

URBAN GROWTH IN COPENHAGEN:

Addressing Challenges Through Regional Urban Design

John M. Maternoski
University of Oregon
2013



ABSTRACT

Copenhagen, Denmark's capital city of 500,000 enjoys a rich history of great success for its architecture, design, and urban planning. The city's "five finger plan," developed in 1947 by Steen Eiler Rasmussen is one of the most widely-recognized urban plans in the world. Addressing a set of 10 challenges facing Copenhagen in the mid-1940s, the plan allowed for controlled suburban growth of the city, while ensuring space was left open for recreational and agricultural activities. 60+ years later, the plan has lost its merits as a feasible urban plan. Growth and suburban sprawl have pushed the length of the fingers well beyond their limits as reasonable growth guidelines, and the city is facing an entirely new set of challenges led by the rise of technology and the advent of global climate change.

In 2010, Copenhagen's own innovative architecture and urban design firm BIG presented a sweeping plan to not only create guidelines for Copenhagen's future development, but used the plan to address a set of 10 entirely new challenges. The plan presents interesting, unique, and sustainable ideas for addressing the needs of and connecting not only the city of Copenhagen, but the entire region surrounding the Øresund Strait, including Denmark and Sweden. These strategies offer a glimpse into ground-breaking urban design in the 21st century.

INTRODUCTION TO COPENHAGEN

| | |
|------------------------|---|
| About | 4 |
| Bike Culture | 7 |
| Climate Change Culture | 7 |

COPENHAGEN'S PAST: THE FINGER PLAN

| | |
|------------------------|---|
| The "Five Finger Plan" | 8 |
|------------------------|---|

COPENHAGEN'S PRESENT: URBAN GROWTH

| | |
|---------------|----|
| Urban Growth | 9 |
| Urban Renewal | 10 |

COPENHAGEN'S FUTURE: LOOP CITY

| | |
|------------------------------------|----|
| Loop City Introduction | 12 |
| Loop City Challenges | 15 |
| Challenge 1: Mobility | 16 |
| Challenge 2 : Energy | 18 |
| Challenge 3 : Waste | 20 |
| Challenge 4 : Water | 22 |
| Challenge 5 : Global Warming | 24 |
| Challenge 6 : Biodiversity | 26 |
| Challenge 7 : Re-Industrialization | 28 |
| Challenge 8 : Health | 30 |
| Challenge 9 : Food | 32 |
| Challenge 10 : Migration | 34 |

APPENDIX A

| | |
|--------------------|----|
| Loop City Critique | 36 |
|--------------------|----|

APPENDIX B

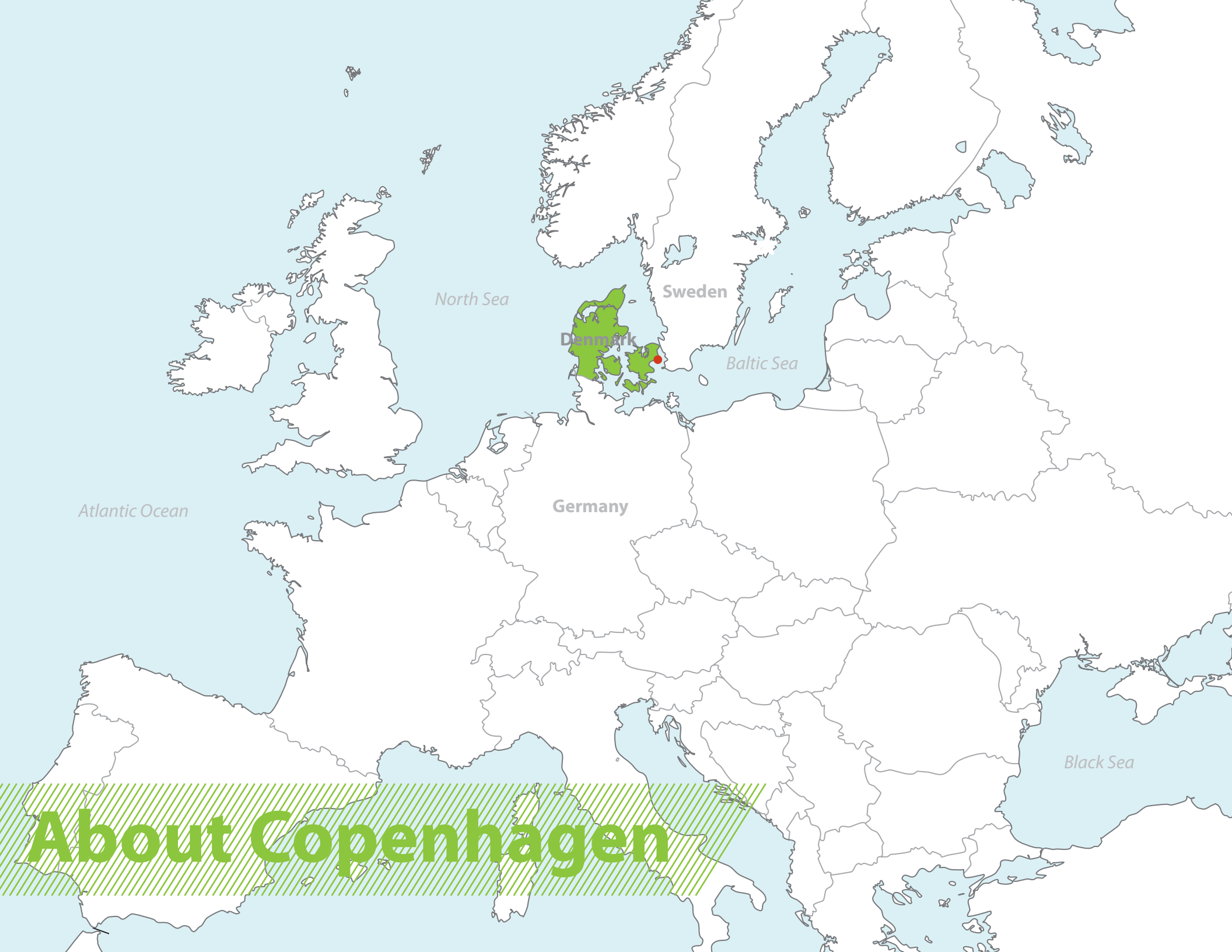
| | |
|-----------------------|----|
| Urban Design Charette | 38 |
|-----------------------|----|

APPENDIX C

| | |
|----------------------------|----|
| Loop City Proposal Updates | 45 |
|----------------------------|----|

APPENDIX D

| | |
|--------------|----|
| Bibliography | 47 |
|--------------|----|



North Sea

Sweden

Danmark

Baltic Sea

Atlantic Ocean

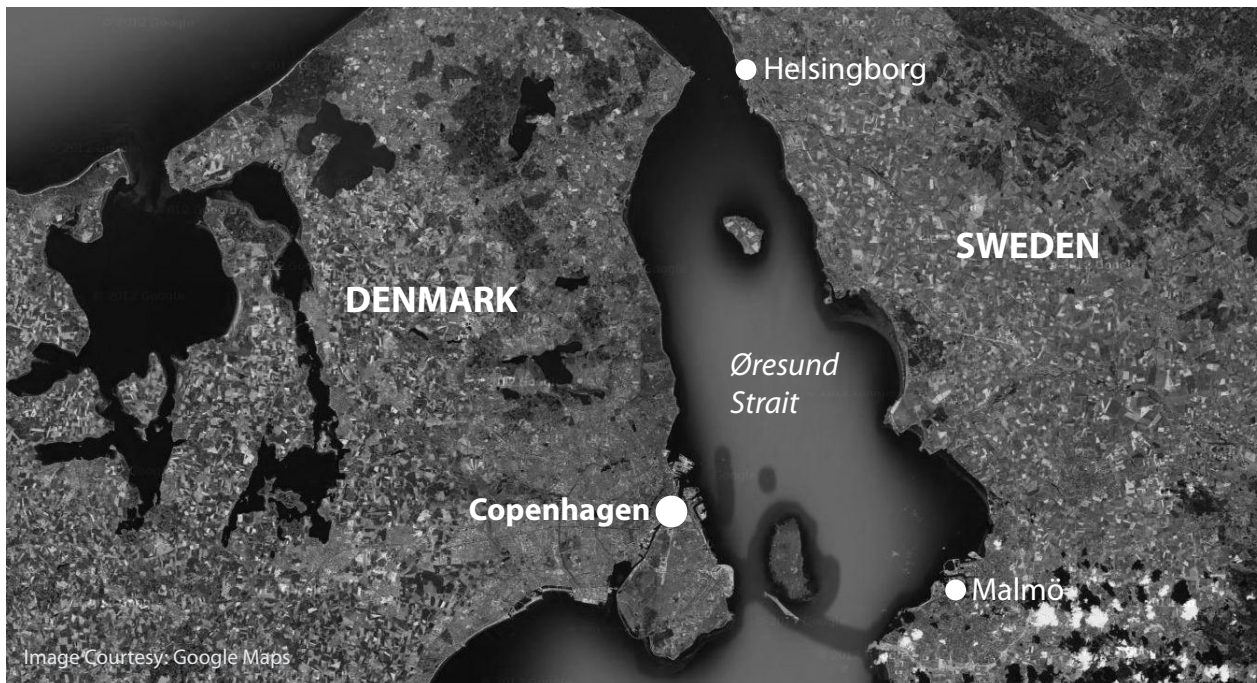
Germany

Black Sea

About Copenhagen

ABOUT COPENHAGEN

The capital of Denmark, Copenhagen is a city with an urban population of 500,000 and a metro population of 1.7 million (2009 statistics.)¹⁰ Copenhagen is located on the eastern coast of Denmark, a country bordered to the south by Germany and to the east, across the Øresund Strait, by Sweden. Denmark and Germany are linked via land mass, while Denmark and Sweden are connected via the Øresund Bridge, a four-lane traffic and rail bridge opened in July of 2000.



While the country of Denmark is known for its natural beauty, including its generous amounts of coastline beaches and fjords, the city of Copenhagen is perhaps best known for the beauty of its built environment. The city is known for its beautiful architecture, both old and new, taking on the forms of castles, canals, palaces, churches, and monuments¹³. The city is also known for its urban parks and for the ease with which one may travel between all of its unique attractions¹³. Walking and bicycling are primary modes of transportation in the city¹³, which also boasts a highly developed mass transit system, which will be further discussed later in this text.



Copenhagen Culture

COPENHAGEN CULTURE

Bike Culture

Copenhagen enjoys a very prominent bike culture, and supports this culture through several initiatives and infrastructure investments. Components of Copenhagen's bike infrastructure include free bike sharing services, bike parking complexes, and traffic lights both designated for bikers and timed to favor their speed and pace¹². In addition, Copenhagen contains around 250 miles of bike lanes and greenways, all well-maintained and many of which are maintained at a priority level higher than nearby traffic lanes¹². Designated bike crossings at major intersections are also a prominent feature of Copenhagen's bike infrastructure, as is the raised level of bike lanes in comparison to adjacent traffic lanes⁴ (see figure 1.)

