

COPENHAGEN CLIMATE PROJECTS

ANNUAL REPORT 2015



**CITY MAP OF COPENHAGEN
CLIMATE PROJECTS**



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PROMISING BEGINNINGS – CHALLENGES AHEAD

Copenhagen has cause for celebration. After committing to becoming the world's first carbon neutral capital, the city has already cut emissions by 31 percent. However, crucial challenges loom ahead, if Copenhagen is to make good on its promises by 2025.

When you set your mind to an ambitious goal, you need to stop every once in a while and reflect on the progress you have made. And we've made great progress in Copenhagen since we embarked on the journey to become the world's first carbon neutral capital. But there are still many and long strides to be made.

Last year showed that, since the baseline year of 2005, carbon emissions have dropped by 31 percent. In that sense Copenhagen has demonstrated a decoupling of a city's growth in numbers and emissions, as the reductions happened over a period when the city's population grew by 15 percent and the city's economy grew by 18 percent.

The reductions are the fruit of a constant focus on the way we produce and use energy, while increasing the quality of life for the citizens of Copenhagen. But despite our progress, we need to keep our eyes focused on the road ahead. To achieve carbon neutrality, Copenhagen must successfully make a number of important transitions in the years to come.

Changing the way we transport ourselves is one of these transitions. Copenhagen is already a bicycle-friendly city, with 62 percent of Copenhageners taking their bicycle to work, we have replaced a large part of our municipal fleet with electric vehicles, and we will soon be introducing waste trucks running on biogas. However, we still need to push to replace trucks, busses and cars running on fossil fuels with hydrogen, biogas and electric vehicles.

Next year, Copenhagen is expected to adopt plans to convert the last of our four coal-fired blocks at the city's combined heat and power plants (CHP) to biomass. This is an important step towards a district heating system running solely on renewable energy. But we still need to ensure that our work with biomass is indeed a part of a truly sustainable system.

2016 will also be important for our ambitions to install 360 MW wind power by 2025. To do so, through our municipal utility company, HOFOR, Copenhagen must successfully win one or more national tenders for offshore wind farms. We also need to develop solutions to reduce the amount of plastic in our waste or recover it via recycling, and we are already seeing willingness from citizens and companies alike to contribute to the sorting and recycling. But we are also aware that we need to sort and reduce even more, that we need to create partnerships and engage our citizens even more. And finally, we must develop methods to jump-start large-scale retrofitting of our buildings. Failure to do so will greatly increase the costs of our transition to a low-carbon future, as it will mean a greater need for energy production capacity.

In 2015 we see an increased awareness of the role that cities can and must play in the global sustainable agenda. With the world's cities accounting for 70 percent of global GHG emissions, it is impossible to imagine a solution to climate change without them. Recently the United Nations Sustainable Development Goals focused – among other things – on the major role cities have in creating a better and more sustainable world. And it is vital that the COP21 negotiations in Paris incorporate a mechanism for major cities and companies to pledge emissions reductions.

Despite these huge challenges ahead of us, Copenhagen remains as dedicated as ever. We have hard work ahead of us, but we have also – in all modesty – found some solutions that work.

I hope that you may find some inspiration and encouragement in this report and the progress we have made so far.

Morten Kabell,
Mayor of Technical and Environmental Affairs



CLIMATE PLAN – NEED TO UP-DATE THE COURSE

Depending on how you look at it, 2014 was a year for cautious optimism about Copenhagen's climate progress – or a little concern. Carbon emissions continue to drop, but some areas are not showing the expected progress, and further initiatives are needed to make Copenhagen carbon neutral by 2025.

The good news is that Copenhagen is showing impressive reductions in carbon emissions.

In 2014 emissions were 31 percent below the baseline year of 2005 – an improvement of 10 percentage points on 2013. And bear in mind that this reduction happened over a period when the city's population grew by 15 percent.

These reductions are primarily due to an increase in the use of biomass in Copenhagen's district heating system and a greater share of wind-generated electricity in the city's energy system. But 2014 also saw some more worrying trends.

Shortfall of 300,000 tonnes carbon

Even though emissions are dropping, the City of Copenhagen is a little behind schedule on meeting its goal of carbon neutrality by 2025. In fact, calculations show that the city may need further initiatives delivering 300,000 tonnes of carbon reductions.

The explanations for this shortfall are many. A number of projects have not had the desired effect – for example it has been harder than expected to achieve the desired energy efficiency gains in existing buildings. Furthermore, the planned

new biomass unit at the Amagerværket CHP plant will have less carbon reduction capacity than expected. Finally, plans to introduce a toll ring around Copenhagen could not be carried out due to lack of support at government level.

A year of achievements

Nonetheless, the year also saw Copenhagen move forward on many fronts. Copenhagen embarked on its journey to make the capital resilient to the effects of climate change. A total of 16 climate adaptation projects were given the green light and will begin planning and construction in 2016. The projects are the first of more than 300 climate adaptation projects needed to protect the city against cloudbursts. 2014 also saw advances in the initiative by the municipal utility company, HOFOR, to develop district cooling using seawater. The company has now signed contracts to distribute cooling to businesses corresponding to more than 40 MW of reductions. In 2014 Copenhagen also accelerated the replacement of garbage trucks running on traditional fuel in favour of biogas-powered trucks. You can read about these projects in detail in the following articles in this publication.



Photo by Ursula Bach, City of Copenhagen.

Taking the plan to the next level

Despite its achievements, Copenhagen is acting quickly to address the 300,000 tonne carbon shortfall.

The city will work to jumpstart retrofitting of existing buildings in Copenhagen. Copenhagen plans to target the buildings with the poorest energy performance and form partnerships with owners, tenants, energy companies and the financial sector. Specifically, the City of Copenhagen will look into new ways of financing retrofitting as well as carry out demo projects of sustainable buildings.

