Copenhagen – Beyond Green

The socioeconomic benefits
of being a green city

GREEN
GROWTH
LEADERS

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Over the course of five years, the green sector in Copenhagen experiences a 55 percent increase in turnover, 12 percent annual growth rates in exports, and an increase in productivity four times higher than the average of the region.

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- Savings constitute $84 million annually.

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- Convenient and efficient transport.
- A reduction in congestions and lost hours. The hours due to traffic congestions. currently constitute DKK 5.7 billion per year for the Capital Region.

37 **Waste not**

- Fewer landfills as only 1,8 percent of the waste is sent to landfills compared to over 40 percent in 1988.
- Incinerated waste produces energy for the district heating system warming 98 percent of houses and apartments in Copenhagen.
- Less negative impact on local real estate.

39 **Hot town – summer in the city**

- A reduction in energy consumption by 80 percent.
- Improvement in health and quality of life.
- Preserving the architectural impression.

Copenhagen – where green investments have offered benefits beyond environmental

The green capital

The city of Copenhagen is well known as a green city.

Through strategic urban planning and a history of environmental ambitions, Copenhagen has created swarms of cyclists, large recreational areas, a high share of renewable energy, clean water in its harbor, and a world class system of district heating and integrated public transportation.

So when the Economist Intelligence Unit ranked 30 European cities for Siemens in 2009, it was no surprise that Copenhagen came out on top. Today, Copenhagen is a well-known role model for cities with green aspirations.

What is not as well known about being a green city are the social and economic benefits.

The mission of Green Growth Leaders is to examine the evidence of green growth and document the benefits. It is from this starting point we set out to examine the economic and social benefits of green initiatives in Copenhagen. What we have learned is that urban green investments offer benefits far beyond environmental. What we have found is evidence of how sustainable life can be more fun, more profitable, and healthier, than ordinary life.

Investing in cycling lanes not only cuts CO2 emissions and improves citizens' health and quality of life, but improves the bottom line of the city. Cleaning the water in the harbor not only improves the environment, but increases real estate values, local business life and tourism. Investing in an integrated public transport system not only reduces traffic congestion, but saves billions of dollars and keeps the city efficient and competitive. Homegrown energy not only produces electricity, but allows local businesses to become strong and competitive.

Green must, therefore, be seen in a broader perspective than strictly environmental. It is not only about reducing CO2 emissions. It is also about improving quality of life and creating jobs and business opportunities throughout the entire economy – not just in the clean-tech sector.

The green sector is an important wealth generator and growth engine for Copenhagen

The green tiger

Looking at Copenhagen as a whole, what can be said about green turnover, green exports and green productivity? What are the economic effects of its green initiatives and ambitions?

The explosive economic growth of China is not news to the world. Since the economic reforms of Deng Xiaoping, China has become accustomed to being the growth engine of the world, with annual growth rates of ten percent of GDP. Nevertheless, looking at Copenhagen, we found a sector that for a few years actually outperformed China.

From 2004 to 2009 the growth rate for the Copenhagen green sector soared. Over the course of five years the turnover generated in the green sector in the capital region increased by 55 percent, contributing more than DKK 50 billion in 2009 alone. The sector was therefore an important wealth generator and growth engine for Copenhagen– contributing three times more than welfare technology.

It is important when looking at the numbers for welfare technology, which include products like hearing aids, that Copenhagen hosts Oticon – one of the world's largest manufacturers of solutions for the hearing impaired. In addition, it is important to note that this is not just because of Vestas. In fact, 87 percent of the total revenue from the Danish wind energy industry takes place in the central part of Jutland – far from Copenhagen[1].

It is important to stress that the 2010 data is not yet available at city level. It is, however, available at the national level, and while the recession impacted the turnover of the green sector in Denmark, the sector still outperforms the overall Danish business sector according to the study "Cleantech – with the Customer in Focus – The Golden Egg of Danish Economy"[2]

Fig A **The green sector contributes three times more than welfare technology sector**

	Green Technology	Welfare Technology	Manufacturing	ICT
Turnover 2009 Capital Region (in million DKK)	52.385	15.590	113.613	81.966

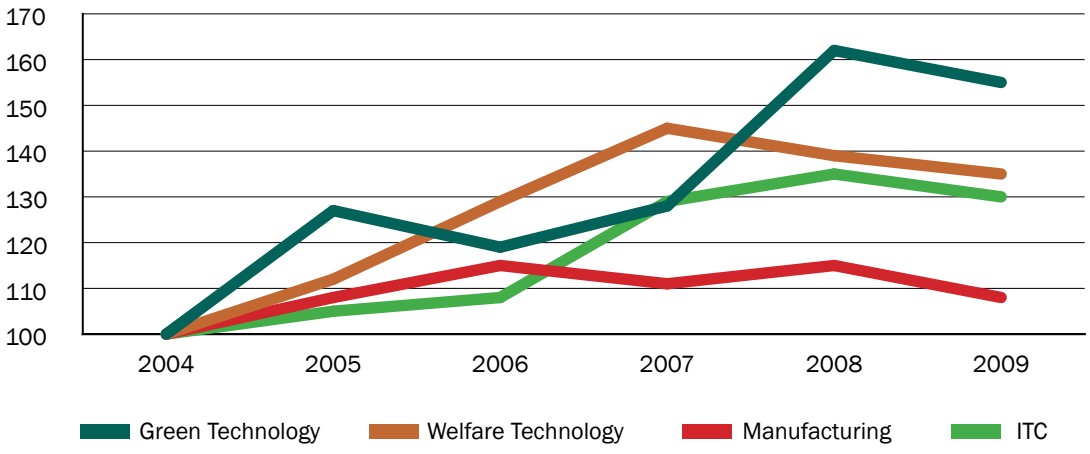
1 Monday Morning, Aarhus – Capital of Wind Energy, 2010.
2 Brøndum & Fliess, Cleantech – with the C ustomer in Focus – The Golden Egg of Danish Economy, 2011.