Copenhagengers:¹¹

- 90% own a bike
- 53% own a car
- 58% use a bike daily
- 37% commute daily on a bike*

**Copenhagen aims to increase this statistic to 50% by 2015 through additional investments in bicycle infrastructure.*

Climate Change Culture

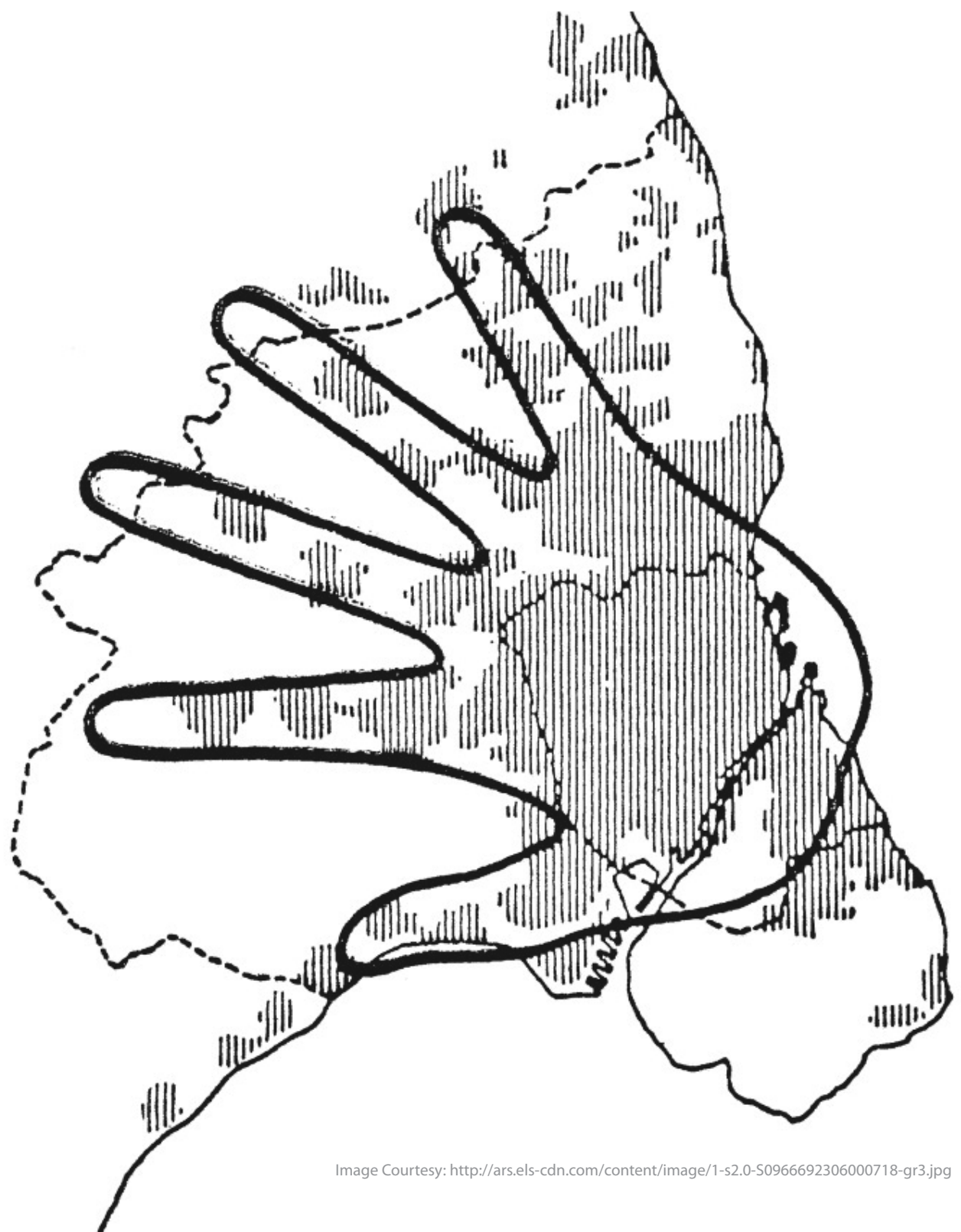
Not only is Copenhagen known for reducing carbon emissions due to its successful bike culture (which reduces CO₂ emissions in the city by 90,000 tons annually,⁴) but Copenhagen has aggressively taken on the challenge of addressing multiple aspects of climate change. The host city of the 2009 UN Climate Change Conference, Copenhagen currently has laws in place to reduce CO₂ emissions by 20% over just the next five years³. Additionally, Copenhagen gets significant amounts of power from wind and other renewable energy sources, and heats 75% of its homes with district heat, rather than each individual home relying on oil as a source of heat³. Copenhagen's dedication to the natural environment will be shown throughout the pages and plans that follow in this text.



Street Section

THE “FIVE FINGER PLAN”

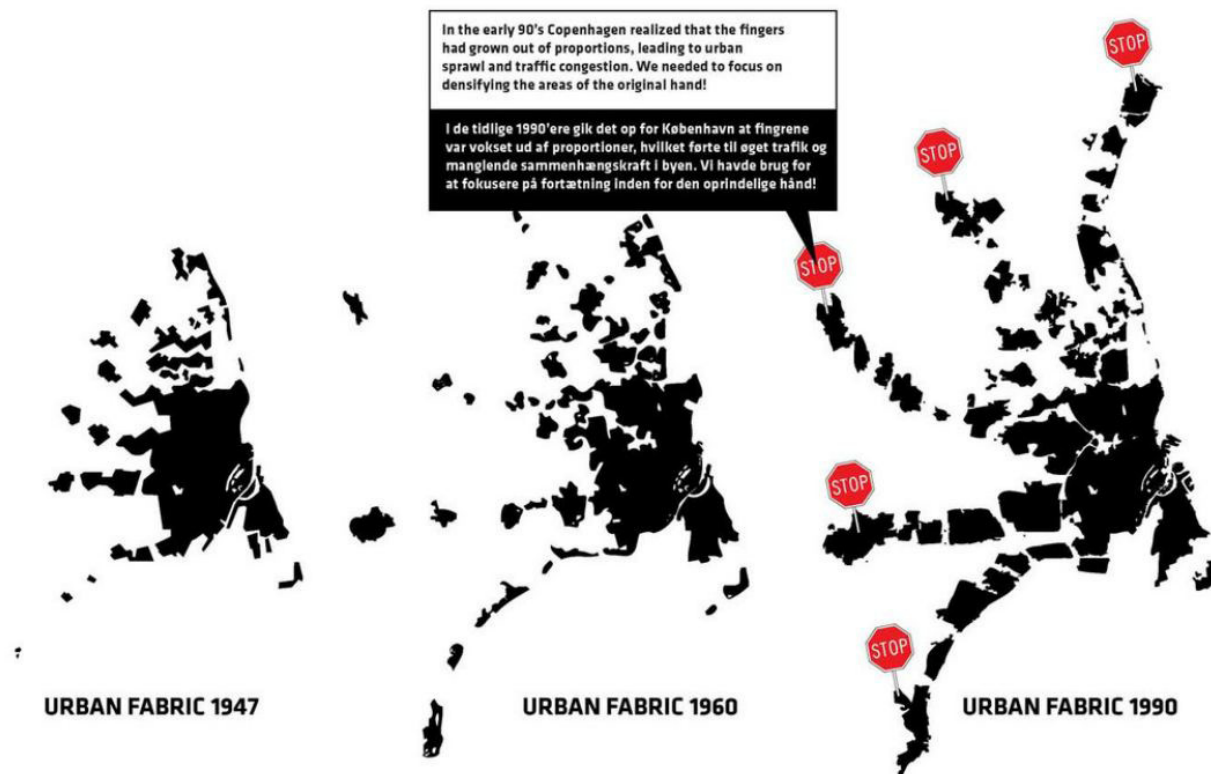
The urban design of Copenhagen became famous in 1947, after the “five finger plan” to control urban and suburban growth in the city was devised under the direction of Danish architect and urban planner Steen Eiler Rasmussen¹⁰. Under Rasmussen’s plan, urbanization was to be “directed along existing and improved rail and highway corridors, leaving the land between the fingers available for recreation and agriculture”². The initial plan intended for public transit throughout the city to be free, and had the ultimate goal of not hindering suburban development, but rather controlling it along pre-determined routes and corridors¹⁰. The plan allowed for residents of Copenhagen to not only enjoy the natural beauty of Denmark, but to have the ability to live close to it with it being preserved within the space between the “fingers.” The plan was also intended to address and attempt to resolve 10 key challenges, which were identified as problems within the city of Copenhagen, but also worldwide. These challenges included **industrialization, migration, mobility, health, energy, nature preservation, food, waste, drinking water, and global war**⁶.



URBAN GROWTH

While Copenhagen's finger plan has worked well for over 60 years, there was a realization in the early 1990s that it was a plan that could not sustain itself much longer, as growth in the city had stretched and would continue to stretch the plan well beyond its limits as an effective model for controlling suburban growth¹⁰.

REGIONAL ANALYSIS REGIONAL ANALYSE



Recent statistics show that urban growth in Copenhagen will consist of:¹⁰

- 10,000 new residents annually through 2025
- 3,500 new homes annually through 2025
- Population growth of 325,000+ by 2047
- Need for increased infrastructure
- Need for better transportation

URBAN RENEWAL

In an effort to address the changing dynamic of Copenhagen and plan for future growth in and around the city, Copenhagen has 17 “master” plans as of 2010, addressing a wide range of challenges and opportunities within the city³. These plans are not all-encompassing, but rather focus on improving individual neighborhoods through urban renewal or redevelopment.

An exception to this is the plan for Nordhavn, a new man-made peninsula on the Øresund coast. The development began in 2011 and is to feature a smart grid, metro connection, and mid-rise, mixed-use buildings throughout the entirety of the neighborhood³. For the most part, however, plans focus on improving existing neighborhoods to attract residents to existing areas of the city, rather than expanding the city and its “fingers” outward. Examples of these neighborhood improvements include:⁷

- Activity and Exercise belts in Skt. Kjelds
- Communal artist studios in Sundholm
- Noise-reducing asphalt in Spydspidsen
- Public urban space renewal in Husum

among many others. A more complete list can be found in a 2012 publication by the Technical and Environmental Administration of Denmark entitled, “Integrated Urban Renewal.” While neighborhood renewal is undeniably helpful, the question begs to be asked...

Maternoski 10



Image Courtesy: <http://b-o-a-r-d.nl/wp-content/uploads/2012/10/image-56.jpg>

How can Copenhagen be **united**
under **one master plan**
that addresses the needs of the 21st century?

THE LOOP AND THE HAND
LOOP'ET OG HÅNDEN

Like a bracelet around the original hand, Loop City becomes a sustainable, dense and recreational growth model of the Øresund region!

Som en kæde omkring den originale hånd skaber Loop City en bæredygtig, tæt og rekreativ vækstmodel for Øresundsregionen!



Loop City

LOOP CITY

Introduction

Loop City is a regional master plan not only for the city of Copenhagen, but for the entire Øresund region, including the cities of Helsingborg and Malmö in Sweden. The plan was developed in 2010 by BIG - Bjarke Ingels Group, in collaboration with the following partners⁶:

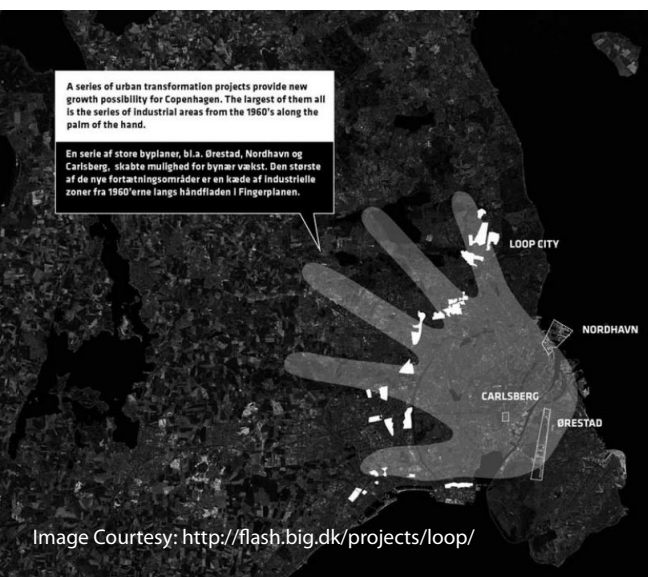
- Tom Nielsen
- Red Associates
- Arup
- Realdania
- Ringby - Letbanesamarbejdet
- Dong Energy

The plan for Loop City is to create a new rail line through the base of Copenhagen's "fingers" and use that rail line as a catalyst for development and urban design opportunities to address a set of 10 updated challenges facing the city, much like Rasmussen's finger plan did in 1947.