Furthermore, Copenhagen intends to adjust its renewable energy target upwards, with another 100 MW of wind power to be installed by 2025.

Copenhagen is also prepared for an increased push with regard to its waste.

The city is aiming to reduce the amount of plastic in waste, and a new waste plan has initiatives to address this. Furthermore, Copenhagen will launch a new partnership, Copenhagen Climate Partners, to establish a closer link to companies and universities, and boost innovation.

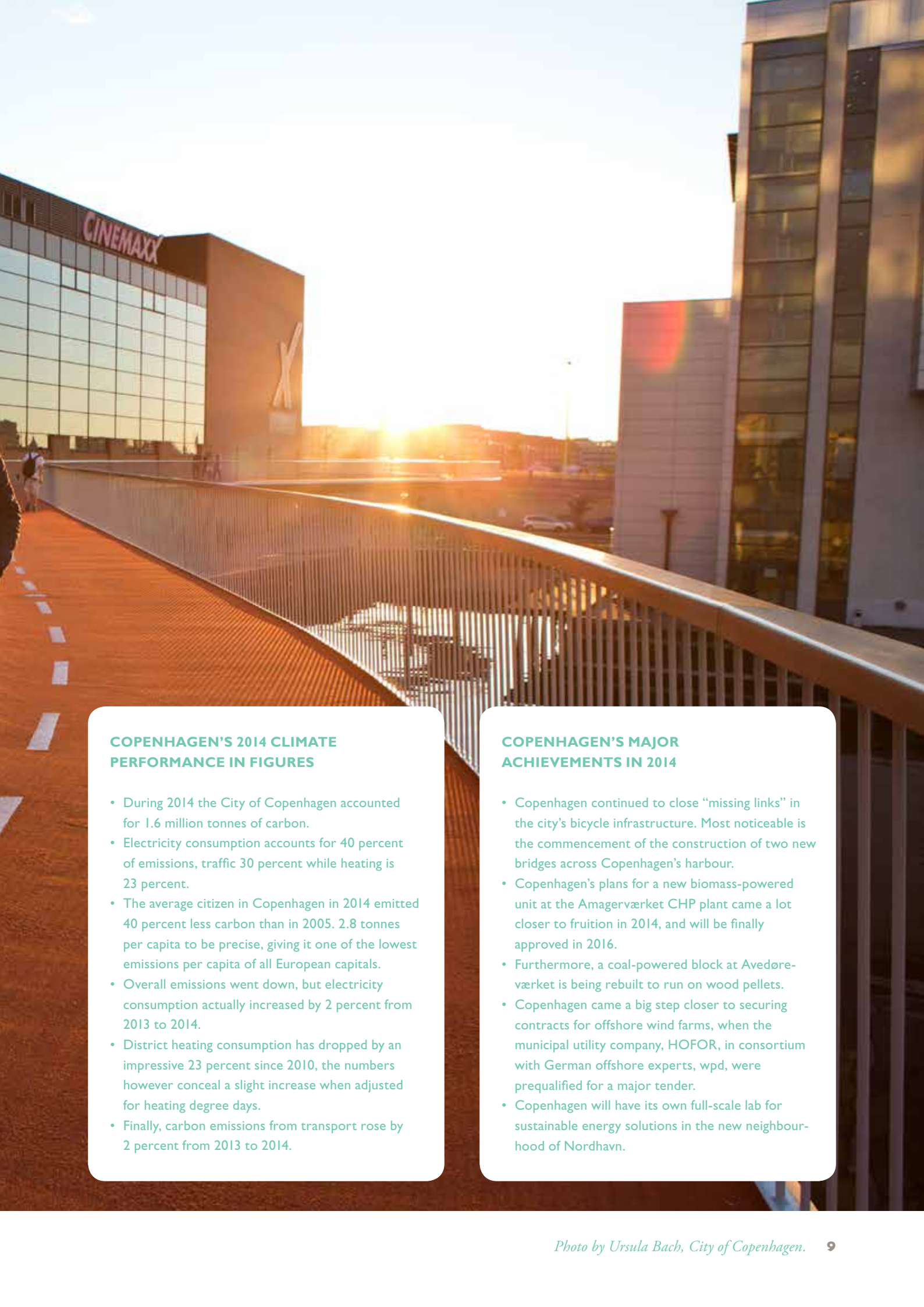
Copenhagen at the vanguard

To further strengthen Copenhagen's climate efforts, the mayor of technical and environmental affairs has enlisted a climate advisory board of Denmark's best experts on climate issues. The board is set to meet 4-5 times a year to discuss specific projects or climate-related challenges and deliver advice to the mayor and the administration.

Furthermore, Copenhagen has helped establish the Carbon Neutral Cities Alliance. This is an elite group of cities, committed to at least an 80 percent carbon reduction by 2025. The alliance counts members like London, Melbourne, Berlin, San Francisco, Oslo, New York, Vancouver, Stockholm and Yokohama. The alliance also funds projects, and Copenhagen has obtained funding for two new projects.

Together with Oslo, Stockholm, London, Vancouver and San Francisco, Copenhagen will examine ways of financing urban retrofitting projects in a workshop in Copenhagen. Secondly, the city will launch a project with other Northern European cities to look at a new infrastructure for alternative fuels.





COPENHAGEN'S 2014 CLIMATE PERFORMANCE IN FIGURES

- During 2014 the City of Copenhagen accounted for 1.6 million tonnes of carbon.
- Electricity consumption accounts for 40 percent of emissions, traffic 30 percent while heating is 23 percent.
- The average citizen in Copenhagen in 2014 emitted 40 percent less carbon than in 2005. 2.8 tonnes per capita to be precise, giving it one of the lowest emissions per capita of all European capitals.
- Overall emissions went down, but electricity consumption actually increased by 2 percent from 2013 to 2014.
- District heating consumption has dropped by an impressive 23 percent since 2010, the numbers however conceal a slight increase when adjusted for heating degree days.
- Finally, carbon emissions from transport rose by 2 percent from 2013 to 2014.

