and pedestrians.



London built the Millennium Bridge. While beautiful, that bridge is for pedestrians-only but London recently proposed a new bridge that is for pedestrians and bicyclists. The areas by the Thames River are no longer active shipping ports with passage needed for many ships. Even so, a draw bridge was still designed to allow passage by tall ships.

reForm Architects

<http://www.standard.co.uk/news/london/revealed-ambitious-plans-for-new-88m-bridge-across-the-river-thames-a3122241.html>

<http://www.citylab.com/design/2015/11/london-bridge-pedestrian-cyclist-thames-eastern-docklands/417702/>

## 23. High Trestle Trail Bridge artful angular arches

The High Trestle Trail in Iowa has a ½ mile long bridge onto which metal frames (angled cribbing)



have been welded. Each metal frame is tilted clockwise and eventually counter clockwise from the succeeding one. In the middle of the bridge, the more tightly clustered metal frames are lighted. The art work on this bridge was designed by David B. Dahlquist.

Website Design and Maintenance by [RDG Planning & Design](#)

[http://rdgusa.com/high\\_trestle\\_trail/latest\\_news/components.html](http://rdgusa.com/high_trestle_trail/latest_news/components.html)

## 24. Skycycle, elevated bicycle super highway, proposed for London

Similar to elevating highways (Boston - removed), streetcars (L in Chicago remains while elevated streetcars in Boston were removed), or pedestrians walkways (some remain in Cincinnati while others in Detroit were removed), the idea of elevating bicyclists is proposed in London's Skycycle. This Skycycle is located over the train lines in suburban areas. This design begs the question of the length



of Skycycles and giving access to bicyclists who might live in adjacent houses or want to go to work in adjacent buildings. If the Skycycle has gradual ramps to ride up and down, the ramps have to be sufficiently long to have a manageable grade. The appearance of the Skycycle should be appealing from the ground and from adjacent houses, unlike the early elevated train tracks. Shorter Skycycle sections might be built that would connect to on-road separated facilities.

Foster + Partners and Space Syntax

<http://www.fosterandpartners.com/ar/news/archive/2013/12/skycycle-proposals-to-create-safe-new-cycle-routes-throughout-london/>

<http://www.theguardian.com/artanddesign/architecture-design-blog/2014/jan/02/norman-foster-skycycle-elevated-bike-routes-london>

## 25. Bicycle escalator

Bicycle stairs with a parallel V ramp are well known but some climbs are too long or steep to have to push a bike up the V ramp. In Nijmegen, Netherlands, a regular escalator has been installed and bicyclists are allowed to take their bikes on the escalator, positioning their tires wherever they wish.



[https://commons.wikimedia.org/wiki/File:Bicycle\\_stairs\\_Nijmegen\\_%28NL%29.JPG](https://commons.wikimedia.org/wiki/File:Bicycle_stairs_Nijmegen_%28NL%29.JPG)  
<https://bicycledutch.wordpress.com/2009/10/16/cycle-bridge-in-nijmegen-netherlands/>

Trondheim, Norway has a novel escalator for bikes in that the bicyclist puts his right foot on the pedal lift and then sits on his bicycle and rides up, propelled by the push from the pedal under his right foot.



<http://www.earthporm.com/norway-builds-worlds-first-bike-escalator/>

Though most escalators have stairs, if the rise is not too great, the escalator could resemble a moving sidewalk that is tilted, as exist in the Rotterdam.



<https://bicycledutch.wordpress.com/2014/08/07/bicycle-parking-at-rotterdam-central-station/>

## 26. Cycle tracks through buildings



Just as train stations sell air rights to build high rise building over the tracks, a cycle track could have a building overhead. This design idea is also similar to having air development rights over buildings or roads. The length of the cycle track could be long, with special bike entrances for bicyclists, or short. The historic Rijksmuseum in the Netherlands, built in 1885, recently restored the cycle track that passes through the museum.

<http://bikeportland.org/2013/06/08/hovenring-and-rijksmuseum-path-two-wonders-of-the-bicycle-world-88082>

A building cut-through with a short cycle track exists in Erlangen, Germany.