Fig B Growth in turnover in the Capital Region

Turnover	2004	2005	2006	2007	2008	2009
Green Technology	100	127	119	128	162	155
Welfare Technology	100	112	129	145	139	135
Manu-facturing	100	108	115	111	115	108
ICT	100	105	108	129	135	130

Note: 2004 is reference year

Fig C The green turnover increases by 55 percent in five years – outperforming ICT, manufacturing and welfare technology



Note: 2004 is reference year

The fastest growing export sector

Simultaneously, the green sector experienced an explosive growth in exports. A 77 percent increase in green exports from the capital region from 2004 to 2009 – or annual growth rates of around 12 percent.

Relative numbers can be tricky. Going from 1 to 2 is a great growth rate. However, the growth rate of the green sector is not due to poor starting levels. In absolute numbers, the green sector contributes heavily to exports. In the capital region, the green sector exports around DKK 18 billion compared to DKK 7 billion and DKK 9 billion in exports generated by the welfare technology and ICT sector respectively. At the same time these sectors are outnumbered by the manufacturing sector, which exports DKK 77 million annually. The numbers for 2010 have not been released at the city level.

Compared to a conventional sector such as manufacturing, the growth of green exports is staggering. But even welfare technology can only muster 31 percent growth in exports from 2004-2009 and ICT experience negative growth over that period. These sectors are usually considered growth industries.

Fig D **The green sector contributes heavily to exports from the capital region**

	Green Technology	Welfare Technology	Manufacturing	ICT
Exports Capital Region (in million DKK)	18.571	7.049	77.508	9.322

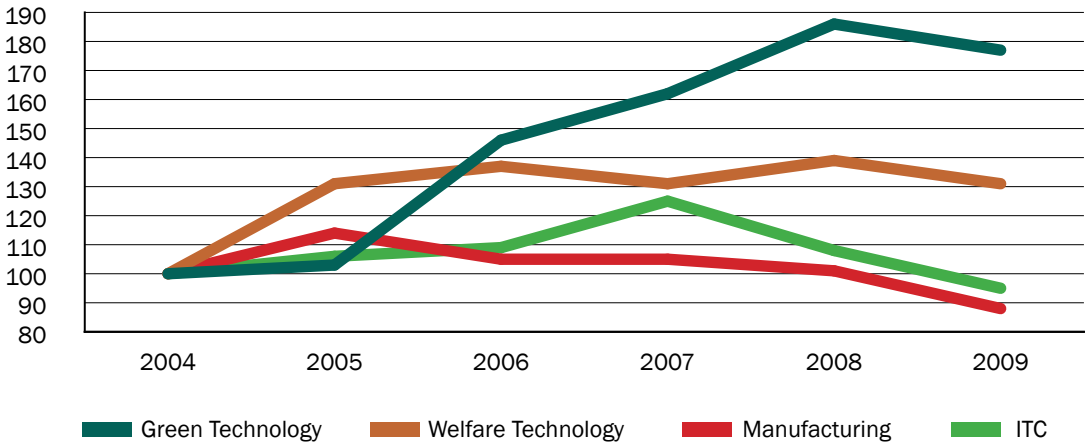
Fig E **Green exports grow by 12 percent on average from 2004-2009, while other sectors experience negative growth**

Exports Capital Region	2004	2005	2006	2007	2008	2009
Green Technology	100	103	146	162	186	177
Welfare Technology	100	131	137	131	139	131
Manu-facturing	100	114	105	105	101	88
ICT	100	106	109	125	108	95

Note: 2004 is reference year

However, at the national level, more recent data is available. Clean-tech has been the fastest-growing sector in Danish exports for years and exports are expected to increase even further in the coming years. However, 2010 did result in a fall in green exports while others exports increased at the national level. Looking over the 2000-2010 period, the total national green exports grew by 98 percent while all other exports only grew by 28 percent. Furthermore, green export constitutes 9.5 percent of total Danish exports, the highest proportion in the EU.

Fig F **Growth in exports in the Capital Region**



The growth rate for exports from the green sector in the capital region reaches 77 percent over a period of five years.

Note: 2004 is reference year

When baby-boomers wrinkle: The green solution to a grey challenge

In addition to the current unemployment levels, the forthcoming retirement of baby boomers poses a serious threat to most western economies – and not only because of increased pensions and medical expenses. As more people exit the labor market than enter it, fewer heads and hands will contribute to GDP. Fewer taxes to support wrinkling boomers and other obligations on the modern welfare state will be collected - unless those remaining are able to produce more. In the coming decades, productivity will be vital. What value is each individual able to produce?

In this respect, green growth is a solution to grey growth. The green sector of Copenhagen proves to be a highly productive sector. Productivity per employee is 44 percent higher than average in the capital region. The green and welfare sector proves where companies are best able to create value per employee.

Fig G **The green sector proves to be a highly productive sector – 44 pct. more productive than the capital region on average**

	Green Technology	Welfare Technology	Manufacturing	Capitol Region of Denmark
Labour productivity Capital Region (in DKK per Full-time employee)	709.312	714.375	509.255	493.982

Today, welfare technology is still more productive than other sectors and creates DKK 714.375 worth of value per full time employee. However, productivity in the green sector has grown by 45 percent over five years and outperforms growth in other sectors. The growth rates are four times the growth in the average company. For further comparison, the annual growth in Danish productivity over the past 20 years has been around 1.1 percent.