COPENHAGEN'S MAJOR ACHIEVEMENTS IN 2014

- Copenhagen continued to close “missing links” in the city’s bicycle infrastructure. Most noticeable is the commencement of the construction of two new bridges across Copenhagen’s harbour.
- Copenhagen’s plans for a new biomass-powered unit at the Amagerværket CHP plant came a lot closer to fruition in 2014, and will be finally approved in 2016.
- Furthermore, a coal-powered block at Avedøreværket is being rebuilt to run on wood pellets.
- Copenhagen came a big step closer to securing contracts for offshore wind farms, when the municipal utility company, HOFOR, in consortium with German offshore experts, wpd, were prequalified for a major tender.
- Copenhagen will have its own full-scale lab for sustainable energy solutions in the new neighbourhood of Nordhavn.

CREATING NEW BUSINESS RELATIONS

Can a public authority function as a matchmaker? The City of Copenhagen is hoping to speed up innovation of climate solutions by linking companies, clusters and universities facing climate-related challenges with companies holding knowhow or solutions to meet these challenges.

For all its good intentions, the City of Copenhagen cannot make the transition to a zero-carbon economy by itself. Obviously, with an annual expenditure close to DKK 48 billion, the city can push for innovation through public procurement. But even a city the size of Copenhagen is still a relatively small player in the city economy.

“If we are to reach our goal of becoming carbon neutral by 2025, we need cooperation across sectors,” says Per Boesgaard, Coordinator Partnerships & Innovation in the Climate Secretariat in the City of Copenhagen.

2014 proved to be an opportunity to test new ways of cooperation. After receiving the European Green Capital award, the City of Copenhagen launched its “Sharing Copenhagen” platform, inviting businesses, organisations and citizens to join in showcasing the best in sustainable solutions.

During conferences, masterclasses and events under the Sharing Copenhagen platform, the best experts from the public and private sectors and NGOs were brought together to come up with new solutions. The success of Sharing Copenhagen inspired the setup of Copenhagen Climate Partners.

SOLUTION: FACILITATING NEW BUSINESS RELATIONS

Still in its infancy, Copenhagen Climate Partners is a growing network of public and private businesses and universities. The City of Copenhagen serves as a facilitator and “platform” by bringing together professionals and users to address different climate-related challenges.

“A major housing association in Copenhagen is looking to retrofit a large number of buildings and is searching for ways to improve insulation without compromising the unique look of the buildings. Here we can serve as a facilitator by bringing professionals together to point out the best solutions or help create new ones,” explains Per Boesgaard.

“The City of Copenhagen is in contact with a wide variety of partners from businesses to universities and organisations. In Copenhagen Climate Partners we are beginning to take advantage of this actively to bring professionals together around climate challenges,” says Per Boesgaard.

One of the companies participating is the engineering consultancy, Grontmij, which employs more than 6,000 professionals globally.



Copenhagen Climate Partners (CCP) offers businesses, universities and clusters the opportunity to discuss solutions to urban climate related challenges. The precursor to CCP was Sharing Copenhagen that held the Green Capital Days in 2014. Photo by Christian Lindgren.

“The City of Copenhagen is a big client to us, so naturally we are keen to participate anywhere we can gain a better understanding of their needs and challenges,” says Henrik Martens, marketing director at Grontmij.

Of course, it’s appealing to contribute to tackling difficult and new challenges. However participating in Copenhagen Climate Partners potentially puts Henrik Martens and Grontmij at the same table as their competitors. How does he feel about that?

“Our approach is that we have to be better than our competitors, so naturally we should be able to deal with this as well,” says Henrik Martens.

RESULTS: NEW TECHNOLOGIES OR BUSINESS MODELS

To Grontmij it’s obviously also an attraction to gain access to their clients’ thoughts and considerations before they make up their mind on whether to get new windows or invest in a heat pump.

“Eventually, this approach will result in better solutions. When consultants, suppliers and manufacturers are part of tackling the challenge, the results will naturally be better

than if the City of Copenhagen or a building association just made up its own mind,” says Henrik Martens.

And there are plenty of challenges for the partners to tackle. Copenhagen will use the network in 2015 to come up with new ideas for a project named “Urban Heat Island” that aims at taking a new approach to city planning to make better use of the heat between buildings during winter and reduce the need for cooling during summer.

Partners will also be asked to come up with new ideas for the urban infrastructure and how to promote vehicles running on alternative fuels.

COPENHAGEN CLIMATE PARTNERS

- Copenhagen Climate Partners is a network of businesses, organisations and knowledge institutions.
- The partners are committed to contributing their expertise to tackling challenges related to climate change in the city.
- Copenhagen Climate Partners was established in 2015.

CLIMATE CHANGE – THE POWER OF SUBNATIONALS

Even an optimist like Michael Northrop of the Rockefeller Brothers Fund can get a little anxious over the enormous challenges ahead. He estimates the world has about 35 years left to turn the tide on climate change. However, he sees encouraging signs in subnationals like cities and businesses.

Michael Northrop has a better understanding than most of what is possible in terms of combatting climate change. He directs the Sustainable Development grant-making programme at the Rockefeller Brothers Fund in New York City, where he focuses on climate change.

Though he awards grants for projects all over the world, he recently had reason to cheer his hometown, New York, as the city's Mayor de Blasio announced a commitment to reduce city greenhouse-gas emissions by 80 percent by 2050. At the same time, the mayor launched a push to transform the city's buildings through retrofitting.

"I love the fact that the political will in cities is so strong. We now have something like a hundred cities that have pledged to reduce their emissions to levels scientists say are necessary. And many are even talking about going carbon-neutral," says Michael Northrop.