In addition to threading together the fingers of the Copenhagen plan, Loop City seeks to extend the rail line over the northern end of the Øresund Strait, into Malmö, and run down through Sweden's western coastal cities, returning across the Øresund Bridge and back into Copenhagen to complete the loop. This loop is intended to spur development in the region, draw people into Copenhagen, and create a shared infrastructure network between Sweden and Denmark, all while addressing the 10 identified key challenges, many of which are related to the overwhelming challenges brought on by global climate change.

Development Areas

The areas of Copenhagen defined by this proposed rail line and that have been identified as potential development areas can be seen shaded in white on the image to the left. This string of development areas includes former industrial areas, factories, surface parking lots, office buildings, and open land and structures ripe for repurposing⁶. This land, in total, equals 4.25 square miles, or equivalent to the size of existing Central Copenhagen or, in other terms, the size of Midtown Manhattan⁶. It is intended that these development areas could be built up with mixed-use development and residential structures, encouraging population growth in existing areas of the city, rather than at its periphery, much like the intent of today's urban renewal efforts in Copenhagen neighborhoods (see page 10.)



LOOP CITY

Nodes

While components addressing the 10 identified challenges driving the Loop City plan are integrated throughout the entirety of the loop, it is the intent of the plan that certain nodes are created along the loop's path. In the image on the right, the previously-discussed development areas in Copenhagen are now shown in greater detail, and are identified as potential nodes within the greater context of the overall plan. Identified nodal opportunities include⁶:

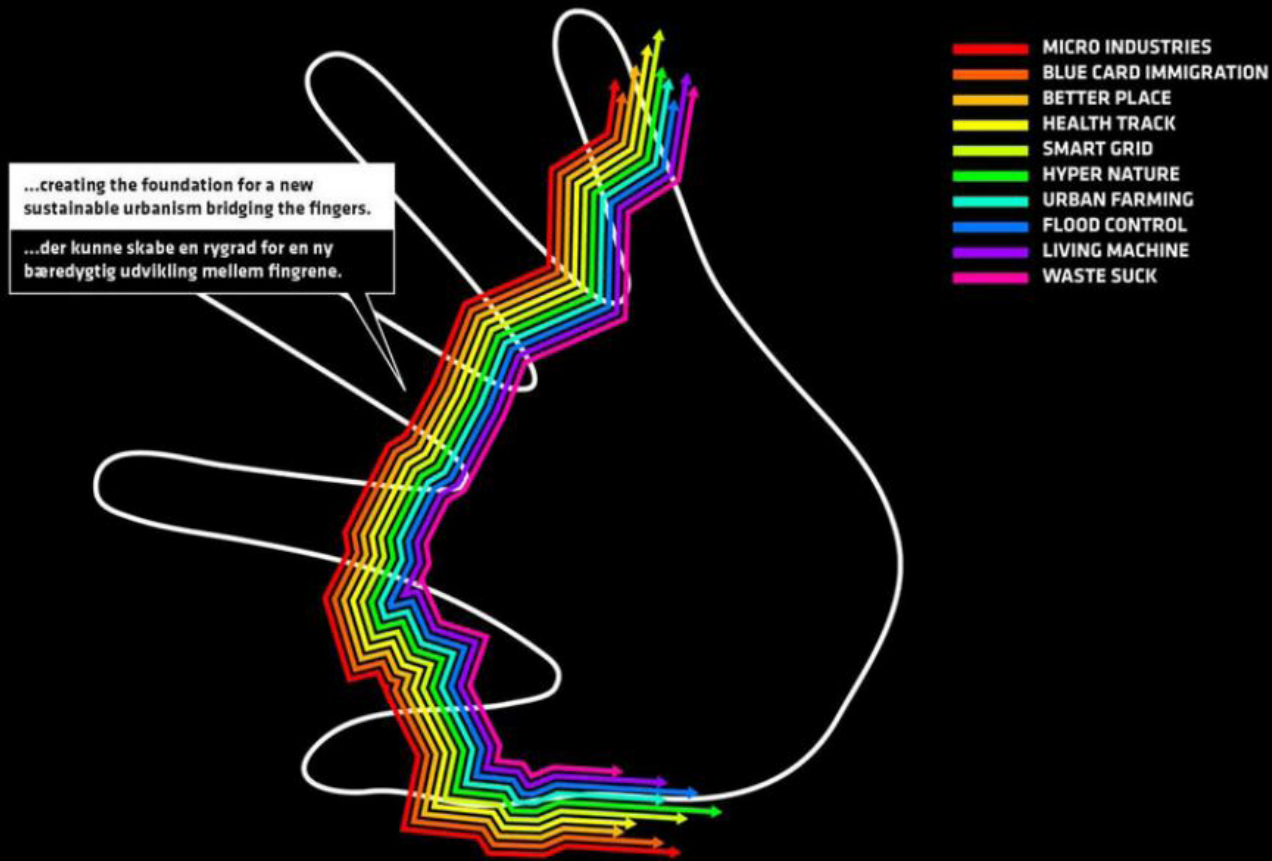
- Industrial Leisure Park
- Food Strip
- River Delta
- Sports Acropolis
- Green Waterfront
- Urban Pocket
- Energy Park
- Health Center
- Education City
- Shopping Hub
- Science City

The following pages of this text will discuss the challenges that the Loop City project is attempting to address, and in many of these discussions, the aforementioned nodes will be visible within the greater context of the overall plan.



CHALLENGES

Like the original finger plan, BIG identified 10 key elements challenging the city and the world that the Loop City plan could address. These elements have been carefully thought about and integrated into the overall plan whenever possible.



The 10 new challenges facing Copenhagen today:

- Mobility
- Energy
- Waste
- Water
- Global Climate Change
- Biodiversity
- Industrialization
- Health
- Food
- Migration

The following pages will identify the reasons for the challenges, Loop City's solution to those problems, and how those solutions are integrated into the overall scheme of the master plan.

6. BIODIVERSITY

Green roofs on all new buildings absorb heavy rain falls while improving biodiversity.

Grønne tage på nye bygninger absorberer kraftige regnskyl og sikrer biodiversiteten i området.

3. WASTE

Former industrial facilities are converted into local waste sorting centers receiving waste from the automatic waste collection system. Organic waste is converted to biogas for carbon neutral electricity production, and by-products include top soil and heating for integrated green houses.

Tidligere industribygninger omdannes til lokale affaldssorteringscentre, som modtager affald fra det automatiske opsamlingsystem. Organisk affald bliver konverteret til biogas til CO2 neutral el-produktion. Bi-produkter er bl.a. muldjord og opvarmning til integrerede drivhuse.

8. HEALTH

The metro platform can be combined with the bicycle track, for direct access to the train from your bike.

Metrostationer kan kombineres med de nye cykel ruter, så cykler kan ankomme direkte til perronen.

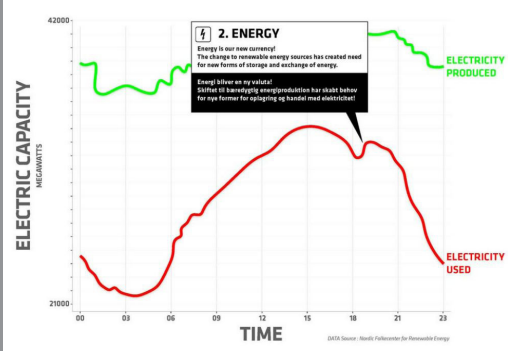
1. MOBILITY

Energy from waste recycling and solar power goes into Better Place electric car charging stations in the metro building.

Electricitet fra affaldshåndtering og solceller føres direkte til Better Place opladnings stationer til elektriske biler.

Integration in the Loop City Plan:

At light rail stations and transit hubs, charging stations will be available for electric cars. These charging stations, following the *Better Place* model, will be operated entirely on renewable energy as a part of a larger smart grid (see page 18.)



ENERGY

The Challenge:

The current energy grid is wasteful. Roughly 2/3 of electricity produced in power plants is lost in transmission lines or energy conversion. Additionally, the current grid has no communication network to inform utility companies of outages.

Loop City Solution: Smart Grid

Loop City seeks to utilize the benefits of a smart grid network of electricity. A smart grid would use better, more efficient, higher voltage transmission lines to reduce energy loss over distance, and incorporate modern, dynamic energy storage so that power is always available when needed⁵. Additionally, the grid would feature an intelligent, two-way communication grid allowing consumers to view their energy use in real-time through the use of wi-fi enabled meters⁵. In the event of an outage, the system would self-heal and self-report issues to utilities for a quicker response time⁵. Mostly renewable sources would be used.

SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.

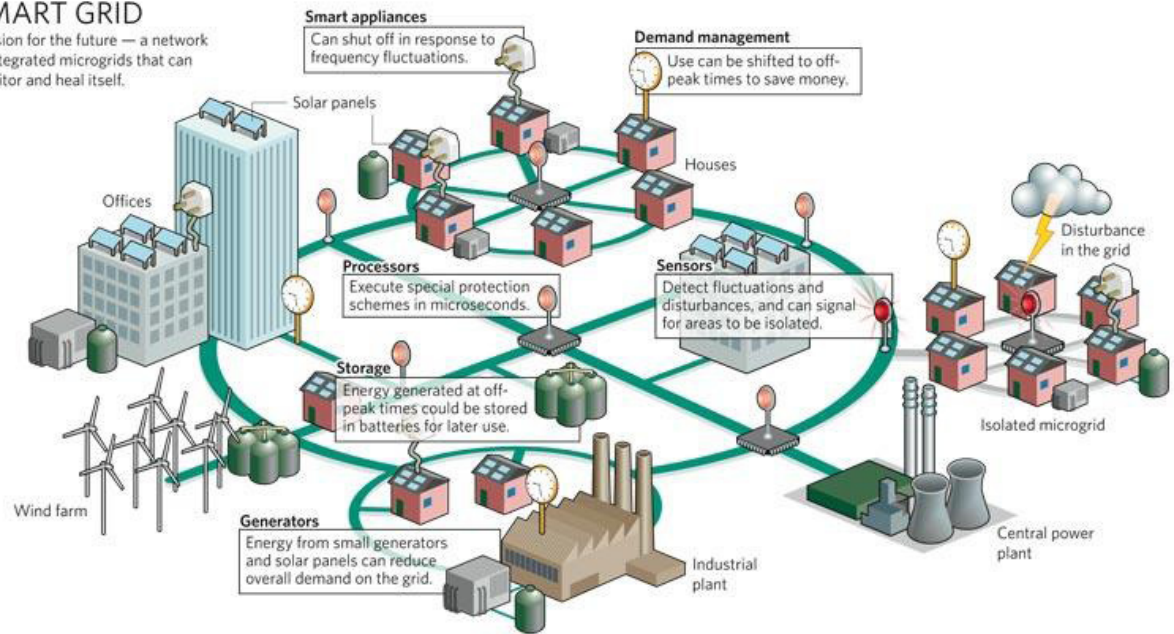


Image Courtesy: http://2.bp.blogspot.com/-2_ho1aU66vQ/TyKPMdbsiCI/AAAAAAAAABQ/j_-9oShHlgY/s1600/smartgrid.jpg



2. ENERGY
Piezo electric tiles and photovoltaic panels becoming a part of the new decentralized energy production.
Piezo electric belægning og solceller bliver en del af fremtidens decentraliserede energiproduktion.

Image Courtesy: <http://flash.big.dk/projects/loop/>

Integration in the Loop City Plan:

Every opportunity to collect energy to support the grid would be utilized, including solar-collecting paving as shown in this image. Energy collected could be used on-site, off-site, or stored for availability when needed in the future.



WASTE

The Challenge:

Waste levels continue to rise as the population increases, while recycling rates have leveled off in the past 20 years. Composting has been slow to catch on, and waste collection is handled in an inefficient, antiquated, and unpleasant manner.