## 27. Cycle tracks as part of buildings – 8-House and Denmark Pavilion by Bjarke Ingels

Shaped like a bow tie, Bjarke Ingels Group, BIG, designed the 8-House with a bicycle path as an integral part of the building. Bicyclists can ride up to their apartment and back down to work on a path that skirts through and around the building. The bicycle path, seen on the far left in the left picture, is less steep than the stairs that rise beside the bicycle path. The bicycle path surface is patterned tile.



<http://www.greenroofs.com/blog/2011/09/03/gpw-8-house-8-tallet/>  
<http://www.archdaily.com/83307/8-house-big>

In Shanghai for the Expo 2010, BIG designed the Denmark Pavilion that includes an interior and exterior ramp system on the building's perimeter for bicycling to the top and back down on bicycles provided at the pavilion.



<http://www.archdaily.com/57922/denmark-pavilion-shanghai-expo-2010-big>

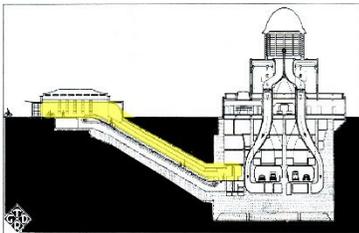
**28. Using abandoned tunnels for bicycle highways.**



London has old train tunnels that could be converted to routes for bicyclists, thus avoiding the conflicts with vehicles above ground. Not all cities have networks of old tunnels but perhaps some have large sewer channels that have been abandoned that could be greatly cleaned and used for bicyclists.

<http://www.fastcodesign.com/3042054/slicker-city/architects-want-to-turn-old-subway-tunnels-into-an-underground-cycling-highway?partner=rss>

**29. A tunnel under a river only for bicyclists as in Rotterdam with the Maastunnel**



To provide passage for bicyclists under the New Meuse River, the tunnel was built between 1937 and 1942. Escalators are ridden with bicycles to go down below the water and to go back up the bank on the other side. Pedestrians have their own tunnel so bicyclists can ride fast and not have to worry about pedestrians, as on a shared-use path.

<https://bicycledutch.wordpress.com/2011/03/29/maastunnel-rotterdam/>

**30. Place a façade of storefronts on the front or parking garages and have cars enter from the back**

In Miami, the Miami 21 Zoning Code recommends as one of its principles of good planning the hiding of parking garages with a façade of storefronts. The parking garage then has many windows and doors which make the street more inviting than only having the sides of a parking garage. To provide safe bicycle infrastructure on the street with this storefront façade, drivers should enter the parking garage from the back, leaving the street for bicyclists (ideally in a cycle track), pedestrians, and a few cars. (See last image in this link and wait until it fades to the parking garage façade)

<http://www.miami21.org/IllustratedGoodPlanning.asp>

**31. LED bus island in Copenhagen to alert bicyclists of disembarking passengers**



In Copenhagen, bus stops are preferred that offer a full island for waiting bus passengers but often the street is not sufficiently wide. Lights in a line that parallels the cycle track will be green when there is no bus at the bus stop but lights will be activated across the full cycle track when bus passengers have priority.

Photo Credit: City of Copenhagen/Rambøll

<http://cleantechnica.com/2014/09/18/copenhagens-new-led-bus-stops/>

**32. Differently-colored LED bus lanes to show when for buses and when for bikes**

In this application, the bus lane would have different colors for whether it was rush hour (bus in operation) or not rush hour. If the bus is not in full operation, the lanes are colored to be bike lanes.

<http://www.irishexaminer.com/viewpoints/analysis/copenhagen--leading-the-green-city-revolution-291173.html>

33. Moveable jersey barriers or changing lights to widen and narrow cycle tracks (Does not exist for bikes)



Highways have zipper barriers that can be moved to provide more lanes for incoming city traffic and outgoing city traffic. Highways also allow drivers to drive on the breakdown lane during rush hour. Copenhagen has lighting to indicate if a bus lane is needed for buses or if it can be used for bicyclists. As there are more bicyclists approaching a city during morning rush hour and more leaving a city at the end of the day, perhaps expanding/shrinking cycle tracks could be explored to accommodate numbers of commuting bicyclists just as vehicle drivers are accommodated.