But getting to a climate-safe world is not an easy task, he admits.

Three transformations for our societies

"We need to manage several very significant transformations. We need to live in buildings that produce as much energy as they consume. We need to eliminate the combustion engine, and we need to produce alternative energy that is fossil-free. Those three things are fundamental challenges, and I see cities taking them on," says Michael Northrop.

Shouldn't this task be with national governments?

"Politicians at national level have a harder time. That's why we're also looking to cities like Copenhagen and New York and states like California and Baden Württemberg to help lead the way. They can help drive the transition; and it's phenomenal what you see out there. By the time we get to Paris (COP21 in November 2015) there'll be more subnationals with declared zero-emissions goals than national governments".

By sub-nationals you also mean companies?

"Yes, companies, like cities, can see the advantages in acting and are used to taking action and making decisions. Apple, Amazon and Walmart, for example, have all shown they can make things happen. They can quickly create payment incentive schemes for their employees to promote sustainable thinking and behaviour. It's still challenging for them, but it's not as hard as getting climate legislation through the U.S. Congress".

You seem optimistic?

"I'm positive, but I'm also worried. We have so little time – 35 years at most to make this transformation happen. But I find it encouraging that so many subnationals are embracing these transformative targets. We need to support and embrace what the cities, states, and businesses are doing. They are very tangible. Take cities for instance. They are doing things like establishing ambitious building codes, creating financing programmes to retrofit buildings and certifying contractors to do the work. These actions are practical and meaningful".



Summer Streets is an annual event in New York City where nearly seven miles of streets are opened up to the public to play, run, walk and bike. Photo by New York City Department of Transportation.

Photo by Rockefeller Brothers Fund.

Why is retrofitting of buildings such an important task?

“Take a city like New York. Here, buildings are responsible for 71 percent of the city’s greenhouse gas emissions and 94 percent of its energy consumption. We have the technology to make the necessary changes. We have the windows, we have the LED bulbs, and we have the insulation. We just have to find a way to create triggers for wide-scale action. One way under discussion is mandating that new owners of older buildings make energy improvements within a year of acquiring the building”.

“Mandating changes” sounds a little bit like infringing on people’s freedom?

“Change seems upsetting before it happens, but the collective benefits will be huge. And the individual benefits for each building will also be great, including energy savings, improved indoor air quality, and worker productivity. I think we can stand a little inconvenience if we get those kinds of benefits. It’s always hard to start programmes, but after we can see and feel the benefits, the natural resistance to change will be alleviated”.

Can you give an example of that?

“In San Francisco people were initially very concerned when the city introduced recycling of household food waste. People worried about smelly garbage on the streets and increased numbers of rats and bugs, but now the system is a great success. We embrace change that we like. People have been worried about moving to electric cars too, but

have you ever talked to a Tesla owner? It’s all they can talk about. We need more savvy entrepreneurs like Elon Musk to help shape people’s approval and excitement. We also need savvy policy entrepreneurs inside government to build public support for policies like building retrofits”

CV OF MICHAEL NORTHROP

- Programme director at the Rockefeller Brothers Fund in New York City, USA.
- He directs the Sustainable Development grant-making programme, specifically focusing on energy and climate change.
- He also teaches as a guest lecturer at Yale University’s Forestry and Environmental Studies School.
- He is a member of New York City’s Sustainability Advisory Board.

FIRST WAVE OF PROJECTS GETS GREEN LIGHT

After years of planning its climate adaptation efforts, Copenhagen is ready to begin construction of the first 16 projects. This poses something of a challenge for a city that has so far only completed a couple of climate adaptation projects. But Copenhagen has to mature fast. To make the city climate-resilient, the plan dictates completion of more than 300 climate adaptation projects over the next decade.

Few areas epitomize Copenhagen more than the Inner Lakes on the border between the inner city and the districts of Frederiksberg, Nørrebro and Østerbro. Originally situated outside the city walls, the five lakes served as reservoirs for drinking water as well as a defence against invaders. As the city grew, the lakes became an increasingly important source of recreation for Copenhageners. Today the lakes are under nature conservation and attract thousands of daily visitors – young and old, tourists, joggers and sweethearts.

But the lakes will have another important task to perform in the future.

The lakes sit in the heart of a densely populated area with high risks of flooding during cloudbursts. During the extreme cloudbursts in 2011, the historic fortifications of Kastellet at the far end of the lakes were flooded. By upgrading the lakes, Copenhagen hopes to create an important safety valve for threatened neighbourhoods during cloudbursts.

To make the Inner Lakes a solid defence against extreme weather, the City of Copenhagen plans to establish a delay area in the lakes using the existing water capacity. Specifically, the project will restore the lake embankments as well as upgrade two pipelines leading water into Copenhagen Harbour.

When it is complete, the project will protect up to an estimated 57,000 citizens against floods. Furthermore, by creating solutions on the surface Copenhagen will reduce climate adaptation costs substantially. By comparison, underground reservoirs and upgrading pipelines would have cost an estimated DKK 618 million, while the Inner Lake project will cost just DKK 34.2 million.

Rapidly increased rate of climate adaptation

The Inner Lake project is far from Copenhagen's first

endeavour at climate adaptation. As you can read in the article on the climate-resilient neighbourhood of St. Kjeld's, in the past year the City of Copenhagen completed an extensive renovation of Tåsinge Plads – a square once covered by asphalt and lawns. The project transformed the square into a green and inviting park for Copenhageners, while serving to retain and delay rainwater during cloudbursts.

The transformed Tåsinge Plads is only one of many climate adaptation solutions in the St. Kjeld's neighbourhood – an area internationally recognised as an open test lab for adaptation solutions and one of the most climate-resilient neighbourhoods in the world. Another project will transform the square, Sankt Annæ Plads, close to the royal palace of Amalienborg. However, compared to the rate of climate adaptation needed in Copenhagen in the coming years, these early projects seem like mere warm-up exercises.