Loop City Solution: Waste Suck

Rather than setting garbage bins out on the curb weekly, “waste suck” seeks to bury waste collection underground. Waste collection for trash, recycling, and compost would occur at the surface, allowing individuals to dispose of waste at their convenience. Waste would then get sucked through underground tubes at a speed of 45mph, transporting it to waste collection sites¹. The tubes are equipped with sensors, engaging suction when waste levels require it, and allowing clogs in the tubes to be immediately reported and corrected, most often remotely using short, powerful bursts of air¹.

Maternoski 20



Image Courtesy: http://excel-uae.com/ver2/images/stories/waste_management/pneumatic_waste_collection1.jpg

CONCEPT SECTION
KONCEPT SNIT

How could a metrobuilding upgraded with technologies addressing the 10 new challenges look?

Hvordan kunne en metrobygning opgraderet med teknologier der adresserer de 10 nye udfordringer se ud?

Green roofs on all new buildings absorb heavy rain falls while improving biodiversity.

Grønne tage på nye bygninger absorberer kraftige regnskyl og sikrer biodiversiteten i området.

AUTOMATIC WASTE COLLECTION SYSTEM

Electric trash trains collect waste at night time for recycling in the industrial ecosystem on the Loop.

Elektriske skraldetog opsamlers affald fra det automatiske sug om natten til genbrug i det industrielle økosystem.

10. INTERNATIONAL METRO TRASH TRAIN

8. HEALTH TRACK

The metro platform can be combined with the bicycle track, for direct access to the train from your bike.

Metrostationer kan kombineres med de nye cykel ruter, så cykler kan ankomme direkte til perronen.

Former industrial facilities are converted into local waste sorting centers receiving waste from the automatic waste collection system. Organic waste is converted to biogas for carbon neutral electricity production, and by-products include top soil and heating for integrated green houses.

Tidligere industribygninger omdannes til lokale affaldssorteringscentre, som modtager affald fra det automatiske opsamlingsystem. Organisk affald bliver konverteret til biogas til CO2 neutral el-produktion. Bi-produkter er bl.a. muldjord og opvarmning til integrerede drivhuse.

6. ENERGY SOLAR PANELS

RAIN WATER FOR TOILETS

5. GLOBAL WARMING

4. WATER

CANAL NETWORK

3. WASTE CENTRAL

7. BETTER PLACE CHARGING STATION

AUTOMATIC WASTE COLLECTION SYSTEM

7. RE-INDUSTRIALIZATION

ORGANIC WASTE

A network of urban canals collect storm water and leads it to artificial lakes in the green surroundings.

Et netværk af kanaler opsamlers regnvand og leder det til nye kunstige søer i de grønne kiler.

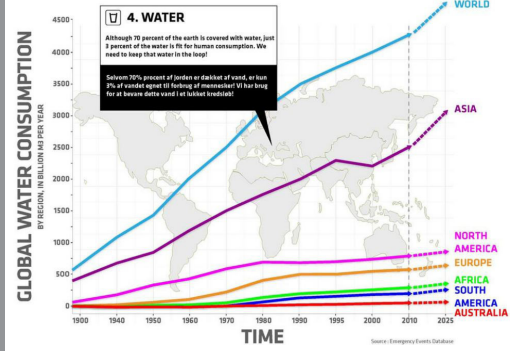
Energy from waste recycling and solar power goes into Better Place electric car charging stations in the metro building.

Elektricitet fra affaldshåndtering og solceller føres direkte til Better Place opladningsstationer til elektriske biler.

Image Courtesy: <http://flash.big.dk/projects/loop/>

Integration in the Loop City Plan:

A network of waste collection tubes would transport waste to collection sites, where organic waste could be converted into biogas electricity generation. This electricity would be fed into the smart grid, and could be used to power things like...*Better Place* electric cars!



WATER

The Challenge:

Water is being used at an alarmingly fast rate, and that rate continues to rise with the world's population as our consumption strains water sources worldwide. As water becomes more and more scarce, strategies to reuse and become more efficient in water consumption are increasingly important.

Loop City Solution: Living Machine

The concept behind "living machine" is to turn wastewater into clean, potable water. Through the use of natural plant and microorganism filtration, the living machine is able to mimic the effects of a natural wetland, including tidal cycles to move the water around and ensure it is fully and properly filtered⁸. This machine can either occur in a controlled greenhouse environment, which speeds up the filtration process, but it can also occur outside as a modified constructed wetland⁸. The latter supports an overwhelming amount of biological activity (see page 26.)

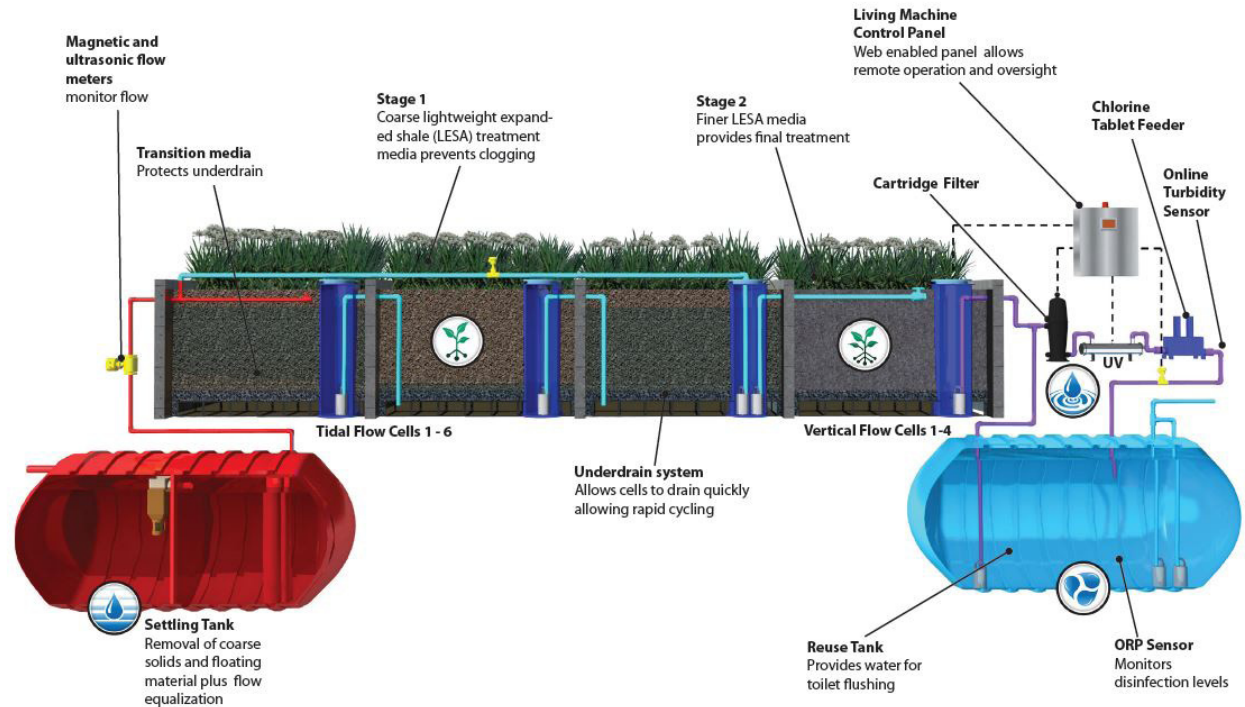


Image Courtesy: <http://www.livingmachines.com/Services/Case-Studies/POP-Case-Study-Final.aspx>

3. WASTE

With improved waste sorting, the efficiency of incineration plants is improving greatly leading to reduced dependency of fossil fuels.

I kraft af den bedre affaldssortering øges effektiviteten på affaldsforbrænding væsentligt, hvilket yderligere vil reducere afhængigheden af fossile brændstoffer.

4. WATER

Grey water is discharged locally into the wetlands for natural biological treatment.

Gråt spildevand ledes til vådområderne for naturlig biologisk rensning.

5. GLOBAL WARMING

The wetlands double as water reservoir for heavy rain showers.

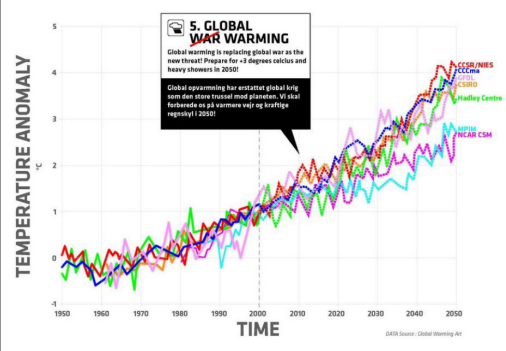
Vådområderne absorberer overflødevand ved kraftige regnskyl.



Image Courtesy: <http://flash.big.dk/projects/loop/>

Integration in the Loop City Plan:

Waste water and storm water runoff can be filtered naturally and attractively, as in this constructed wetland which also supports an abundance of wildlife and plants. A greenhouse-type structure can be seen on the left of this image, filtering water under ideal conditions at a rapid pace.



GLOBAL WARMING

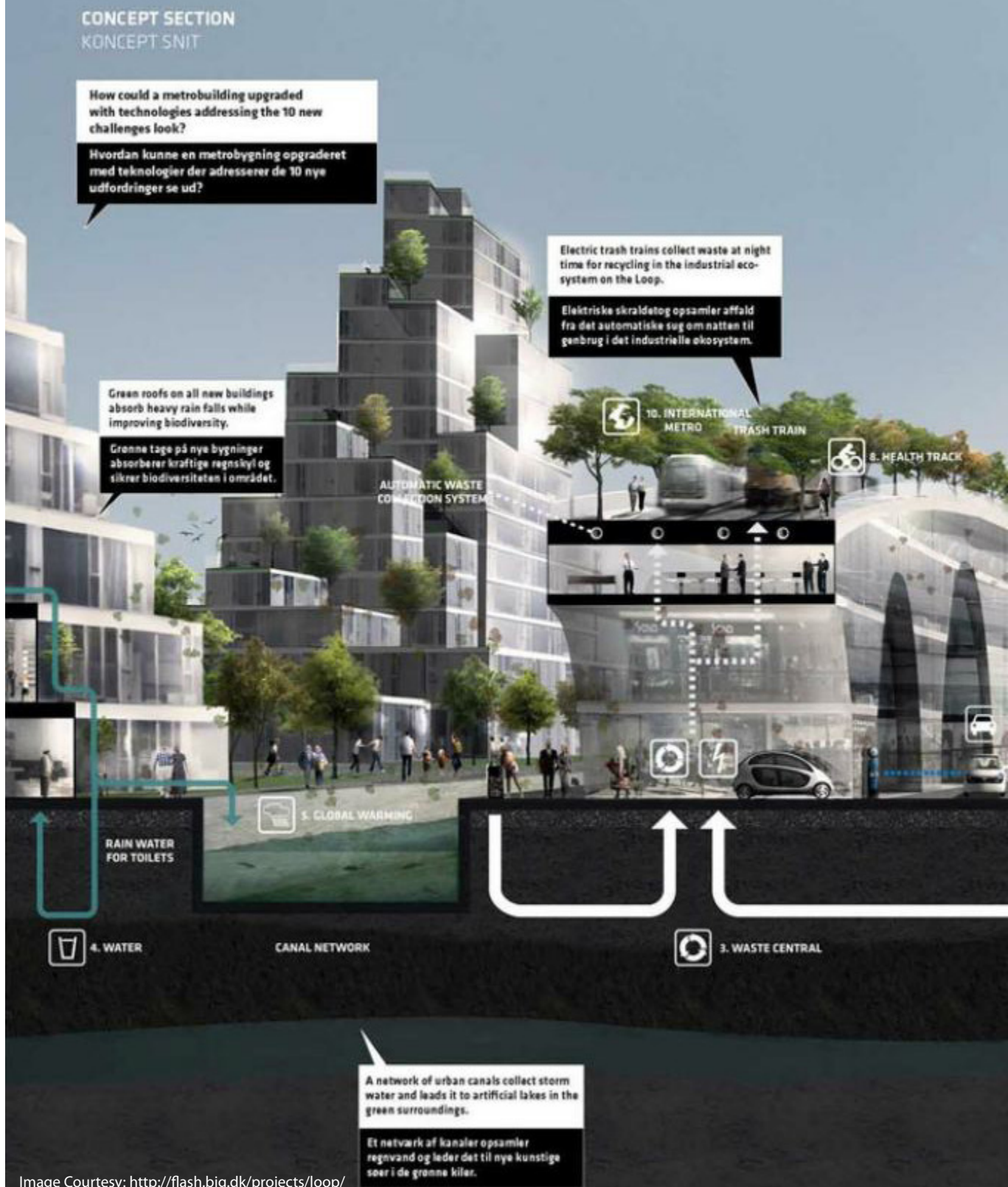
The Challenge:

The rise in global temperature is resulting in changing weather patterns, which now often include infrequent but powerful weather events. These events can produce more precipitation in a shorter period of time than many infrastructure systems are designed to handle.