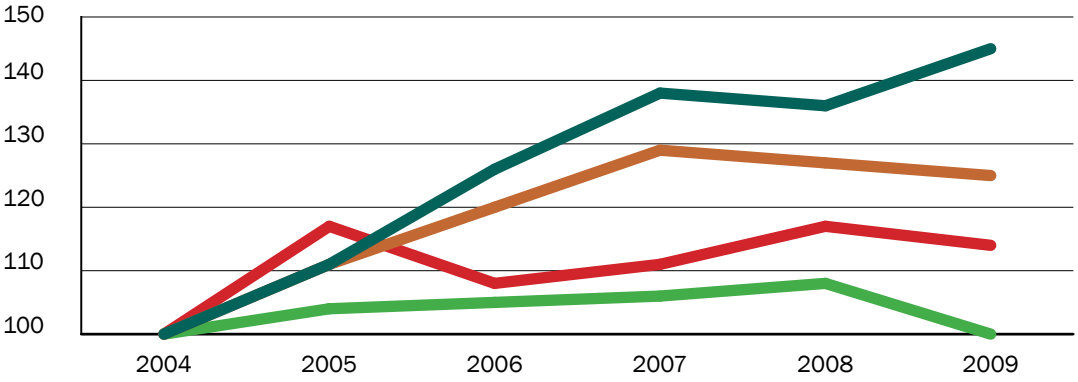
Along with welfare technology, the green sector is adding significantly to overall growth in the region, and both sectors are of key importance to countries such as Denmark – where labor is increasingly becoming a scarce resource.

Fig H **Productivity in the green sector grows by 45 percent over five years**

Productivity Capital Region	2004	2005	2006	2007	2008	2009
Green Technology	100	111	126	138	136	145
Welfare Technology	100	111	120	129	127	125
Manufacturing	100	117	108	111	117	114
Average - Capitol Region of Denmark	**100**	**104**	**105**	**106**	**108**	**100**

Note: 2004 is reference year

Fig I Productivity



Note: 2004 is reference year

Teething tigers

The green sector in Copenhagen has proven to be a local tiger economy. But how did the tiger grow strong and competitive? How much of its success can be subscribed to Copenhagen having green ambitions? Local demand for green solutions create a domestic market – but does local demand provide exports?

Exports are by definition driven by international demand. The dramatic increase in exports is generated by global demand for sustainable solutions as clean tech investments have leapfrogged since 2004. Global investment in green solutions surged to a record $243 billion last year according to Bloomberg New Energy Finance. The number is up 30 percent from last year and covers technologies including wind, solar, energy efficiency, smart grid, bio-fuels, and carbon capture and storage. Local demand may, however, provide a foundation on which companies can develop. Few companies are born global and some survive through infancy because of local demand.

Vestas Wind Systems delivered the first wind turbines in 1979 when the second oil crises struck and Denmark – at the time completely dependent on energy import of fossil fuels – was looking for alternative energy solutions. It is doubtful this once smalltime pioneering business would have become the global hi-tech and market-leading company, employing tens of thousands of people, without local demand for its products.

The wind industry at large has also been driven forward by visionary projects and investments that gave scale and size to the industry. For instance, another Danish wind pioneer, the energy company DONG Energy, built the world's first offshore wind farm in 1991 and has built most of Denmark's offshore wind farms.

Today, more than 350 companies in Denmark produce turbines, blades, generators, gear boxes and control systems. More than 25,000 Danes are employed in the Danish wind

industry, which produces more than half of the world´s wind turbines – making the Danish wind turbine industry the global leader with a combined turnover of DKK 91.4 billion in 2009.

Indeed, Denmark produces around 20 percent of its electricity through wind. This has not only resulted in a successful wind energy industry and increased independence from fossil fuels, but the country has also gained a lot of experience in dealing with fluctuating energy sources making it ideal for smart grid experimentation and installation.

To a great extent, the secret behind the success of the Danish wind industry can be found in its early days. Denmark's big wind power push is owed to close collaboration between public authorities, research institutions, the business world, and the general public. Four factors in particular provided the conditions for Denmark's exploit:

A BOLD VISION: From the beginning, the wind turbine industry's development has been driven by a clear vision to make Denmark energy self-sufficient.

POLITICAL SUPPORT: It took a long time to develop functioning and profitable wind turbine technology. But the Danish wind industry was supported by a strong political belief in the project during the entire development phase.

PROLIFIC INNOVATION: Refining the technology through new thinking and innovation. Right from the beginning, the technology was developed in small clusters across sector and professional boundaries.

TIMING: Denmark took an interest in wind energy before it was profitable. In the 1970s and '80s, the wind turbine industry's development was supported by grants and schemes.

The success story is not unique to Denmark. Several countries have built strong domestic industries and positioned themselves to capitalize on the rapid growth in global demand for energy by encouraging renewable energy technologies.

Germany subsidized industrial rooftop photovoltaic (PV) installation beginning in 1991 and has provided a 20-year "feed-in" tariff since 1990. To encourage adaptation, from 1995 -2004, the government provided loans for PV installation. The combined result of these policies made Germany the top market for solar installations in the world.

During the first oil crises in the 1970s, Japan – as Denmark – was completely dependent on imported energy. Today, solar- powered electricity in Japan is cost-competitive with electricity produced from coal. The solar-industry is now subsidy-free and Japanese manufacturers represent a substantial share of the global solar PV market.

We now move the broader perspective to isolated cases.

> **Today, America produces less than 3 percent of our electricity through renewable sources like wind and solar. Meanwhile, Denmark produces almost 20 percent of their electricity through wind...**
>
> **PRESIDENT BARACK OBAMA, 2009**

Welcome in my backyard – and investment portfolio

Just outside the shores of Copenhagen, the city is producing home grown energy. 20 turbines, of which DONG Energy owns half and Middelgrunden Wind Turbine Cooperative – where locals could buy shares –own the other half. Each share represents the production of 1000 kWh per year and was sold for DKK 4250 or $ 809 to 8650 members of the local community – increasing public support for the project. The city of Copenhagen made a profit out of the sale of its first successful wind farm and revenue has now been channeled back into city projects.

Wind farms are not just for small local investors. Green energy infrastructure is becoming an attractive asset in an era of low fixed income returns and volatile equity markets. For pensions funds wind farms have a very appealing risk-return profile.

Therefore, two pension funds in Denmark are investing more than $1 billion in the major offshore wind farm at Anholt in Denmark. The Danish Government has guaranteed fixed

prices of electricity from the farm for the first 12 years. Other countries offer similar deals ensuring stable and reliable returns – making investment managers happy. The average annual returns from Anholt are expected to be at least double current Danish bond yields of just above 3 per cent over the wind farm's 20-year lifespan.