To make Copenhagen climate-resilient, the City of Copenhagen needs to implement 300 projects across town over the next twenty years. That means a rate of at least 15 projects a year. Now the capital is starting this journey with its first 16 projects.

Reduced costs by coordination

In a bustling city like Copenhagen there is always on-going construction work. Currently the lengthy and colossal infrastructure project – the expansion of the city's metro net – is the most visible and major construction work, and the City of Copenhagen is being careful not to needlessly test the patience of Copenhageners.

For that reason, Copenhagen is careful when prioritizing which climate adaptation projects to give the green light.

Copenhagen always has multiple construction projects going on. From expanding bike lanes to complete urban



After undergoing major renovation, Tåsinge Plads is ready for cloudbursts. The square now serves as an important element in securing the neighbourhood against climate change by collecting, delaying and seeping precipitation. Photo by Mette Fjendbo Petersen.

renewal projects. To make sure the city does not have to dig the same holes twice, Copenhagen prioritizes climate adaptation projects that can fit into existing projects or projects that are being planned.

For example, a new bike lane is being planned along Amagerbanen – an old railway track on the island Amager. At the same time, construction of new residencies will begin in the area. For Copenhagen, this is an excellent opportunity to launch a climate adaptation project and construct a delay road for precipitation from neighbouring houses.

In another area, Fuglekvarteret is planned to undergo complete urban renewal in 2016. The City of Copenhagen will use this opportunity to establish cloudburst roads, delay roads as well as delay squares designed to collect rainwater during cloudbursts and delay it to relieve pressure on sewers.

Finding funds for urban improvements

There is another advantage to coordinating climate adaptation projects with other on-going construction work. The city can maximise urban improvements; especially urban renewal projects.

This is because climate adaptation projects in Denmark are financed from sewage charges collected from citizens and companies by public utility companies. The municipalities then apply for funding for climate adaptation projects from a centralized secretariat. The secretariat grants funding to projects on the basis of their hydraulic effect and documentation that the proposed climate adaptation project is cheaper than scaling up capacity in the traditional sewer system.

However, the secretariat does not finance additional urban improvements that often provide great value to the city in terms of quality of life. In short, municipalities have to continuously dig into their own pockets to finance urban

improvements as part of climate adaptation projects.

Climate adaptation projects are a great opportunity to add value to cities. However, it takes continuous political commitment to allocate the necessary funds.

An example of this is the planned cloudburst pipe (a pipe designed specifically to collect and lead precipitation underground) and delay road on Strandboulevarden in the neighbourhood of Østerbro. The project is estimated to cost DKK 111.4 million and will provide protection from cloudbursts for up to 33,000 citizens in the area. However, the project also has the potential to transform the area into a green urban area for recreation. Unlocking this potential however, will cost additional DKK 180 million.

COPENHAGEN'S CLIMATE ADAPTATION PLAN

- The City of Copenhagen tracks its climate adaptation progress by using an indicator.
- Currently the indicator estimates that Copenhagen has reduced the risk of flooding by 30 percent, while protecting 160,000 Copenhageners from floods.
- 300 different projects are needed to make Copenhagen resilient to the extreme weather of the future.
- Realizing all of the projects will take up to 20 years.
- The projects will cost DKK 9.8 billion.
- Copenhagen is divided into seven catchment areas that form their own hydrological unit.
- Prioritized project packages are designed for each catchment area.

NEIGHBOURHOOD READY FOR RAIN

Copenhagen has already had its first taste of extreme weather events. Fortunately the city began preparations for heavy downpours years ago, and by 2020 a whole neighbourhood, from public squares to private courtyards, will be ready for a future with more and more violent precipitation.

Until recently, the public square in Eastern Copenhagen, Tåsinge Plads, was a perfect illustration of why many major cities struggle to adapt to climate change. The square basically consisted of a large grass area and vast area of asphalt. Ideally, you want ample space for parking while leaving a green area that is relatively easy for the city to maintain. However, this very type of fortified area has huge downsides when cloudbursts happen.

“Most cities are now realizing that covering huge areas in asphalt and pavement is a certain way to create floods during extreme rain events. The water has nowhere to go but into the sewers or remain on the surface. Unless a city has very deep pockets and can build huge sewer pipes underground, the most cost-effective way to manage precipitation is by catching and delaying the water on the surface, and subsequently directing it in a controlled way into underground pipes,” says Henriette Berggreen of the City of Copenhagen.

And Copenhagen is working diligently to do just this. The city has laid out a plan to adapt the capital to the effects of climate change. Tåsinge Plads, along with the entire neighbourhood of St. Kjeld’s, is pioneering the transition.

SOLUTION: AN INFRASTRUCTURE FOR PRECIPITATION

Today, Tåsinge Plads looks very different from the grass and asphalt of the past. The square has been turned into a lush green oasis in the middle of the capital. The hydraulic

purpose of the redesign is to detain and redirect as much of the precipitation that falls around the square. The square slopes downwards to the east, creating a permanent reservoir to channel rain away from the sewers.

However, an almost equally important aspect of the redesign has been to demonstrate that climate adaptation projects can also improve the quality of life for people.

“Securing a city like Copenhagen against climate change is a huge investment, and we need to make sure that this investment benefits our citizens’ everyday lives,” explains Henriette Berggreen. Therefore, Tåsinge Plads today is a gathering point for the entire neighbourhood; it’s like a park, and cafes and restaurants are springing up all around. The final design of the square was decided with help from the area’s residents.

RESULTS: ADAPTATION AND IMPROVED QUALITY OF LIFE

Tåsinge Plads is a significant element in the push to secure the neighbourhood against climate change. The square sits on a slope and will be an important element in a network of “Cloudburst Roads” – roads designed to contain and direct rainwater to parks, reservoirs or the harbour.