Loop City Solution: Flood Control

To prevent localized or widespread flooding from these heavier weather events, Loop City envisions a network of canals placed throughout the city to collect rainwater, rather than straining the existing network of storm drains⁶. The canals would carry water from the urban sources of runoff to constructed wetlands and living machines for treatment and filtration (see pages 22-23.) Loop City also utilizes the services of green roofs on new and existing buildings, which help to capture and absorb rainfall, while releasing excess water slowly over time after the weather event, rather than all at once while the event is occurring⁶.

Maternoski 24





6. BIODIVERSITY

Green roofs on all new buildings absorb heavy rain falls while improving biodiversity.

Grønne tage på nye bygninger absorberer kraftige regnskyl og sikrer biodiversiteten i området.

1. MOBILITY

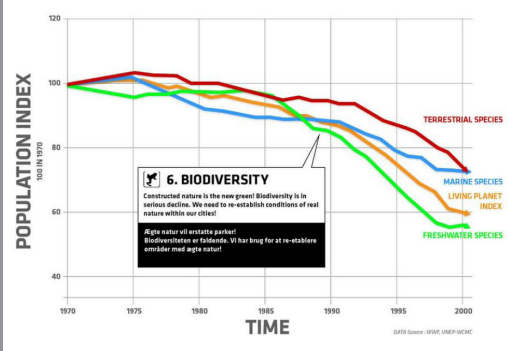
Energy from waste recycling and solar power goes into Better Place electric car charging stations in the metro building.

Elektricitet fra affaldshåndtering og solceller føres direkte til Better Place opladnings stationer til elektriske biler.

Image Courtesy: <http://flash.big.dk/projects/loop/>

Integration in the Loop City Plan:

In this image, green roofs can be seen atop several structures, collecting much of the rainfall at the source and keeping it out of the stormwater system. On the opposite page, diagrams show excess water flowing into a network of canals, to be taken away to local water treatment facilities.



BIODIVERSITY

The Challenge:

Many cities have an abundance of turf grass and city trees, but most urban areas lack the “true” ecological environments in which most species of plants and animals thrive. Rich natural environments and the edge conditions and overlap of ecosystems are disappearing as the urban edge continues to spread out further from the core, and these fragile environments are not being replaced, resulting in a noticeable drop in biodiversity.

Loop City Solution: Hyper-Nature


A network of artificial wetlands, marshes and swamps (see pages 22-23) are to be re-introduced into the environment as a key component of the Loop City plan⁶. Areas for these spaces include the restoration of former wetlands, or the creation of entirely new ones. The Loop City plan touts a 1:1 ratio between green areas and urban areas as being the benchmark for the regional master plan⁶.



6. BIODIVERSITY
 Green roofs on all new buildings absorb heavy rain falls while improving biodiversity.
 Grønne tage på nye bygninger absorberer kraftige regnskyl og sikrer biodiversiteten i området.

3. WASTE
 Organic waste is converted locally to biogas for carbon neutral electricity production, and by-products include top soil and heating for integrated green houses.
 Organisk affald bliver konverteret lokalt til biogas. Bi-produkter er bl.a. muldjord og opvarmning til integrerede drivhuse.



 **6. BIODIVERSITY**

The metro runs through an almost equal part of open green areas and dense urban areas. The green areas will play an important role for the urban development providing wetlands for water treatment and improved biodiversity.

Letbanen passerer gennem en næsten lige stor del åbne grønne områder som tætte urbane zoner. De grønne områder vil spille en stor rolle for byudviklingen, ved omdannelse til vådområder til vandrensning og søer til overfladevand.

Image Courtesy: <http://flash.big.dk/projects/loop/>

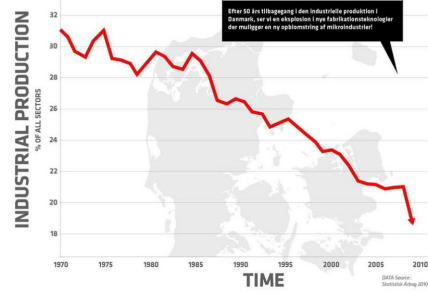
Integration in the Loop City Plan:

In addition to creating areas of beauty, natural wetlands support the invaluable ecosystems of thousands of species of flora and fauna. Additionally, wetlands provide for natural water filtration and space for Copenhageners to enjoy recreational activities in the natural beauty of Denmark.

7. RE-INDUSTRIALIZATION

After 50 years of decline in industrial output, the evolution of automated fabrication and design technologies is creating a new sector of micro-industries, allowing a new form of industrialization to mix into our cities!

Etter 50 års tilbakegang i den industrielle produksjonen i Sverige, ser vi en utvikling i nye fabrikkteknologier der mulighet er i oppblomstring av mikroindustri!



RE-INDUSTRIALIZATION

The Challenge:

Not so much a challenge as it is an opportunity, large-scale manufacturing is on the decline. Large factories continue to close their doors, giving way to research and development and the much smaller-scale technology industry. Former industrial buildings, warehouses, and entire industrial areas now sit vacant, waiting to be re-purposed.

Loop City Solution: Micro Industries

As industrial areas of cities continue to decline, Loop City proposes that new, micro industries based on CNC and 3D printing technology be integrated within the city⁶. Not only does this provide for greater walkability and shorter commutes to work, it begins to put manufacturing on display as a celebrated part of the city, rather than being an undesirable reality of the city. Loop City also proposes re-purposing former industrial buildings into new multi-use buildings housing residential, commercial, and micro industrial zones together.

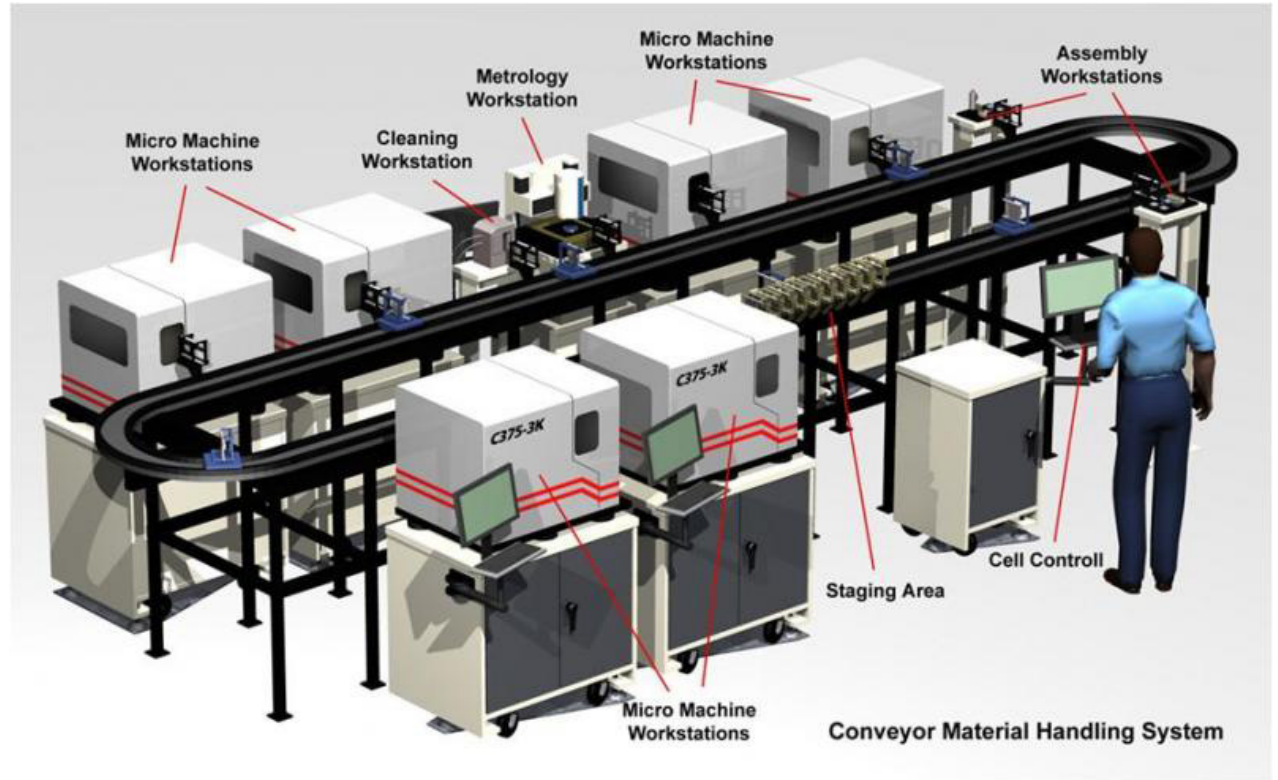


Image Courtesy: http://reallco.com/yahoo_site_admin/assets/images/Micro_Factory.120121932_std.jpg



7. RE-INDUSTRIALIZATION
Towards the highway a strip of new developments become the public face of the new industries.

Mod motorvejen skaber et smalt udviklingsbånd en facade mod byen for de nye industrier.

7. RE-INDUSTRIALIZATION
Clean-tech industrial buildings are transformed into architectural attractions with visitor centers and surrounding recreational landscapes.

Clean-tech industrier transformeres til arkitektoniske attraktioner med besøgscentre og omkringliggende rekreative landskaber.

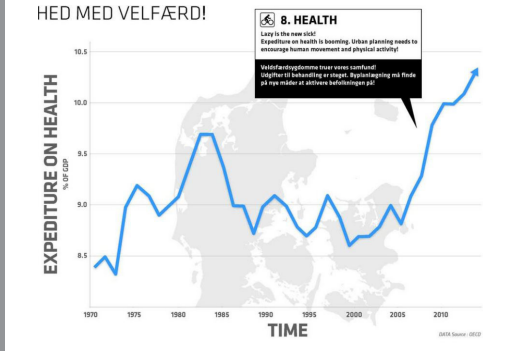
2. ENERGY
Waste heat from incineration is lead into outdoor heated baths with-in the industrial landscape.

Lunkent vand fra affaldsforbrændingen og genanvendelsesindustrierne ledes ud i opvarmede offentlige bade i det industrielle landskab.

Image Courtesy: <http://flash.big.dk/projects/loop/>

Integration in the Loop City Plan:

Re-purposing former industrial buildings can take on a variety of forms. In this image, a former industrial building was transformed into an architectural attraction. For an in-depth charette exercise exploring the re-purposing of a former industrial area, see pages 38-44.



HEALTH

The Challenge:

The healthcare system is becoming strained as more and more people seek treatment for obesity and heart disease. As people live increasingly sedentary lifestyles, healthcare visits and costs rise at an alarming rate. These instances can be greatly reduced as more people exercise regularly.