34. Remote cameras to record license plates and ticket drivers for double parking (Does not exist in the U.S.)

In Shanghai, China, cameras are installed that look at intersections and also at painted bike lanes to capture license plate numbers. If a driver goes through a red light or drives in a painted bike lane they



are sent a fine. In the U.S., one great danger to a bicyclist is a double parked car or truck in a painted bike lane. To get around the double parked vehicle, the bicyclists has to look over her left shoulder, merge into traffic, and then merge back into the bike lane. To discourage drivers from double parking in the painted bike lane, police have to spend time ticketing drivers. Sometimes, the police are the ones with a cruiser parked in the painted bike lane. Cameras could be pointed toward the license plates of vehicles in painted bike lanes or double parking. The owners could be sent a ticket. Instead of having the funds for these tickets put into a general municipal fund, the funds could be relegated to building safe bicycle environments.

35. Increase (not decrease) car parking quotas in new parking garages and sell the parking spaces to adjacent home owners (Does not exist in the U.S.)

Many communities are now encouraging developers to install fewer car parking spaces (0.5) per dwelling unit instead of more car parking spaces (3.0) per dwelling unit. The purchasers of these now-more affordable housing units are storing their cars on the street where wide cycle tracks could be built. The roads are a public right-of-way and should not be used 24/7 by owners of cars. Many individuals, especially young families, will still need a vehicle. Therefore, instead of having them park on the side of the road, they should be given the option of buying a parking space in the nearby parking garage. They would own their parking space and follow the same principles as if they owned a small condo (pay taxes on the space, pay a modest condo association fee, etc.) Cities in Europe that have wanted to discourage cars from being parked all over the city, have built parking garages or purchased surface lots to get the cars off the sides of the road. Denmark has been taking parallel parking spaces and installing cycle tracks but the issue becomes where do the cars park that once were parked on the side of the road.

<http://www.irishexaminer.com/viewpoints/analysis/copenhagen--leading-the-green-city-revolution-291173.html>

**36. Lovers Lane, Date Night, side-by-side Bakfiets, or Conversation Lane-width cycle tracks with room for others to pass (Does not exist in the U.S.)**



The standard in the U.S. is to have cycle tracks that are about 6 feet wide with some buffer space on both sides. Individuals on sidewalks, in cars, and on mass transit can be side-by-side and talk but bicyclists are supposed to not have friends or children. While a bicyclist could shout to a bicyclist in front or back, a parent bicyclist prefers to put a hand on the back of their child and have them beside them. Two parents with Bakfiets should be able to bicycle side-by-side and have another bicyclist pass them. This

should be the starting standard instead of always squeezing in 6 feet of space for a single person cycle track. Copenhagen is proposing to build bicycle lanes (cycle tracks) that are four bicyclists wide. The current cycle tracks are three bicyclists wide.

<http://www.irishexaminer.com/viewpoints/analysis/copenhagen--leading-the-green-city-revolution-291173.html>

**37. Unisex-family bathrooms that accommodate a bicycle inside (A few are big enough)**

When highways started to be built in the U.S., it wasn't long before gas stations appeared and these often offered bathrooms. Bicyclists, like car occupants, are transporting themselves but they won't stop to buy gas. Without the possibility of making a profit from selling gas, the bicyclist, unlike the car occupant, has few opportunities to use a public rest room because no business owner profits from the bicyclist unless they sell them food. Having a bathroom is not an issue if the bicyclist is just commuting a short route from home to work but if a parent is trip chaining with children, a public bathroom will be necessary. Large public bathrooms are now routinely provided for handicapped access. Perhaps public bathrooms could be built that would allow the person to wheel their bicycle into

the bathroom, eliminating the need to lock a bicycle. If a parent could take a bicycle into a bathroom with a child still seated on the back, it would resemble a unisex family bathroom with a changing table. At least a few of the public bathrooms could accommodate the bicyclist, their child, and their bicycle. With the aging population, this family bicycle bathroom could also serve senior citizen bicyclists. Perhaps these public bathrooms could be dual handicapped accessible/family-with-bicycle bathrooms.



City of Portland

<http://www.citylab.com/design/2012/01/why-portlands-public-toilets-succeeded-where-others-failed/1020/>

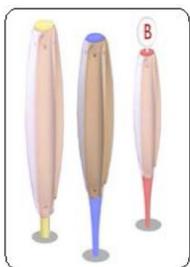
**38. Universal stencils painted on pavement for bicyclists way-finding (Does not exist in the U.S.)**



Signs on posts often resemble sign graffiti, or if billboards labeled "litter on a stick," and adding more signs is not desirable for an aesthetic community. Bicyclists have one advantage over car occupants because they are always looking at the pavement for uneven surfaces. Universal stencils could be developed that wouldn't clutter the view upright but that could guide the bicyclists to a bathroom, bike repair shop, coffee shop, grocery store, or to another community, as least when there isn't snow on the ground.