More elements are soon to follow, as the nearby square of St. Kjeld’s Plads will undergo a similar transformation and test technology to divert the first flush of often polluted



Tåsinge Plads passed the test after its first cloudburst in July 2015. The renovated square is designed to store and divert precipitation away from the neighbourhood. Photo by Mette Fjendbo Petersen.

“The entire St. Kjeld’s neighbourhood is already a showcase for ground-breaking climate adaptation solutions ...”

Henriette Berggreen

rain water to sewers and treatment, while managing the rest of the rainfall locally and on the surface.

“The entire St. Kjeld’s neighbourhood is already a showcase for ground-breaking climate adaptation solutions. This will continue as we launch four new projects to ready private courtyards for climate change. Courtyards often suffer from the same problems as public areas; that surfaces are covered in asphalt or pavement,” says Henriette Berggreen.

The four demonstration projects will take a different approach to making courtyards a part of the city’s defence against cloudbursts. One will test how to locally divert precipitation without overloading sewers. Another will test ways to create coherent solutions between the closed courtyards and the streets outside. In a third project, the city will test low-energy solutions as well as climate adaptation.

ST. KJELD’S NEIGHBOURHOOD

- St. Kjeld’s neighbourhood is an area in the eastern part of Copenhagen.
- The neighbourhood is committed to becoming the first climate-resilient neighbourhood.
- The neighbourhood sits atop a slope that leads to the harbour and to the sound of Øresund.
- The City of Copenhagen has adopted plans to secure the neighbourhood against extreme rain with a network of surface projects to delay rain-water and then lead it via specially designed roads, pipes or tunnels to the harbour.
- The transformation of Tåsinge Plads cost DKK 16 million.
- The next projects, St. Kjeld’s Plads and Bryggervangen are scheduled to be ready in 2017.
- The first two of a total of four courtyard projects are scheduled to be ready in 2016.

RELIEVING A STREAM UNDER PRESSURE

Harrestrup Stream runs through vital parts of Copenhagen and neighbouring municipalities. However, the stream is under immense pressure during heavy downpours, and this pressure will only increase with the effects of climate change. Therefore, the City of Copenhagen is preparing one of its biggest climate adaptation projects to date.

Through history, rivers and streams have often been compared to the arteries in the human body – especially if they were vital routes for transportation.

Today you might think waterways were not as important in the infrastructure as before, but if you had seen Harrestrup Stream during the dramatic cloudburst in July 2011, you would realize your mistake. To a major city like Copenhagen, streams like Harrestrup Stream serve the vital purpose of transporting precipitation away from buildings, basements and roads. And if the Harrestrup Stream were an artery, it would be in need of major surgery.

“Harrestrup Stream carries water from a large part of the capital area. It runs through ten municipalities and is under enormous pressure with the increasing urbanisation of its catchment areas. That’s why we’ve launched this enormous joint project,” explains Jan Burgdorf Nielsen of the City of Copenhagen.

SOLUTION: TEN CITIES JOIN FORCES

Though Harrestrup Stream has been a bit of headache for local decision makers, it could also prove to be the cheapest solution to the threat from increasing rainfall in the capital region.

“The stream is surrounded by parks, lakes and meadows that can serve as reservoirs to delay rainwater during extreme weather events. The alternative would be to build concrete reservoirs, pipes and tunnels and these could easily cost ten-times the amount of using the natural solution of the stream,” says Jan Burgdorf Nielsen. For example, it would cost around DKK 2 billion to build an underground reservoir at the meadow, Damhusengen. By comparison, levelling the ground in the meadow to serve as a reservoir would cost a mere DKK 200 million.

However, a project of this scale poses serious challenges as well. The ten municipalities working jointly on the project need to agree on what they want to do.

“If one municipality acts on its own and launches its own project, it could potentially influence the nine other participants negatively. So we need to coordinate closely and hold steering committee meetings every six months,” says Jan Burgdorf Nielsen.

RESULTS: ADAPTATION AND INCREASED QUALITY OF LIFE

By the summer of 2015, phase 2 of the project had been concluded, in which increasingly more advanced calculations of possible scenarios were run.



In the future, citizens will benefit from the streams expansion making room for more water during heavy rain. Photo by Jan Burgdorf.

“The stream is surrounded by parks, lakes and meadows that can serve as reservoirs to delay rainwater during extreme weather events ...”

Jan Burgdorf Nielsen

The detailed calculations and simulations serve to provide decision makers with the best possible data for selecting which projects to prioritize. A third phase, with even more detailed modelling of weather events, has to be carried out before the final plan is ready by the spring of 2016.

“One of the solutions we’re looking at is to prepare the meadow, Damhusengen, so it can be used as a reservoir during heavy rainfall. We’re working closely with the local community to ensure that we end up with a solution that also creates value to the residents in the area,” says Jan Burgdorf Nielsen.

HARRESTRUP STREAM

- Harrestrup Stream is a heavily regulated stream, running for 20 kilometres through the western part of Greater Copenhagen.
- After the massive cloudburst in July 2011, ten municipalities signed a cooperation agreement to work to make the stream resilient to future heavy rainfall.
- The first step in the cooperation was to reach agreement on a common model to calculate the runoff of rainwater.
- In the second phase, a number of simulations looked at the possible effects of different climate adaptation projects.
- In the third phase, all the projects in the catchment area will be incorporated into the model, and an overall solution for all the municipalities will be worked out.
- The first projects will be ready to begin by 2016.

FOUR FRONTIERS FOR SUSTAINABLE BUILDINGS

Cities like Copenhagen and Vancouver are at the forefront of combating climate-change, despite the absence of a global agreement. Professor John Robinson from the University of British Columbia in Canada has more than three decades of experience within the field of energy and sustainability, and he sees four major challenges for buildings to become not just energy efficient but net positive.