Wind farms not only produce home grown and environmentally friendly energy, they make an appetizing investment opportunity for small time savers and pension funds and provide valuable expertise and experience.

Already, the energy company DONG Energy, headquartered in Denmark but one of the leading energy groups in Northern Europe, has built more wind farms than any other company in the world. Over 20 years' experience of offshore wind farm development makes the company the current market leader in offshore wind power.

In addition, in the coming decade, thousands of offshore wind turbines are to be installed in the North Sea, creating jobs planning, building and maintaining the windmill farms.

35 percent of all trips to work or education in the city of Copenhagen were made by bike in 2010

The consequences of copenhagenization

Benefits include:

- **Improved health and quality of life**
- **Total avoided cost is estimated to $43 million**
- **Increased tourism and job generation**

A student late for class pedals at full speed, businessmen and women in suits going to work, groups of girls in stilettos going out – no matter where they are going Copenhageners go by bike. For the majority, it is the transport of choice - simply because it is easy. It gets you from A to B. Quickly.

In Copenhagen, urban planners have gone beyond designing the city to make cycling possible – they have designed it to make cycling the norm. Therefore, urban planners from around the world have come to the Danish capital to look for ways to get people out of cars and onto bikes, an effort known as copenhagenization. But what are the consequences of copenhagenization, beyond the obvious environmental ones – from reduced carbon emissions and air pollution in the city?

Fewer traffic jams

Firsts of all, cycling provides an easy, fast and low cost transport alternative. 93 percent find Copenhagen is very good, good or satisfactory to cycle in. This has lured thousands and thousands onto bikes instead of into cars. In 2010, 35 percent of all trips to work or education in the city of Copenhagen were made by bike. For people working AND living in Copenhagen, the numbers are even higher – 50 percent use their bike.[3] The result of this has been a considerable reduction in traffic congestion.

Still, an estimated 100,000 hours are lost in the Capital Region Area due to congestion. Each day.

The shift from cars to bikes has saved the city of Copenhagen time and money. The city of Copenhagen has examined the effects of travelling by bike or car. Looking at the total cost of air pollution, accidents, congestion, noise and wear and tear on infrastructure when travelling by bike and car - bikes came out on top. For every kilometer traveled by bike instead of a car, the city actually saves DKK 0.45.[4]

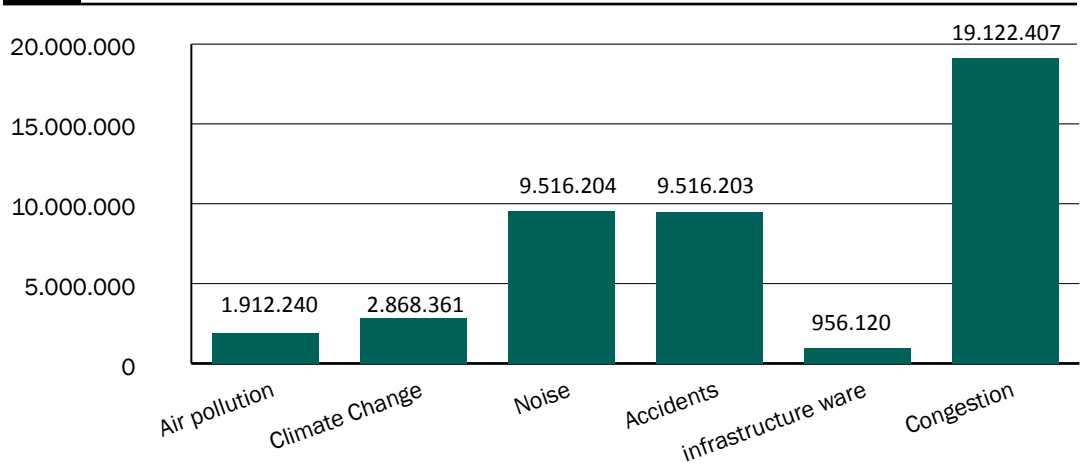
3 City of Copenhagen, City of Cyclists – Bicycle account, 2010
4 COWI and City of Copenhagen, Samfundsøkonomiske analyse af cykeltiltag, 2009

Fig J Reduced external cost

	Reduced external cost per kilometer conducted by bike instead of car, in DKK 2008 prices.
Air Pollution	**0,02**
Climate change	**0,03**
Noise	**0,1**
Accidents	**0,1**
Infrastructure wear	**0,01**
Congestion	**0,2**
Total saved costs	**0,45**

With 1.2 million kilometers cycled each day, this adds up. The saved cost from less congestion alone is estimated at $19 million. But less traffic congestion is not the only economic benefit of cycling. The infrastructure is also less beset by car use. Fewer car accidents also play into the total avoided external costs of $43 million.

Fig K Estimated avoided external costs (in US $) of the shift from vehicle to bicycle



Data from City of Copenhagen accumulated 1995-2010.

Copenhagens position
on Monocles Top 25 "Most Liveable Cities" list

2011:	#3	2008:	#1
2010:	#2	2007:	#2
2009:	#2		

Quality of life

In 2008, the lifestyle magazine Monocle elected Copenhagen as the world´s most livable city, citing the city´s bike culture as one of the reasons. In addition, it is no coincidence that among the cities competing in the top 25 most livable cities in the world, most of them are also among the most bikable cities. Besides Copenhagen, cities such as Berlin, Vienna and Stockholm fall into this category.

Cities such as these are focusing on making people happy and not on cars. They may be on the right track. In a survey where Copenhageners were asked, "Which of the following reactions do you regularly experience when you travel by car/bus/train/bicycle?" 58 percent of cyclists answered "enjoyment". In comparison, people in cars and on buses experienced 34 and 17 percent enjoyment respectively. Mind you, they where sheltered by the harsh weather Copenhagen offers at times. When it came to experiencing stress while travelling, the numbers were reversed. While around 20 percent of motorists and bus passengers experienced stress, this was only the case for 12 percent of people on bikes.[5]

In addition, it is not just the cyclist who benefits from cycling. Pedestrians in the city are also less likely to get killed in traffic accidents and can enjoy a city with a lot less noise and pollution due to the cycling culture.