These stencils would have to be repainted but the kind act of giving information to bicyclists would be appreciated in level equal to or above the amount of time spent in re-stenciling.

### 39. Power generated for cycle tracks from small aesthetic vertical wind turbines on delineator posts or light posts



Solar power has been the mainstay-off-grid power source used in multiple bike innovations (solar panels on light poles, on the cycle track surface, and overhead) but, looking at what exists on a cycle track, two other items might be considered. The delineator posts are currently unattractive plastic posts that sit between the vehicular traffic and the bicyclists. Instead of being a static-non-contributing post, perhaps the delineator posts could be small vertical wind turbines and generate power through regular wind but also the wind of passing vehicles.

Jonathan Harris

<https://cdn1.sph.harvard.edu/wp-content/uploads/sites/1008/2013/09/pushing-the-design-boundaries.pdf>



Some vertical wind turbines are extremely attractive and might be aesthetically preferable to having tilted solar panels on the top of street lights. These vertical wind turbines on light posts would also create a signature “look” for cycle track, especially due to the phenomenon of “sign waving” (signs that are hung from hooks that blow in the wind and that then are seen as a result of human’s attention to fascination).

<http://cleantechnica.com/2014/04/07/vertical-axis-wind-turbines-great-1890-also-rans-2014/>

### 40. Internally lit X-Last LumArt Bollard – Krola



Unlike the cylindrical plain plastic delineator post that takes away the aesthetics of a downtown area or a residential street, X-Last has developed a flexible delineator post that lights up from a LED light placed in the ground. The LED light shines up into the cavity of the delineator post, casting a warm glow. The Krola is most reminiscent of the English bollard, a classic feature that could lend class to the bicycle.

<http://www.moodie.com.au/?product=x-last-lumart-bollard-krola>

<http://trafficproducts.gr/en/traffic-products/road-safety-products/bollards/x-last-bollards/krola-detail>

### 41. Bicycle-oriented development (Does not exist in the U.S.)

Transit oriented development (TOD) has also been called “Mall oriented development” due to the location of shops by the transit stops in addition to the dense housing. Bicyclists are sometimes provided with safe ways to bicycle to the TOD and sometimes the TOD apartment buildings include bike parking in the basement garage. Development has never, though, been solely focused on the bicycle, especially for the young and old (Bicycle Oriented Development – BOD).

**42. Bicycle piazzas as social gathering places centered on the bike (Does not exist in the U.S.)**



Piazzas in Italy are for pedestrians who want to stroll or sit at sidewalk cafes. Bicycle piazzas that are centered on the needs of the bicyclist do not exist. Instead, the bicyclists can use a pedestrian piazza, parking their bike in a rack far away. In the bicycle piazza, a bicyclist would be able to have their bicycle beside them, as a Social Bridge to start a conversation. They would be able to even lock their bike to the back of the café chair because no one would carry away a bicycle locked to a chair. Around this piazza would be self-vendor establishments so the bicyclist could get their coffee and walk back to sit at their table, avoiding the need for wait-staff to have to walk between a sea of bikes.

**43. Social Bridges for the biker that enable a positive interaction between strangers (Does not exist fully in the U.S. as a strategic design component)**

A Social Bridge is something in the built environment that makes it easy to have an eye glance or say hello to a stranger. A door is a Social Bridge because it can be opened and the other person has the opportunity to say thank you. A dog can be a Social Bridge. In biking, the bike share can be a Social Bridge because a veteran renter could help a novice take out a bike and raise the saddle. A map of the city with the best bike routes could be a Social Bridge because someone could, as in triangulation, use the map as to ask someone about the best route. There are five types of Social Bridges (Anne Lusk): 1) Assist; 2) Connect; 3) Observe; 4) In Absentia, and 5) Information.