John Robinson, professor at the University of British Columbia, has been in the game for long enough to have noticed the shift in focus from the 1990s when global warming entered the global agenda.

“I spent a lot of years with the IPCC assessment reports and the focus then was on setting up an international system and reaching a global agreement. To an important extent, that focus has shifted to cities,” he says.

Why the shift, do you think?

“Because of the difficulty in reaching a global agreement and perhaps the realization that even if we had one, it would not have been effectively enforced. The failure has made people focus at a level they can deal with. Don’t get me wrong, we still need international agreements, but we also need local action. Moreover, we need to go beyond climate policies alone. Cities are experimenting with a broad range of policies that offer the possibility of changing the underlying development path”.

What are the biggest obstacles to cities making a real difference?

“The biggest obstacle is path-dependence. And by that I mean there are a bunch of rules that exist to govern what we do (job descriptions, performance evaluation criteria, codes of practice, regulatory requirements, professional standards, etc.). All of these rules were made before we became aware of climate change. If we don’t change these rules, we will have a very hard time reaching our sustainability goals.

This means that the barriers to change are almost never technical or economic, but related to these organisational rules. The City of Vancouver, for example, has been successful because its greenest city goals permeate the entire organisation. When we looked at other municipalities across Canada and recorded their best practices, we also found that when the political and organisational priority is in place, the money is not far behind”.

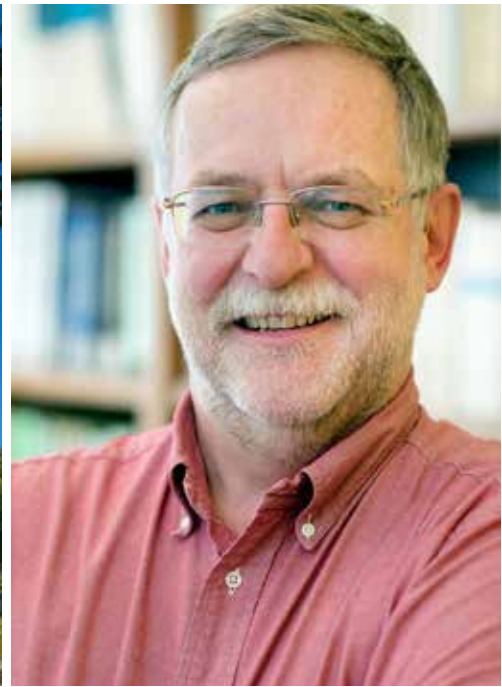
Unlocking the potential in our buildings

John Robinson was deeply involved in development of the Centre For Interactive Research on Sustainability (CIRS) – a living lab on sustainability research. When the CIRS opened in 2011, it was the most innovative and high-performance building in North America.

“When we built CIRS, some of the biggest barriers were building regulations. We experienced that health and safety regulations worked against sustainability. For example we had issues with regulation because the building has its own water treatment facility to clean rain water for use in the building”.

Apart from the regulatory obstacles, what are the main challenges to making buildings that contribute to combatting climate change?

“I see four frontiers for sustainable buildings: The Performance Gap, the Behavioural Dimension, Going Beyond Net Zero and Moving Beyond the Building”.



The Centre For Interactive Research on Sustainability (CIRS) in Vancouver – a living lab on sustainability research. CIRS opened in 2011 as the most innovative and high-performance building in North America. Photo by Varun Saran.

What do you mean by The Performance Gap?

“We see a lot of buildings not performing according to the way they were designed. If you won awards for your energy-efficient design, you may be reluctant to publish performance data, if the building falls short of expectations. But this knowledge is crucial so we can learn collectively. We need to learn how to avoid the performance gap in future buildings”.

You also mentioned the Behavioural Dimension?

“It’s not enough to design low-energy buildings – you also need to look at the behaviour of both the occupants and the operators. Often we see sabotage from inhabitants, who, for example, bring in electric heaters or put towels under the doors to prevent the air from circulating, because the building is not comfortable; or from operators, who turn off sustainability features because they have not been trained in their use. We need to get better at thinking of the inhabitants and operators and how they experience living or working in the buildings”.

What do mean by Going Beyond Net Zero?

Much talk revolves around getting buildings to a net zero level, where they produce as much energy as they consume. But we need to go into net positive buildings, which actually improve conditions, and not just in terms of carbon. CIRS is designed to be net positive, in terms of carbon, and in terms of environmental impact and water consumption. Even net positive in terms of health, productivity and happiness”.

Finally, you mentioned Moving Beyond the Building?

“We tend to look at buildings as a single unit, but actually they’re nodes in networks. We often only look at the building footprint, but it may make more sense to look at how the neighbourhood is performing. District heating is a step in that direction, but could we have neighbourhood-level treatment of water, waste and food? So far, no city has cracked this. That’s why we need to keep experimenting”.

CV OF JOHN ROBINSON

- Professor at the Institute for Resources, Environment and Sustainability at the University of British Columbia (UBC) in Vancouver, Canada.
- Came to UBC in 1992 to head the Sustainable Development Research Institute.
- Between 1999 and 2010 deeply involved in founding the Centre For Interactive Research on Sustainability (CIRS) – a living lab on sustainability research.
- Currently Associate Provost, Sustainability at UBC, responsible for integrating academic and operational sustainability on the UBC Vancouver campus.

DEVELOPING INCENTIVES FOR RETROFITTING

Progress is slow in retrofitting Copenhagen's buildings. Owners are reluctant to make long-term investments as energy savings tend to end up with the tenants. However, Copenhagen is developing promising models and incentives to promote large-scale retrofitting. Moreover, Copenhagen will soon be sharing ideas and best practices with some of the world's largest cities.