Loop City Solution: Health Track

Copenhagen already boasts an excellent bicycle infrastructure and culture (see page 7,) but that culture could continue to expand and become more streamlined, through traffic light timing and “smart” bike systems, bike-share services, and the continued encouragement of bicycle use⁶. Loop City seeks to make an active lifestyle easy for Copenhageners by offering ample amounts of bicycle storage at transit stations, and bike service stations at regular intervals⁶. Loop City also aims to provide a city-wide “health track” of gyms, “adult-friendly playgrounds” and more to encourage active lifestyles⁶.

Maternoski 30





6. BIODIVERSITY

Green roofs on all new buildings absorb heavy rain falls while improving biodiversity.

Grønne tage på nye bygninger absorberer kraftige regnskyl og sikrer biodiversiteten i området.

3. WASTE

Former industrial facilities are converted into local waste sorting centers receiving waste from the automatic waste collection system. Organic waste is converted to biogas for carbon neutral electricity production, and by-products include top soil and heating for integrated green houses.

Tidligere industribygninger omdannes til lokale affaldssorteringscentre, som modtager affald fra det automatiske opsamlingsystem. Organisk affald bliver konverteret til biogas til CO2 neutral el-produktion. Bi-produkter er bl.a. muldjord og opvarmning til integrerede drivhuse.

8. HEALTH

The metro platform can be combined with the bicycle track, for direct access to the train from your bike.

Metrostationer kan kombineres med de nye cykel ruter, så cykler kan ankomme direkte til perronen.

1. MOBILITY

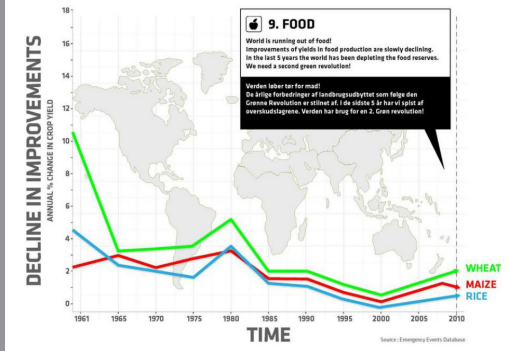
Energy from waste recycling and solar power goes into Better Place electric car charging stations in the metro building.

Electricitet fra affaldshåndtering og solceller føres direkte til Better Place opladnings stationer til elektriske biler.

Image Courtesy: <http://flash.big.dk/projects/loop/>

Integration in the Loop City Plan:

Small-scale plazas around transit hubs discourage automobiles and encourage bicycling and walking. Bicycle storage and service stations are tucked under the transit hub above, while an expanded public transit network offers an alluring alternative to driving.



FOOD

The Challenge:

As the population increases, food is becoming increasingly more scarce. Large scale farming is becoming increasingly un-sustainable as farms continue to be pushed further and further away from population centers as urban areas continue to grow. Additionally, the widespread use of fertilizers and the embodied energy used to transport food across great distances is detrimental to our natural environment.

Loop City Solution: Urban Farming

Rather than depending on large-scale food production at great distances from the urban core, Loop City proposes small-scale food production in the heart of the city where the increasing majority of people live.⁶ Small farms could be integrated into the fabric of the city, creating pockets of agriculture at a neighborhood scale⁶. By allowing space for this farming to take place, and by including open areas for markets and bazaars, local food cultures can flourish.

Maternoski 32





2. BRØNDBY BRØNDBY STRAND THE FOOD STRIP

The metro passes through Brøndby Strand, a housing development from the 1960's. The area is characterized by an industrial layout with a linear green area running along the development. With a building density around 25% there is almost too much green space to create public life in the park, that becomes more a barrier than an attraction for the inhabitants. In the future the linear park could be redefined as a new kind of urban food production landscape sowing together the housing area with its surroundings. The production park is combined with a new bazar market at the metro station, transforming the area from a monofunctional housing mass into a vibrant commercial food center for the region.

Letbanen passerer gennem Brøndby Strand, en boligbyggeri fra 1960'erne. Området er karakteriseret ved et industrielt layout med et lineært grønt område i hele bebyggelsens længde. Med en bebyggelsestæthed på kun 25% er der næsten for meget grønt areal til at skabe liv i de grønne områder, som får karakter af barrierer snarere end en attraktion for beboerne. I fremtiden kan parken omdannes til en ny form for urban fødevarerproduktion med økologiske brug og drivhuse, der kunne sy boligområdet sammen med nabokvartererne. Den lineære landbrugspark kan kombineres med en ny regional bazar ved stationen, der kunne redefinere Brøndby Strand fra at være et monofunktionelt boligområde til en regionalt center for økologisk producerede madvarer.

9. FOOD
Urban Farming creates new activity and working spaces in the green strip.
Urbane landbrug skaber ny aktivitet og arbejdspladser i det grønne bånd.

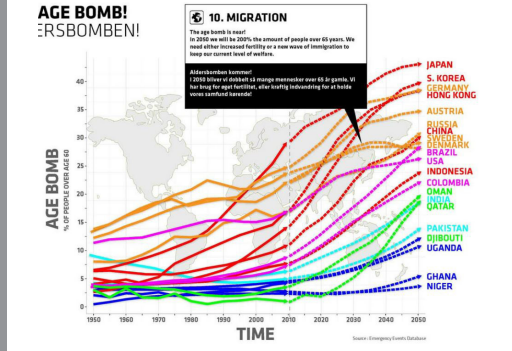

The Food Market fills out the space under the metro with temporary functions, and creates a regional commercial hub at the station.
Markedet fylder området under metroen ud med midlertidige funktioner og skaber en regional kommerciel hub ved stationen.

1:5000

Integration in the Loop City Plan:

With mixed-use developments and residential areas flanking it on both sides, this proposed food strip offers urban agriculture at a neighborhood scale. Organic waste from urban agriculture can be disposed of in facilities that convert the biogas energy to electricity (see pages 20-21.)

Image Courtesy: <http://flash.big.dk/projects/loop/>



MIGRATION

The Challenge:

As the workforce in Copenhagen ages and reaches retirement, younger workers are needed to continue the growth of a stable economy in the city and surrounding area. With the amount of retiring workers projected to outpace the amount of the incoming workforce, Copenhagen is looking beyond its borders to fill open positions in and around its city.

Loop City Solution: Regional Infrastructure

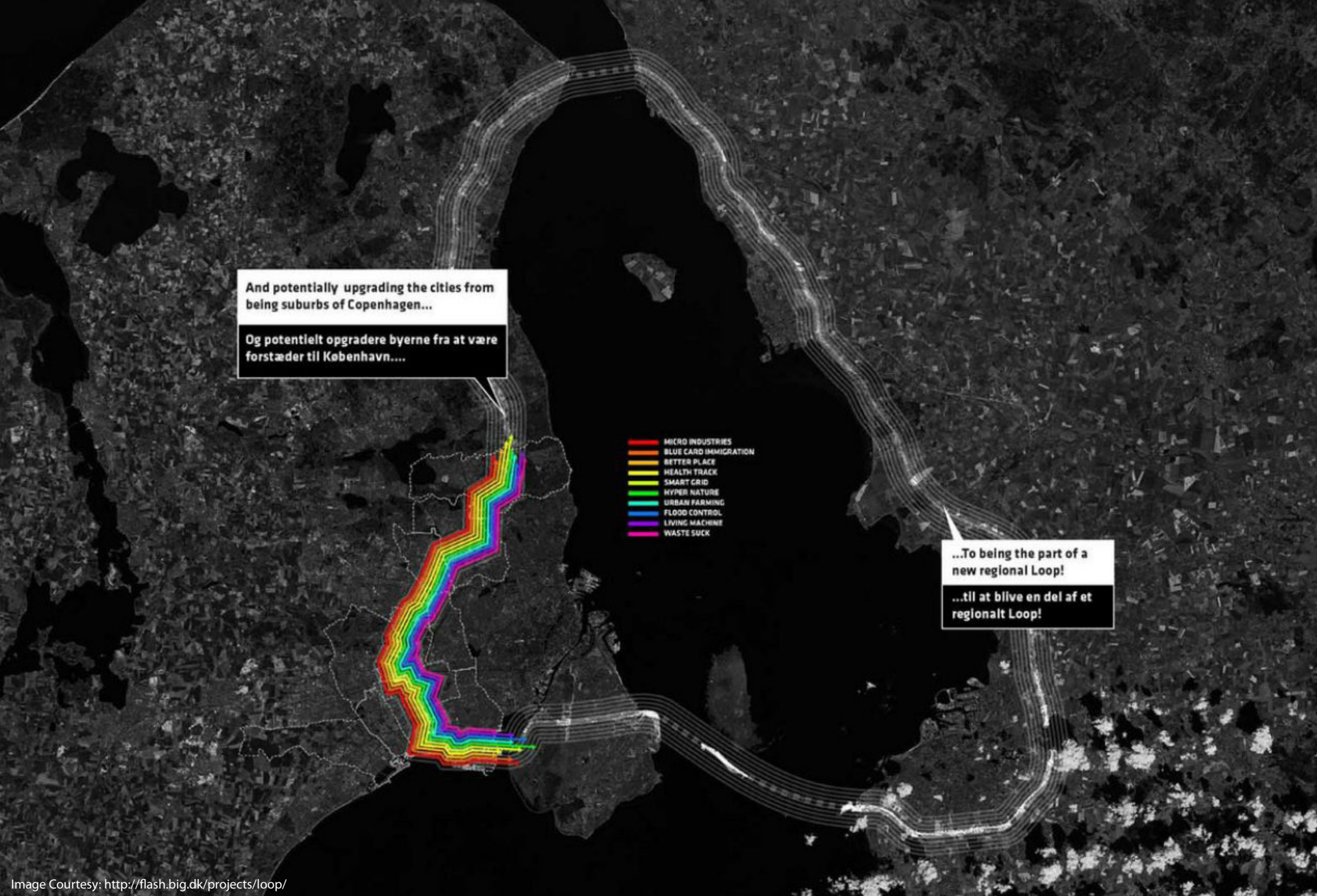
As the country of Denmark works to revamp its “blue card” to allow for easy access to the country for those wishing to work there, Loop City looks to provide a physical connection with the entirety of the Øresund region⁶. A proposed high speed light rail line travelling in a ring around the Øresund Strait promises to move people from one end of the loop to the other in less than 45 minutes⁶. This connection makes a commute from Malmö or Helsingborg in Sweden quite feasible, attracting a regional, not just city-wide, workforce to Copenhagen.

Maternoski 34



10. MIGRATION
 A metro connected to the cross border Medico Region could optimize the workforce and create an international research network.
 En metro forbundet til Medico Regionen kunne optimere arbejdsstyrken og skabe et internationalt forskningsnetværk.

1. MOBILITY
 Energy from waste recycling and solar power goes into Better Place electric car charging stations in the metro building.
 Electricitet fra affaldshåndtering og solceller føres direkte til Better Place opladnings stationer til elektriske biler.



And potentially upgrading the cities from being suburbs of Copenhagen...

Og potentielt opgradere byerne fra at være forstæder til København....

- MICRO INDUSTRIES
- BLUE CARD IMMIGRATION
- BETTER PLACE
- HEALTH TRACK
- SMART GRID
- HYPER NATURE
- URBAN FARMING
- FLOOD CONTROL
- LIVING MACHINE
- WASTE SUCK

...To being the part of a new regional Loop!

...til at blive en del af et regionalt Loop!

Image Courtesy: <http://flash.big.dk/projects/loop/>

Integration in the Loop City Plan:

While addressing the needs of Copenhagen, the Loop City plan reaches beyond Denmark to create a real connection with Sweden, carrying the focuses of the plan throughout the entirety of the multi-national loop around the Øresund Strait.