**44. Family-friendly bike streets as measured by children and seniors (Metric does not exist in the U.S.)**



Streets are measured for Level-of-Service based on low to high traffic congestion and now some measures are evolving about level of stress for bicyclists. In Crime Prevention Through Design (CPTED), the best way to measure safety of an environment is to ask an older female senior how she perceives safety in the dark alley or walking through the park at night. Her perception will be completely different from the perception of an able bodied full-sighted younger male. Streets should be built based on the eye sight and capabilities of children and seniors and the adults should be invited to use their Family-friendly bike environment.

**45. Safe Bike Routes to School and Safe Bike Routes to Play (Does not exist in quantity in the U.S.)**

Safe Routes to School are intended to provide safe ways for children to walk and bike but the default mode has become walking and the default facility the sidewalk. Children are healthier if they can bike to school. Communities should develop cycle track networks to the schools with child-appropriate intersections. As children want to be free-ranging and get to the playground, communities should also develop safe ways to bicycle to the playgrounds and parks.

#### 46. Signature art incorporated into bike facilities (Does not exist)



When Paris introduced the metro, Art Nouveau entrances to the underground stations were placed throughout the city. These entrances signaled that the underground metro was a place of sophistication and elegance. The bicycle has been associated with design elements from highways, i.e., paint, plastic delineator posts, street lighting. Perhaps the entrance to a cycle track and the barrier beside the cycle track could be as artful as the Paris metro entrances.

[https://en.wikipedia.org/wiki/Paris\\_M%C3%A9tro](https://en.wikipedia.org/wiki/Paris_M%C3%A9tro)

<https://www.khanacademy.org/humanities/becoming-modern/symbolism/v/hector-guimard-city-entrance-paris-m-tropolitain-c-1900>

#### 47. Painting cycle tracks or adding whimsy



Though solid colored cycle tracks (grey, green, or red) that only have a bicycle stencil, a directional arrow, and maybe a middle line (two way), are not confusing to a bicyclist, perhaps some novelty could be considered if the art enhances the streetscape. Montreal, through photo shop, is exploring the reaction to art on the cycle track.

<http://www.mtlblog.com/2016/04/montreal-could-be-first-city-to-let-street-artists-paint-bike-paths/#>



One major issue is surface color and paint can fade. If the surface material is integral to the asphalt mix (red in the Netherlands), the color won't wear off as with paint. If a bicycle symbol is painted, it will wear off faster than a bike stencil in preformed thermoplastic but those, especially in wet weather, can be slippery.

<https://www.bikeauckland.org.nz/cars-parking-bike-lanes/>

#### 48. Wayfinding for bicyclists with a colored (dashed) line on the side of the cycle track (one way) or in the middle (two way) as in subway lines and hospital hallways (Does not yet exist.)



Subway maps often included colored lines to indicate where each subway line starts and ends. Looking at a map, the user knows which subway to take to their destination. If they want to end at a different destination, they switch to a differently colored subway line to arrive at that destination. Hospitals use colored lines in the hallways to help with wayfinding. In a city with a networked system of cycle tracks and paths, perhaps a small painted intermittent rectangle could be painted on the outside (one way) or the middle (two way) to show that main route. A map, like a subway map, could help bicyclists with wayfinding. Perhaps a main route could have a fatter colored dashed rectangle and a secondary route a smaller dashed rectangle.

[http://www.mbt.com/schedules\\_and\\_maps/subway/](http://www.mbt.com/schedules_and_maps/subway/)

## C. Bicycle parking

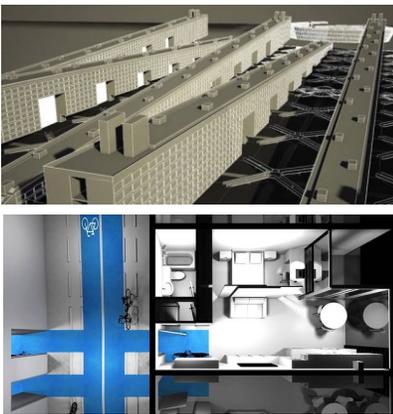
### 1. Place to park cargo bikes in a bike parking station



In Malmo, Sweden, 30% of the people in the city bike to work or school. With the high percentage of bicyclists, a state-of-the-art bicycle parking station needed to be built by the train station. The one in Malmo includes lockers, a shower, rest rooms, air pumps, a bike shop, space for more secure bike parking by subscription, a train-waiting area, and train times but it also includes parking spaces for cargo bikes.