I Bike Copenhagen - Increased tourism

Reading a guidebook about Copenhagen, you won´t get beyond the first page before bikes are mentioned. In addition, rumor has it that the most photographed icon in Copenhagen is not the little mermaid on her rock but a Copenhagener on a bike. Bikes improve the urban atmosphere. 67 percent of all citizens think that Copenhagen's bicycle culture has either a positive or very positive impact on the city's urban life and atmosphere.

For Copenhagen the bike brand is a tourism treasure and the "I Bike Copenhagen" t-shirt is steadily becoming as iconic as the "I heart NY" t-shirt across the Atlantic. An estimated 23 pct. of all tourists who choose Denmark as their destination do so because of the bicycle opportunities. Time Magazine also rated Copenhagen as the world´s fifth most attractive tourist attraction in 2010 partly due to excellent cycling conditions and The Ecologist called Copenhagen Europe´s coolest green city to visit. The Global Green Economy Index also found Copenhagen on the top of the list, when people were asked which city they most associated with sustainability and green leadership.

However, wonderful as this may be for Copenhagen, it is doubtful that this asset is transferable to other cities. As the copenhagenization of cities accelerates and cycling becomes an integrated part of urban transportation around the world, cyclists will become less of a novelty.

5 Road Directorate, Collecation of Cycle Concepts, 2000.

Extend your lifeCYCLE

Some people might be afraid to get out of the four-wheeled rides and onto two wheels. But for every major cyclist casualty in Copenhagen, cyclists have biked 4.4 million kilometers – the equivalent of 110 times around the world.

In fact, the British Medical Association has found that the increased life expectancy gained from exercise via cycling outweighs the added risk incurred from accidents by a factor of 20.

Half an hour cycling daily increases your mean life expectancy by 1-2 years. Cycling has a preventive effect on e.g. cardiovascular diseases, non-insulin-dependent diabetes, colon cancer, osteoporosis and depression. Motorists who switch to the bicycle can thus expect to live longer!"[6] Another study shows that adults who cycle to and from their workplace on a daily basis have a 30 percent reduced mortality rate.

Besides these incentives, the health benefits of cycling also include fewer sick days, fewer medical expenses and treatments. Tallied up, the total health benefit of Copenhageners cycling is 5.5 DKK per kilometer – making the benefit per year a total of DKK 2 billon or $ 380 million.[7]

Bike pushers

According to the Bicycle Account 2010, issued by the City of Copenhagen: "There are 309 businesses selling and repairing bicycles registered in the capital region, including 267 bicycle shops, 22 wholesale bicycle dealers and 20 firms that design and sell bicycles. These firms generate 650 full time jobs and a total estimated annual turnover of DKK 1.3 billion. Add to this other firms such as bicycle rental firms, pedicabs, bike messengers and firms whose employees cycle during working hours such as postmen, police and home couriers.

Finally, an increasing number of firms are purchasing staff bicycles for use on the job. Cycling infrastructure investments are the basis of Copenhagen cycling and the reason that Copenhagen citizens and businesses can enjoy all the benefits of urban cycling. Commuters save time, bike messengers, mobile coffee bicycles, Post Danmark, and many others save on costs thereby making it possible to give their customers a better product, and employees can get to and from external meetings without having to worry about traffic."

6 Road Directorate, Collecation of Cycle Concepts, 2000.
7 City of Copenhagen, City of Cyclists – Bicycle account, 2010

30 minutes of cycling each day increases your mean life expectancy by 1-2 years

Since the harbor has been cleaned the value of real estate next to the harbor has increased by 57 percent, while apartments in the same area of town but further from the harbor only increased by 12 percent

From health hazard
to urban oasis

Benefits include:

- **Revitalization of the local business life**
- **Increased value of real estate**
- **Increased quality of life and tourism**

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15 years ago, close to 100 overflow channels fed waste water into the harbor of Copenhagen turning the harbor water into anything but wonderful.

Today the harbor is one of the trendiest spots in Copenhagen. In the summer and spring months, Islands Brygge is bustling with BBQ parties, couples strolling along the pier, businessmen and women having a swim after work and exam tormented students tanning while cramming in the heart of the Danish Capital.

The payoffs of the municipal strategies and investment in cleaning up the harbor come in a variety of forms.

From quality of life to cash?

Visiting the public bath in the harbor, the link between improved water quality and quality of life is easy to see. But what about the link between green and growth? Looking at the local level we find evidence that support such a link.

The harbor is an urban oasis that marks Copenhagen´s position as a clean and livable city. In recent years there has been an increased awareness in the livability of cities. Policymakers looking to find ways to boost business in their cities are exploring the relationship between livability and economic growth. One of the reasons for this is that livability is a major factor when international companies are shopping for new cities to set up business in.[8]

However, despite its importance, quality of life can be difficult to measure. Nevertheless, the lifestyle magazine Monocle has done so for the past few years and Tyler Brûlé, Editor-in-chief at Monocle, explains how: *"Copenhagen took first prize in the global quality of life survey 2009 for a number of reasons. In monocle we looked at the core factors that make a great city when it comes to livability. Transport, education, security. In all of those areas the city did really well. I think what really did it for us, when we looked at the city, was that there was a lot*

8 Entrepreneur, How to relocate your business - www.entrepreneur.com/article/81406-2

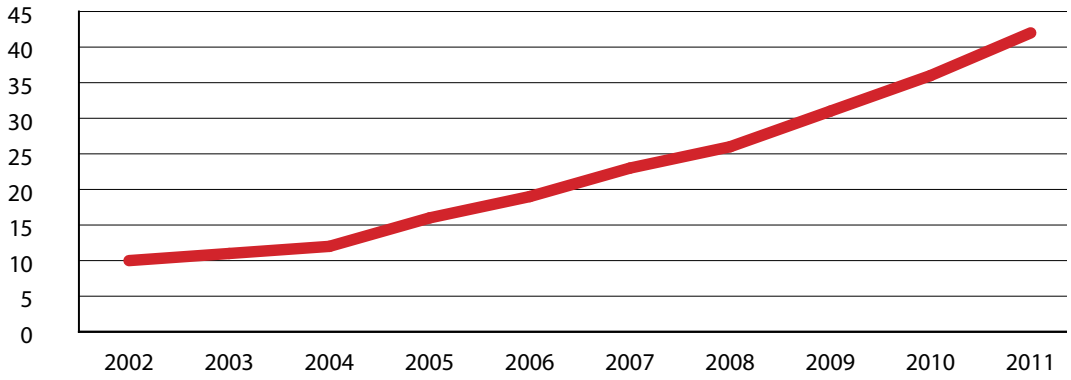
of soft features. And I think it is really the soft features that make a place. The harbor has been cleaned up. You can actually go swimming."