APPENDIX A:
LOOP CITY CRITIQUE

CRITICAL QUESTIONS OF THE LOOP CITY PLAN:

Mobility (pages 16-17):

- Isn't this program exclusionary to those who cannot afford cars? Who do not wish to own one?
- Could streetcars be incorporated to provide ancillary service to the light rail line?
 - This question addressed in Appendix B, pages 38-44.
- Could areas be dense enough that long range transportation is not a primary necessity to begin with?
- How are highways, traffic integrated into the Loop City plan? How could they be improved?

Energy (pages 18-19):

- Are any sources other than solar and wind being considered?
- Are there initiatives for net-zero building to reduce overall energy need?
- How efficient or economical are arrays such as the solar paving array (page 19)?

Waste (pages 20-21):

- How is larger trash, furniture collected?
- How do you ensure proper waste goes to proper location?
- What are the security concerns of such a system? How are they addressed?

Water (pages 22-23):

- How could water be directed to be used as irrigation for urban farming?
- How could rainwater or greywater be recycled or reused within the context of the city?

Health (pages 30-31):

- Better bike infrastructure may not be enough to address health.
- Could other forms of physical activity be incorporated into loop?
- Are establishments selling non-healthy items regulated along the proposed "health track"?

Food (pages 32-33):

- How can food security be established within the city? What about bioterrorism?
- Is there any control for pest infestations? Disease outbreak?
- Does pollution in the city leech into plant soil, plants?
- What are the opportunities for community education in urban farming?

Migration (pages 34-35):

- Are more people in the region necessarily better?



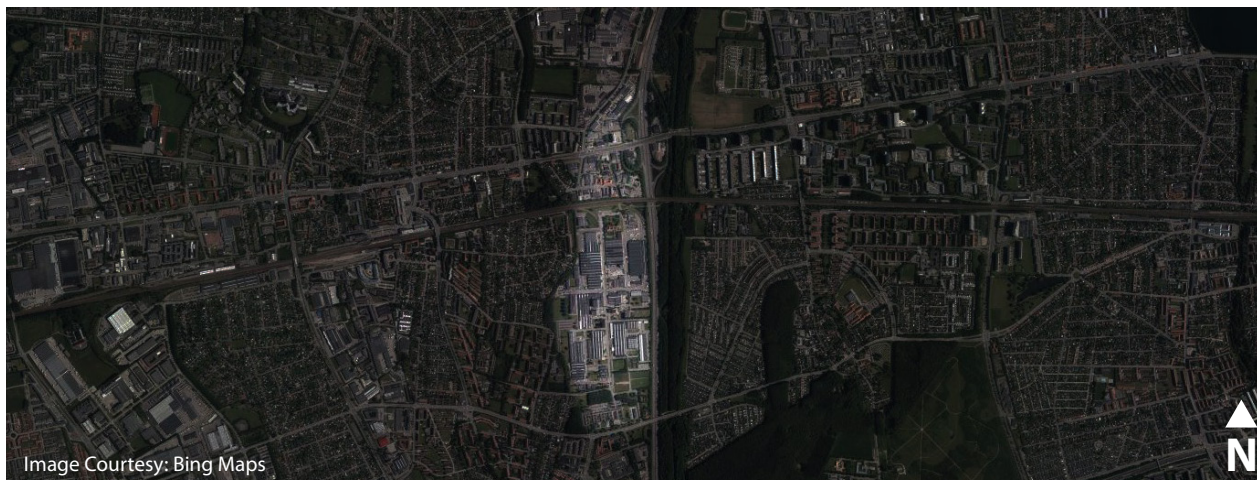
APPENDIX B:
URBAN DESIGN CHARETTE

URBAN DESIGN CHARETTE

With several criticisms of the BIG plan focused around mobility in the Copenhagen area, I chose to address the plan's sometimes weak handling of this issue. I wanted to use the design charrette to think more about transit and connections that can be made to better tie the city together at a local, intermediate scale, rather than at the big picture, regional scale, which BIG has already addressed. I chose a site (shaded in yellow at left) that was in prime position to make these sorts of connections. Situated in between the "thumb" and "index finger" of the finger plan, this site is in an excellent position to begin webbing together the fingers for ease of transportation, rather than forcing travellers to go through the urban core to access different fingers.

The site is flanked to the east by a major highway, creating this "webbed" connection for motorists, but not for public transit. Major roads bound the site to the north and the south, and an existing rail line bisects the site in an east-west direction.

The site is currently occupied by several very large office and warehouse-type buildings. Searches online show that some seem to be occupied while others appear to be vacant.



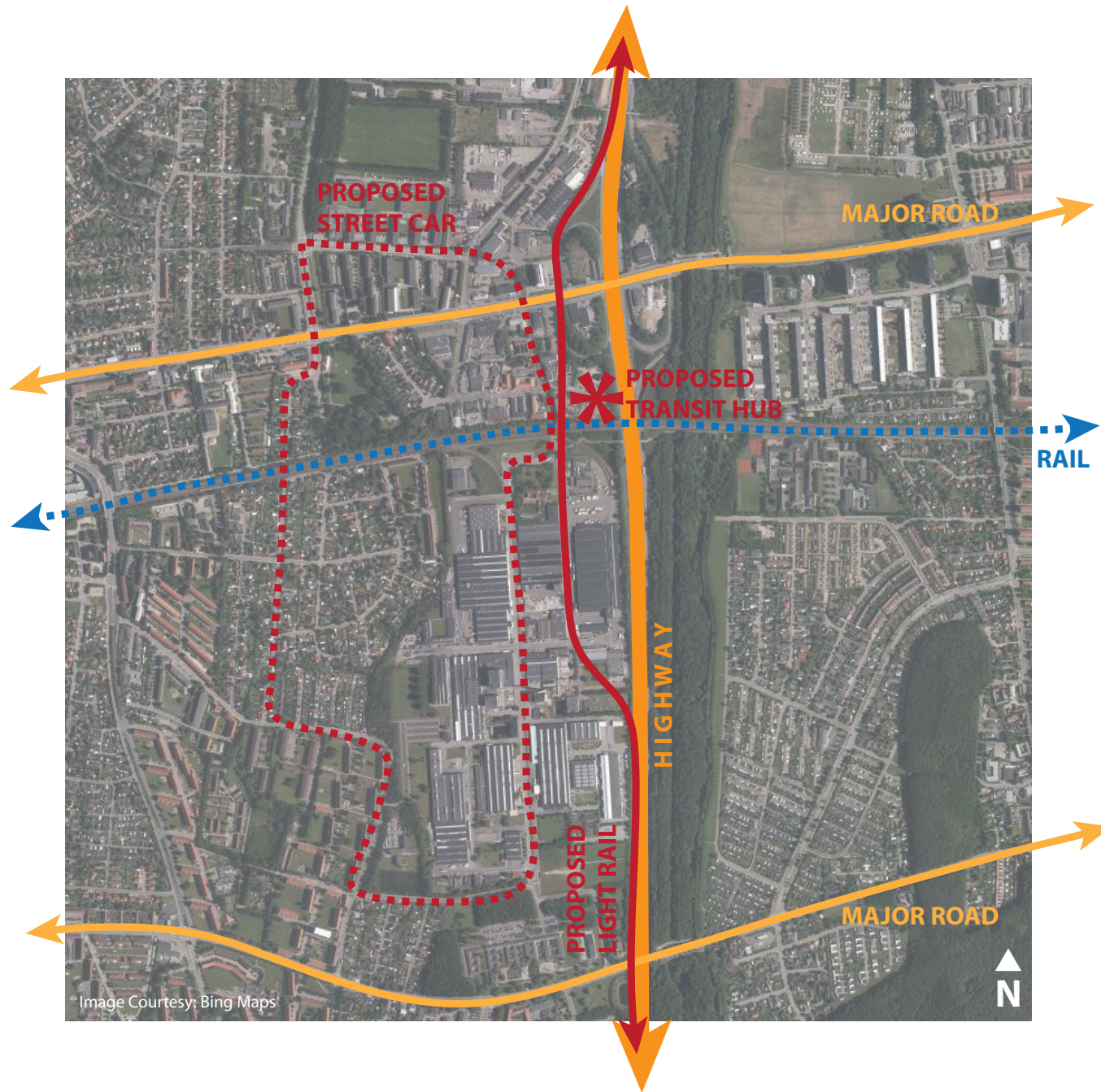
URBAN DESIGN CHARETTE

Transit Issues

The following transit issues exist in Copenhagen's current urban design:

- Linear suburban development connected at a point (the urban core,) not in a web
- Walkability and long-range transit good, intermediate-scale transit not good
- Highway system good, not well-incorporated into the Loop City plan

In an attempt to address these challenges, I propose to construct a new light rail line along the existing major highway running adjacent to the site. This route, if extended throughout Copenhagen, will begin to tie the fingers together and reduce the need to go through the urban core to get from finger to finger. It is also in line with the Loop City regional plan. Additionally, I propose a free street car loop (red dashed line at right) running down the heart of the site, and connecting back through nearby residential areas. This will respond to the needs of people looking to travel distances too great to walk to, but not far enough to take the light rail or a bus. It also stitches together existing residential and potential commercial zones, creating one unified neighborhood rather than two distinct zones for those who inhabit it.



URBAN DESIGN CHARETTE

With so many different modes of transportation running in and around the site, I wanted to connect them at one central point, so that people are free to make the move between walking, biking, street car, light rail, and automobile in whichever combination best meets each individual's transit needs. It is for this reason that I placed a transit hub (red star, opposite page) where these moments all converge. The proposed site for this transit hub is served by the proposed light rail expansion and street car installation, and has convenient access to the major road to the north, which connects to the highway via on and off ramps just behind the transit hub site. The site (pictured, top left) is currently a storage yard, very low density, with large amounts of surface paving, making it a site ripe for development.

Building Reuse

As for the rest of the buildings on the site, it is envisioned that many could become mixed-use with residential on the upper floors, and commercial/retail on the ground floors. Buildings similar to the one pictured (lower left) would be prime for this. Other structures could contain micro-industries, essentially allowing residents to live, work and play in this neighborhood, or live nearby and visit the site for work or play via the new streetcar connection.