<http://www.copenhagenize.com/2014/02/malmo-opens-fantastic-bike-parking-at.html>

### 2. Bike arrival/departure and parking in a building facilitated through tilted floors



Buildings for living and working have been designed for the pedestrian walking on a flat surface, stepping onto the flat step on an escalator, or walking into a flat-surfaced elevator. Car parking garages, if designed cleverly, offered slanted floors so cars were driven up or down on the garage floors instead of in space-using spiral drives. The same car parking idea has been applied to apartment housing by Steven Fleming, Ph.D. so bicyclists could pedal to their front door, park inside their apartment easily, and coast back out to the street on tilted hallways.

<http://www.treehugger.com/urban-design/cycle-tracks-will-abound-velotopia-architect-proposes-new-building-type-designed-around-bikes.html>

### 3. Cylindrical bicycle parking by automated underground elevators at Kasai Station in Tokyo.

To eliminate the chaos of having bicycles parked on the sidewalks, at Kasai Station in Tokyo a system of underground automated cylinders were installed that accept a member's bike at the elevator door. The bike is clamped and pulled into the elevator and taken down to the available storage slot in the cylinder. When the bike needs to be retrieved, the bicycle owner uses their card to call up their bike. The major downside to this system is it is completely reliant on electricity. In the event of a power failure, all the bike owners would not be able to pedal home because they couldn't retrieve their bicycles.



[http://www.toa.jp/works/transit/kasai\\_station\\_underground\\_bicycle\\_parking\\_lot.html](http://www.toa.jp/works/transit/kasai_station_underground_bicycle_parking_lot.html)  
<http://cozybeehive.blogspot.com/2009/06/how-its-made-nishi-kasai-underground.html>

4. Outfitted green bicycle parking modules installed as part of all city parking garages. (Does not exist yet).



Developers of parking garages have produced certification standards for green parking garages. These include basic provisions for bicycle parking but not all developers will include state-of-the-art bicycle parking. Therefore, bicycle parking modules, rather like pre-constructed mobile homes or deluxe port-o-potties used at weddings, could be created and inserted on the ground floor of all parking garages. Basic modules could include simple bicycle parking with only racks, lights, and windows for visibility. Additional bike parking modules could include showers and changing rooms.

<http://www.greenparkingcouncil.org/certified-green-garages/certification/>

5. Bicycle parking in office complexes (Does not yet fully exist)



Guidelines for parking bicycles in multi-story residential buildings, office complexes, stores, and schools exist but the primary focus is on a bike rack outside or inside. Office buildings could instead offer freight elevators and escalators that bicyclists could use to get their bicycles to their desks. At each desk, especially in an office of office cubicles and carrels, a slot could be provided that is for the worker's bike to be parked. They could then have access to their papers, etc. stored on their bike, rather like having a brief case that is carried to the desk.

[http://www.changelabsolutions.org/sites/default/files/Getting\\_the\\_Wheels\\_Rolling\\_Toolkit-FINAL\\_20130823\\_0.pdf](http://www.changelabsolutions.org/sites/default/files/Getting_the_Wheels_Rolling_Toolkit-FINAL_20130823_0.pdf)

6. Standards for bicycle parking based on the capabilities of children and seniors (Does not exist in the U.S.)



Bicycle parking is often designed by fit young males who prefer to park their lightweight bike from the ceiling or on the wall as a tech-inspired space saver. Seniors and children cannot lift their bicycles to hook them high. They also cannot put a bike on the top tier of tiered bike parking. While there can be sections for parking bikes by young fit people, there should also be sections where the bike parking standards are geared for children parking their bikes or seniors resting their bikes. These areas might be easier and more convenient and thus prone to use by others. Therefore, the majority of the bike parking should be geared toward children and seniors.

7. Bike parking in the school and home that is as bike centric as car parking (Does not exist)

Elementary schools, high schools, and colleges provide ample car parking spaces for teachers and staff but the bike parking is often a few outdoor racks. The bike parking should be extremely superior to car parking to motivate commuters to arrive by bike. The bike parking could be inside with lockers beside each bike. This still would be less square footage than is provided to vehicle owners who also have to have space provided for pulling in and out of a parking space and driving within the parking lot. Bike

parking in the home could also be better than the interior car parking space. For every amenity (automatic door opener, inside, overhead lighting, door to the kitchen, etc.) for the car, the amenity provided to park a bike should be better.