Because of increased quality of life for people living close to the revitalized harbor this has had a tremendous effect on the value of real estate. Property in direct connection with the harbor area has experienced increases above property further from the harbor.

Furthermore, due to its position as one of the trendiest spots – and hence busiest - in Copenhagen, local business life in the service sector has soared. The area next to the harbor bath is now packed with Italian ice cream parlors, wine bars, tapas bars, sushi restaurants and old fashioned bodegas servicing the hedonistic hordes.

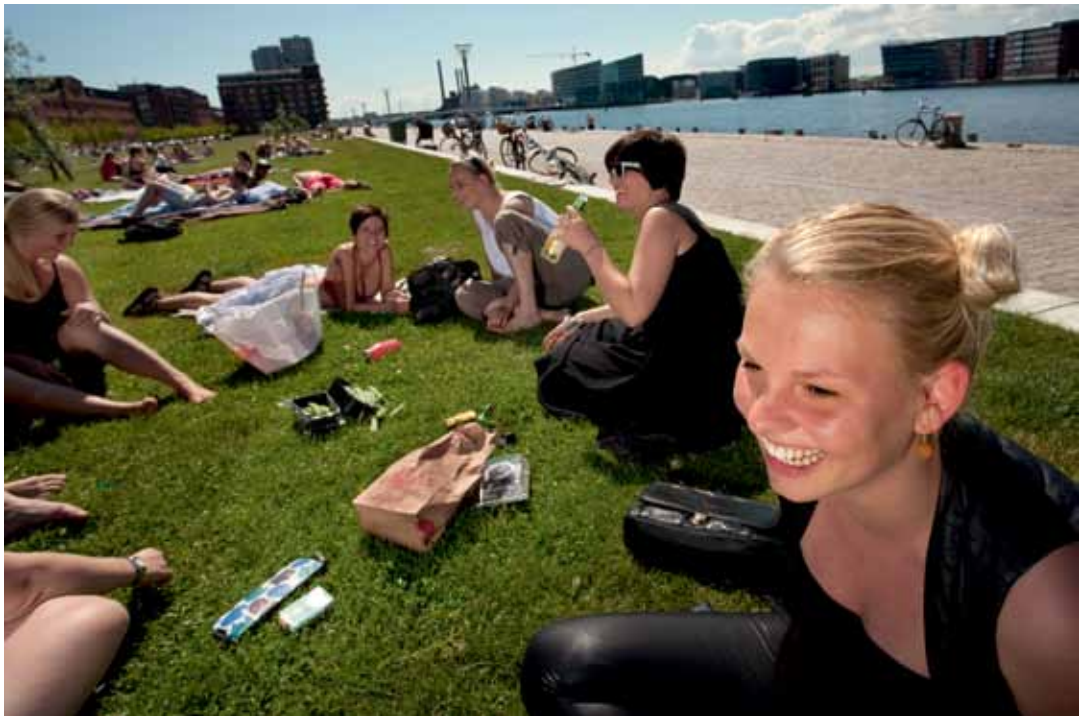
Looking at the all the current cafés, bars and restaurants, in the harbor area only 10 of them existed before 2002 – before the opening of the public harbor bath –an increase of 300 percent. In addition, it is important to notice that the development has also taken place in the post 2008 crash climate.

Fig L Cafés near the harbor



This revitalization of local business life has increased the number of jobs and revenue generated in the area. In addition, because of an increased quality of life, more families who would otherwise move to the suburbs stay in the city and contribute to economic growth.

The desire to stay in the city – particularly near the harbor bath – is reflected in the value of real estate. The area has become increasingly popular – and increasingly expensive – according to a study conducted by DAMVAD. From 2002 to 2011 the prices of apartments close to the harbor increased by 57 percent while apartments in the same area of town but further from the harbor only increased by 12 percent. In addition, the study shows that the price per square meter next to the harbor is 42 percent higher than real estate in the same part of town but not next to the harbor.



Quality of life – difficult to measure – easy to recognize

This evidence supports the broader view of urban oasis´ – such as the harbor bath - which have been emerging. Urban oasis´ have long been recognized as major contributors to the physical and aesthetic quality of urban neighborhoods. However, the economic impact has not been recognized to the same degree. Fortunately, institutions such as The Urban Institute and The Wallace Foundation have advocated this view in the study Beyond Recreation.

The publication focuses on the evidence of urban oasis as contributors to e.g. job opportunities and finds that "*Parks' value to neighborhood quality is confirmed by studies that find a statistically significant link between property values and proximity to green space, including neighborhood parks and urban forested areas.*" The evidence from Copenhagen supports this view – that we must look beyond the environmental benefits in order to understand the full value of greening our cities.

7 DAMVAD, Vækst gennem grønne løsninger i København, 22 juni 2011.

The public outdoor swimming facility was established in 2002 – seven years earlier the water in the harbor posed a serious health risk.

After installing individual meters in apartments water usage fell by 26 percent

Blue gold. Clearance sale.
Save 84 $ million.

Benefits include:

- **Water savings of 12.409.935.974 liters per year**
- **A reduction in water consumption of 26 percent**
- **Savings constitute $84 million annually**

The world is rapidly consuming one of the most important resources of the planet – water.