Image Courtesy: Google Street View



Image Courtesy: Google Street View

URBAN DESIGN CHARETTE

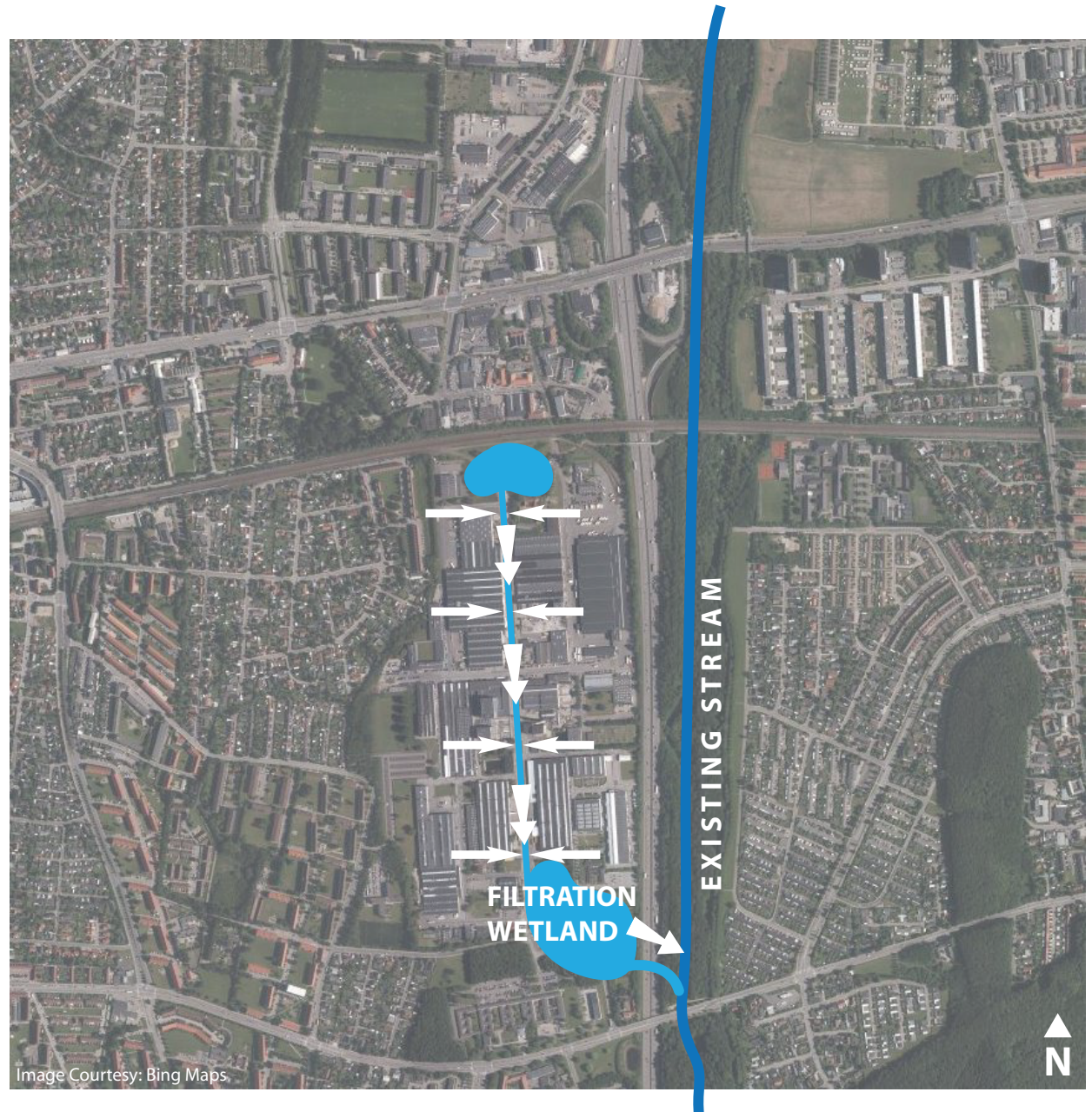
It is envisioned that 1,000 housing units could be built into existing buildings with very little need for new construction. The units are to be of varying sizes and configurations so as to accommodate a wide range of living situations, encouraging people of all age groups to live in close proximity to one another in a community welcome to all. 1,000 units could accommodate approximately 3,000 people - 1/3 of the projected 10,000 new inhabitants moving to Copenhagen annually. The community on the site, in addition to the aforementioned retail and light industry, would also include community services to truly create a sustainable, walkable community with quick and easy connections to surrounding neighborhoods, greater Copenhagen, and entire Øresund region.

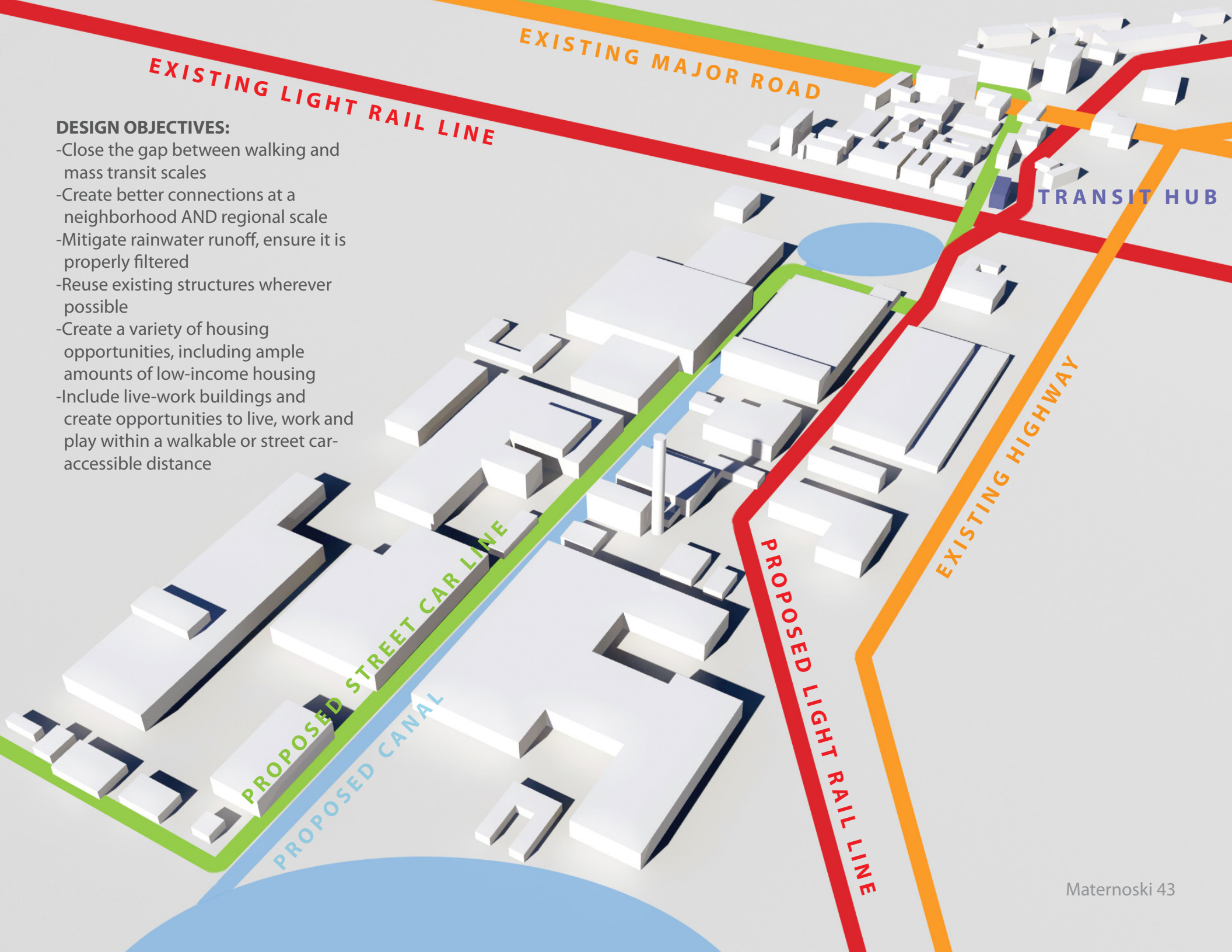
Water Issues

Challenges identified in the Loop City plan involving water and nature include:

- Need for more biodiversity
- Need to address changing weather patterns
- Need to protect our natural water resources

In order to address these issues, the hope for this site is that as buildings are renovated for their new purposes, they would be retrofitted with green roofs.





DESIGN OBJECTIVES:

- Close the gap between walking and mass transit scales
- Create better connections at a neighborhood AND regional scale
- Mitigate rainwater runoff, ensure it is properly filtered
- Reuse existing structures wherever possible
- Create a variety of housing opportunities, including ample amounts of low-income housing
- Include live-work buildings and create opportunities to live, work and play within a walkable or street car-accessible distance

URBAN DESIGN CHARETTE

The addition of these green roofs would:

- Capture rain water and release it slowly into the wastewater stream in the event of major rain events
- Reduce the overall amount of rainfall entering the storm water network as the green roofs absorb some of the water
- Reduce the Urban Heat Island effect

While roofs can be improved, there is still a large amount of impervious hardscape throughout the site. I propose constructing a canal down the center of the site, allowing stormwater runoff to flow into the canal, and away from the buildings, especially during heavy rainfall events. The water from this canal would flow into a new constructed wetland to be built at the southern (low) end of the site, in an already open area. The wetland would not only filter the water before it flows into a nearby existing stream, but it will provide a real habitat for thousands of species of flora and fauna.

Conclusion

By utilizing principles and addressing challenges that are already listed in the Loop City plan, some of the aspects that the regional plan misses can be thoughtfully addressed and executed with a level of great success.

Maternoski 44



Image Courtesy: Bing Maps

APPENDIX C:
LOOP CITY PROPOSAL UPDATES



LOOP CITY PROPOSAL UPDATES:

Loop City Plan Adopted:

In a May 22, 2013 conversation with Kai-Uwe Bergmann, a Partner at BIG's New York office, I was informed by Kai-Uwe that the Loop City proposal of 2010 has been presented to 11 municipalities in both Denmark and Sweden. All 11 municipalities accepted the proposal and have adopted it as a guiding master plan for their communities and the Øresund region.

"Better Place" Files for Bankruptcy:

In a May 27, 2013 article (<http://www.washingtonpost.com/blogs/wonkblog/wp/2013/05/27/what-better-places-bankruptcy-tells-us-about-the-future-of-electric-cars/>) in the *Washington Post*, it was reported that *Better Place* has filed for bankruptcy (see pages 16-17.) The article reports that *Better Place* was losing \$500 million due to a lack of customers signing on to the revolutionary idea, raising questions about the future of "swappable batteries" in electric cars. While no details were shared regarding *Better Place's* role within the Loop City proposal, the article does mention *Tesla*, another electric car startup company, that features battery "supercharging" as its specialty service. *Tesla* would not comment on any exploration into the swappable battery market, but the article claims that the company's business model is currently successful in the United States. While this specific aspect of the Loop City proposal is now in question, the underlying concept of using electric cars instead of gas consuming vehicles remains valid and extraordinarily feasible.

APPENDIX D:
BIBLIOGRAPHY



BIBLIOGRAPHY

- ¹*Better Place*. Better Place, n.d. Web. 13 May 2013. <<http://www.betterplace.com/>>.
- ²Bosselmann, Peter. *Urban Transformation: Understanding City Design and Form*. Washington, DC: Island Press, 2008. Print.
- ³Bullivant, Lucy. *Masterplanning Futures*. 1st ed. New York: Routledge, 2012. Print.
- ⁴"*Denmark.dk*." The Official Website of Denmark. Ministry of Foreign Affairs of Denmark. Web. 8 Jun 2013. <<http://denmark.dk/en/>>.
- ⁵Gore, Al. *Our Choice: A Plan to Solve the Climate Crisis*. Emmaus, PA: Rodale, 2009. Print.
- ⁶Ingles, Bjarke, and Andreas Pedersen. "Loop City." BIG CPH. BIG, 29 Jun 2012. Web. 21 Apr 2013. <<http://flash.big.dk/projects/loop/>>.
- ⁷*Integrated Urban Renewal (in Copenhagen, 2012)*. Copenhagen: Technical and Environmental Administration of Denmark, 2012. Print.
- ⁸"*Living Machine*." Living Machine. Living Machine, n.d. Web. 13 May 2013. <<http://www.livingmachines.com/About-Living-Machine.asp&xgt>>.
- ⁹Lynch, Dennis. "LOOP City in Copenhagen / Bjarke Ingels Group." eVolo. EVOLO, LLC, 25 Jan 2011. Web. 13 May 2013. <<http://www.evolo.us/architecture/loop-city-in-copenhagen-bjarke-ingels-group/>>.
- ¹⁰Moughtin, Cliff, Paola Signoretta, and Kate M. M. Moughtin. *Urban Design: Health and the Therapeutic Environment*. Amsterdam: Architectural, 2009. Internet resource.
- ¹¹Russell, Terrence, and James Glave. "Montreal's Subterranean Vacuum System Sucks Garbage Out of Sight." *Wired*. 22 JUN 2010: n. page. Web. 12 Jun. 2013. <http://www.wired.com/magazine/2010/06/st_trashsucker_canada/>.
- ¹²Troy, Austin. *The Very Hungry City: Urban Energy Efficiency and the Economic Fate of Cities*. New Haven: Yale University Press, 2012. Print.
- ¹³Witkowska, Monika, and Joanna Hald. *Eyewitness Travel: Denmark*. New York: DK Publishing, 2010. 10, 48-49. Print.

John M. Maternoski
University of Oregon
2013