## ***D. Climate Change***

### 1. Building parks in Copenhagen that can become ponds

In the U.S., greenways/shared-use paths were often located in low lying areas that were prone to flooding. Buildings could not be constructed in these low lands and, rather than just deem the land as flood plain, the goal was to have a useful purpose for the land when the land was not flooded (hockey rink or ballfield). During a flood, the water would be held there but eventually sink into the ground or, on a gentle grade, return to the adjacent river. Designers in Copenhagen have expanded on the simple principle and designed parks that capture rain water with umbrellas and hold water in flexible panels on which children can jump. If integrated with a cycle track, the cycle track could be placed on higher ground around the flood prone area so the cycle track was always



above water, even during flooding.

<http://citiscopescope.org/story/2016/why-copenhagen-building-parks-can-turn-ponds>

### 2. Involve fire, police, and public works departments in design charrettes for the bike (Does not exist yet)

Often after plans have been drawn the fire department is shown the plans and asked to respond. They may then say that, with cycle tracks, the street is too narrow for passage by fire trucks, ambulances, etc. With Climate Change involving weather related disasters and the fire and police departments in charge of emergencies, perhaps they could be asked to design safe bicycle infrastructure instead of just individuals with the transportation department.

### 3. Signed emergency evacuation routes by bicycle (Does not exist yet)



Cities established evacuation routes for vehicles and signed these routes. Weather disasters have shown that roads become quickly clogged with vehicles, either as a result of traffic jams and/or because people ran out of gas and couldn't move their cars. Plans have also been developed to evacuate communities by walking but few plans have been developed for evacuating a city by biking. The highest land could be assigned as the evacuation route by bicycle with signs along the way. At intermittent locations, solar panels with outlets could be available for recharging cell

phones and bike lights. Signs along the way could indicate public areas (shelters, bathrooms, water from a manual pump, bike pumps, etc.).

#### 4. Shared resources for disasters that includes bicycle-related components

Amongst shared resources for disasters (portable phone, message board, traffic cones, etc.), other items that could be included are bicycle generators, cargo bikes for carrying water or medical supplies, bicycle ambulances, bicycle pumps, bicycle tools, and containers to carry water, Bakfiet bikes to evacuate children, etc.

<http://www.mapc.org/sites/default/files/Whole%20Calendar.pdf>

#### 5. Bike Bus or buses in which bicyclists bring their bicycles inside

Many say they cannot bicycle because the distance is too far. Their preferred option is to drive, further increasing mobile source air pollution. With the Bike Bus, the bicyclists can pedal in a large catchment area (larger than for pedestrians) to the Bike Bus “port” where the quick-return ferry sits. The Bike Bus is driven, ideally on a Bus Rapid Transit (BRT) route, to the other “port” where bicyclists are left in another large catchment area. A bicycle shuttle that carries bicyclists in a van with bikes in a trailer exists on Cape Cod to transport bicyclists a distance is too far to ride for some.



Cape Cod National Seashore

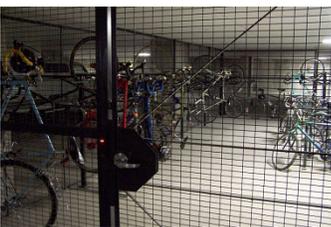
<http://www.capecodtimes.com/article/20120616/NEWS/206160322>



In San Francisco, a bicycle van carries bicyclists from Oakland to San Francisco over the Bay Bridge (and not in the tunnel) with 14 bicyclists inside the van and their bikes on a trailer. One rider of the Caltrans bike shuttle said of the fellow passengers, “My people. Bike people.”

<https://spoaktown.wordpress.com/2011/03/20/the-bike-shuttle/>

#### 6. Bike parking that will not flood and in which bike are accessible without power (**Does not exist**)



United States Environmental Protection Agency

To evacuate a city by biking, residents must know they can gain access to their bikes. If their bikes are in a basement cage and the basement is flooded (break away walls), then the bikes are not available. If any bike cage has a swipe mechanism powered by electricity, then the bicyclist cannot get their bike.



If the resident is a member of a bike share, they might not be able to take out a bike unless the bike share station is powered by solar panels. Bikes should be accessible in disasters.

<http://movabilityaustin.org/2013/10/the-uses-for-bike-share-that-no-one-saw-coming/>