Global water use has tripled over the last 50 years and demand is increasing worldwide; with the prospects of feeding 9 million people in 2050 the industrial, individual and especially the water demands for agricultural purposes is expected to escalate dramatically. By 2050 we need an 80 percent increase in water supplies purely to feed ourselves – putting even more pressure on water resources.

The World Bank reports that 80 countries now have water shortages with more than 2.8 billion people living in areas of high water stress. The increasing urbanization is putting pressure on city reservoirs and cities around the world are facing 'water bankruptcy'. In America alone, cities such as Atlanta, Houston and Los Angeles are facing severe water shortages, according to the National Resources Defense Council.

Severe drought in cities is not just a human problem – it is a business problem. The competition for water could make life in some of the world´s largest cities nearly unbearable, as well as unproductive. Several industries rely on access to water e.g. agriculture. Today, 70 percent of global water is used for food production. A decisive factor of the growing water crisis is resource management. Making the last drops last is what counts. This is no different in Copenhagen. The city is facing a lack of water resources in close proximity to the city. Therefore, a combination of solutions has been applied.

One of the solutions is the installation of individual water meters. Previously, residents in buildings paid a fixed share of a collective water bill for the building – instead of their actual individual consumption.

After individual meters were installed, the consumption fell remarkably. Over the following six years, the consumption fell by 26 percent on average. Especially in the apartments with the highest usage where the reduction was considerable: 40 percent saved per capita per day.

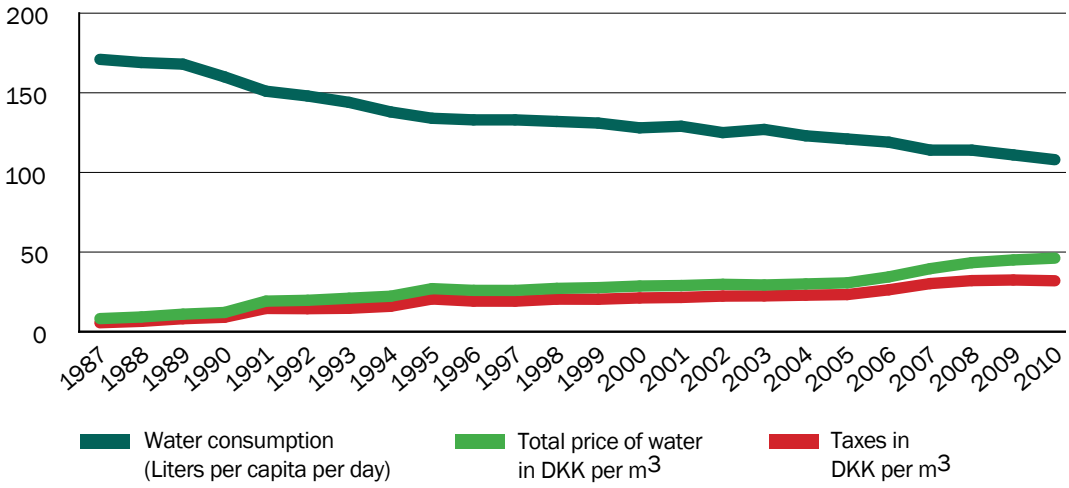
The individual water meters were installed in order to fight water usage in Copenhagen – but also price mechanisms, awareness campaigns and a series of other solutions were applied.

Fig M Water usage - and reductions

Water consumption before installation in litres	Reduction after 6 years in percentage
>120	13,38
120-140	17,61
140-150	25,75
160-180	33,65
<180	39,77

Because of these efforts, water usage from 1987 to 2010 went from 171 liters to 108 liters per capita per day. A saving of 63 liters per day per capita - or annual reductions of 23.000 liters per capita.

Fig N Water usage from 1987-2010. Savings of 63 liters per day per capita



For Copenhagen, this adds up to savings of 12.409.935.974 liters of water each year – or the equivalent of almost 5.000 Olympic size swimming pools.

In dollars and cents the savings constitute 155 $ annually per capita - adding up to 84 $ million for the people of Copenhagen.

Average water use per capita per day varies from about 450 liters in USA and Canadian C40 cities to just over 100 litres in African C40 cities.

Additional roads means additional cars

Making cars happy. Or people?

Integrated public transportation

Benefits include:

- **Convenient and efficient transport**
- **A reduction in congestions and lost hours. The hours due to traffic congestions currently constitute DKK 5.7 billion per year for the Capital Region**

1000 additional cars roll onto the streets of Delhi. Each day. But that is just a drop in the ocean of vehicles expected to hit city shores in the coming decade. According to the International Association of Public Transport, the number of road vehicles are expected to double from just over 1 billion in 2010 to 2 billion in 2020. No wonder that transport is the sector where global greenhouse gas emissions are rising most quickly.

The soaring numbers of cars in cities have brought road movement to a halt. Traffic congestion has ceased to be a rush hour phenomenon. In a world where time is money, sitting frustrated in a queue of cars is costly. In Los Angeles alone, the price tag on congestion is more than 485 million working hours per year.

The Martin Prosperity Institute, headed by urban guru Richard Florida has calculated that "*every minute shaved off America´s commuting time is worth $19.5 billion in value added to the economy.*"[10]

One of the reasons for this is that for the past century we have been building cities that make cars happy.

Copenhagen has also been struggling with increased traffic congestion. Almost 100,000 hours are lost each day in the capital region. However, this number would have been substantially higher if it had not been for the integrated transport system of the city.

A2B-ism

The young woman takes a seat on the train and starts reading today's paper. For the next nine minutes she has time to catch the headlines, check her email or watch the scenery as the train takes her from Hellerup, a well-off suburb of Copenhagen, to the center of town.

Arriving in Copenhagen, the young woman gets on a bus by the train station. The driver nods as she shows him the ticket from the train allowing her to use all other trains, buses

10 Richard Florida, The Great Reset, 2010.

and metros for the next hour. A few other people get on the bus; some of them bring their bikes, as they did on the metro and on the train. The bus pulls into traffic - not into the congested car lanes but into a designated bus lane allowing the bus to pass the cars queuing up despite the green light. Five minutes later she arrives at her destination, faster than she could have done had she taken her car. Not calculating the time spent looking for parking.

Transport is a means to an end not a goal in itself. Getting from A to B is what counts. We´ve been getting it wrong. It´s not about the destination OR the journey. It is about how long the journey takes.

Fig 0 Lost hours due to congestion

	Morning rush hour (Busiest hour of the day)	Daily level	Lost full-time equivalents per day
City of Copenhagen	4.006	38.234	20
Capital Region	10.787	96.634	50

It's the economy, stupid.

Additional roads should not be the default answer to car congestion. Additional roads bring additional cars leading to more congestion.

Due to the integrated public transportation system of Copenhagen, thousands of people leave their cars at home because it is the fastest and most convenient way for them. This saves gas money and keeps the roads less congested. Because of this, billions are saved.

The benefits of integrated public transport in Copenhagen are considerable. Every day, businessmen and women, politicians, students and the rest of Copenhagen save valuable time by using the metro, train and buses knitting the city together. Without this integrated system much more than 100,000 hours would be lost each day. The hours lost constitute a value of 5.7 billion DKK per year for the Capital Region – the equivalent of $ 1 billion. The cost would be considerably higher if it had not been for the integrated transport system of the city.

Infrastructure is not only about transportation. Infrastructure is about the economy. Competitive cities ensure that people and goods are moved around efficiently.

> **“ The most efficient and productive regions are those in which people are thinking and working – not sitting in traffic**
>
> **RICHARD FLORIDA, THE GREAT RESET**

Do we want move people or cars from A to B?

98 percent of all houses and apartments in Copenhagen are heated by district heating, partly based on incinerated waste

Waste
Not

Benefits include:

- **Fewer landfills as only 1,8 percent of the waste is sent to landfills compared to over 40 percent in 1988**
- **Incinerated waste produces energy for the district heating system warming 98 percent of houses and apartments in Copenhagen**
- **Less negative impact on local real estate**

Copenhagen produces more than 800.000 tons of waste each year. For comparison, the world's largest containership, the 398 meter long Emma Mærsk, weighs around 150.000 tons. Fortunately, instead of loading the equivalent of five containerships of waste onto landfills annually, Copenhagen is making the most of waste.

For the past several decades the city has been reducing the waste produced and used what was produced as a resource. Copenhagen is therefore no longer using landfills as a general solution to waste problems. In 2009, only 1.8 percent of the waste produced was send to landfills compared to over 40 percent in 1988.

Instead, the waste is recycled or incinerated in combined heat and power plants. The incinerated waste generates power and heat for thousands of households and makes use of the valuable energy contained within the city's trash. In fact, 98 percent of houses and apartments in Copenhagen are heated by the district heating system, where 50 percent of the

Fig P **Combined heat and power – Fuel sources for district heating**

	Gwh	Pct
Waste – recyclable materials	1.693	39
Waste – non-recyclable materials	434	10
Wood pellets	477	11
Straw	217	5
Coal	998	23
Oil and diesel	260	6
Natural gas	304	7
Total	**4.340**	**101**

energy stems from waste. This is not only a giant environmental benefit – as the alternative to burning waste would be to burn fossil fuels – it also holds a variety of socioeconomic benefits.

Not In My Backyard

The least favorite neighbor to a lot of people is landfills. Not only are they an eyesore and reek – they are also devastating to real estate value. Several studies have examined this effect. The most thorough is *"A study to Estimate the Disamenity Costs of Landfill in Great Britain"* by Food & Rural Affairs Department for Environment, in Great Britain.

The study concludes – not surprisingly– that the properties closest to the landfill lose the most value. On average, the price of real estate within 400 meters of landfills is cut by $ 1.100. As Copenhagen is no longer using landfills as a solution, fewer homeowners have to bear the cost – or smell and sight of landfills.

In addition, the incineration solution creates the benefit of strongly reducing the risk of health hazards due to landfills, while also avoiding the cost of having to dispose of waste. Denmark has taxes for waste disposal and incineration. In addition, costs exist beyond taxation whether the trash is stockpiled or burned.

The total cost of disposing one ton of waste is $ 14 more expensive than incinerating it. With 800,000 tons of waste produced every year in Copenhagen, this adds up. Moreover, the calculation does not take the value of the energy produced from incinerating the waste into account.

> **"Waste is better utilised through incineration than through landfills but recycling is an even better option. Of course, the best option is prevention of waste production altogether, which often requires direct reuse. The less waste, the better – it's as simple as that."**
>
> **CITY OF COPENHAGEN, COPENHAGEN WASTE SOLUTION, 2008**

11 C40 and Arup, Climate Action in Megacities, 2011

Hot town –
summer in the city

Benefits include:

- **A reduction in energy consumption by 80 percent**
- **Improvement in health and quality of life**
- **Preserving the architectural impression**

Despite its northern latitude, Copenhagen can hit temperatures as high as 35 degrees Celsius during summer. Installing air condition units are the default solution for some. In order to keep cool, people are willing to swallow the electric bill of air conditioning units and close their eyes when passing buildings plastered with AC units.

However, there is a different solution to the problem – one that does not ruin the architectural impression of beautiful cities, reduces electricity bills by 80 percent, improves health and quality of life, and puts less strain on the environment. In several buildings in the old part of Copenhagen, district cooling systems have been installed.

District cooling is a system where chilled water is produced – partly by cold water from the sea – and distributed via insulated pipelines underground to cool commercial and industrial buildings in central Copenhagen.

The district cooling system provides environmental benefits – CO2 reductions are cut by 70 percent compared to traditional cooling methods. Due to the district cooling system some of the beautiful buildings in the old part of town offices now have rooftop terraces instead of 2-3 tons of installations whereas traditional cooling systems would demand almost all the space on roof tops. Sustainable life proves more enjoyable than conventional life.

Improved quality of life is also ensured as air conditioning is noisy compared to district cooling systems. Additionally, district cooling removes many of the health risks associated with cooling towers e.g. legionnaire´s disease.

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