At its introduction in 1997, the mandatory energy labelling of houses faced criticism in Denmark. Some argued that it put an unfair expense on owners looking to sell their house, as they were made responsible for acquiring the label. Others argued that an energy label would do nothing to stimulate energy retrofitting of buildings.

Today, however, studies confirm that the energy label on single-family houses does in fact affect house prices, as houses with the best labels fetch higher prices. In short, in some parts of Denmark the energy label has created an incentive for building owners to retrofit their buildings. However, the energy label has the least effect on house prices in the capital region, and the rate of retrofitting in Copenhagen remains slow, despite the enormous potential for energy savings.

The city has 6,000 buildings with an E energy label or lower (the scale goes from A 2020 to G). These buildings account for 23 percent of the energy consumption of residential housing and 32 percent of the consumption of commercial buildings.

Increase in electricity and heating consumption

For a city committed to becoming carbon neutral by 2025, energy savings are a no-brainer. It is generally more cost-effective to cut energy demand than to increase energy production. However, 2014 saw some worrying trends in terms of Copenhagen's energy consumption.

Though electricity consumption fell by 7 percent between 2010 and 2014, consumption actually increased by 2 percent between 2013 and 2014. Likewise, the period saw a

drop in district heating consumption by 23 percent, but when degree days are taken into account numbers actually show a 2 percent increase.

The City of Copenhagen hopes to tap into the massive building investments expected in the future. The capital is currently growing a rate of 1,000 new citizens per month, and it is estimated that developers before 2025 will invest about DKK 80 billion on retrofitting buildings.

For a major change to happen, more large and small building owners must take part in the necessary "deep" and holistic renovation of their buildings in the forthcoming years. They will also have to create the right basis for retrofitting by securing efficient energy operation of their buildings. To boost and target its efforts, the City of Copenhagen has adopted a four-tier approach to retrofitting. At the first level, the city collects data material and analyses the building mass. Secondly, it focusses its efforts on securing that heating installations are operated correctly. This is significant, as estimates show that up to 10 percent of heat consumption can be saved simply by operating the installations optimally.

Thirdly, the city aims to encourage investment in energy savings in connection with planned renovation projects. And finally, the city plans to monitor and evaluate progress.

Unlocking the power of partnerships

Copenhagen has no means of coercing private building owners to carry out retrofitting, so instead it has to create incentives to encourage these investments. One way is to establish a dialogue and facilitate partnerships with large building owners, private companies and financial institutions.



A thorough urban renewal demonstration project, testing new technologies for ventilation and with solar panels on the roof and gables, a green roof and penthouses. Gammel Kongevej 51 / Værnedamsvej 18-20. Photo by City of Copenhagen.

As an example, the City of Copenhagen has already helped develop a new model to stimulate retrofitting of office buildings. Called “The Copenhagen Model”, the model aims to deliver incentives to the actors in the value chain – from owners and administrators to tenants. One dedicated innovator of new financing solutions for retrofitting is the private company, SustainSolutions. Apart from developing tools for owners and developers looking to start retrofitting, SustainSolutions also works to develop alternative means of financing energy efficiency projects in buildings.

Funding retrofitting – challenging business-as-usual

One such alternative financing model for energy retrofitting projects was developed in cooperation with the private pension fund, PKA, in 2015. The company set aside DKK 300 million for retrofitting projects. What makes the fund interesting is the fact that it promises to fund energy savings from the reduced costs in heat and electricity. This means that the projects are fully financed and usually repaid within 4 to 6 years.

The Danish Government also launched an initiative in 2015 that could potentially boost retrofitting of private houses. From 2016, house owners will be able to claim up to DKK 18,000 in tax deductions on energy improvements and climate adaptation work done on their houses.

Collecting global best practices on retrofitting

Copenhagen is not alone in its struggle to stimulate private-sector energy retrofitting of buildings. In the newly established network of 17 major cities with ambitious climate targets, Carbon Neutral Cities Alliance (CNCA),

Copenhagen has joined forces with cities like Stockholm, New York, London, Yokohama, Melbourne, and Vancouver.

The Alliance aims to find solutions for leading international cities to achieve significant emission reductions and share best practices. At a conference in Copenhagen in October 2015, experiences and best practices on retrofitting will be shared and collected.

THE CASE FOR RETROFITTING

- By 2025 a family of two adults and two children living in an 80 m² apartment will save between DKK 2,000 and 6,000 on their heating bill by reducing their consumption by 20 percent. This corresponds to an 8 percent increase in their disposable income.

THE MAJOR GOALS FOR ENERGY CONSUMPTION BY 2025 IN COPENHAGEN

- 20 percent reduction in heat consumption.
- 20 percent reduction in electricity consumption in commercial and service companies.
- 10 percent reduction in electricity consumption in households.
- 40 percent reduction in energy consumption in municipal buildings.
- Installation of solar cells corresponding to 1 percent of electricity consumption in 2025.

EUROPE'S GREENEST RETAIL STORE

Unlike office buildings, retail stores have sizeable operating costs. Stores need to be heated, while many goods need cooling. The retail chain Lidl wanted to change that and ended up building Europe's greenest retail store.

Retail stores have to balance two very contradictory needs. Customers and staff want to do their shopping and work at a comfortable temperature, while food, dairy and vegetables require cooling or even freezing to prolong durability. As a result, retail stores have considerable energy consumption to power coolers and freezers and to keep customers warm. Rather than taking an existing retail store concept and making slight modifications to improve energy performance, Lidl opted for a complete rethink.

"As a retail chain, we feel we have an obligation to develop and deliver solutions to the common challenges we face. At the same time, we are always looking for solutions to improve our competitiveness. This project is a great example of a win-win situation, where we push innovation of more sustainable retail stores, while reducing our operating costs," says CEO of Lidl Denmark, Finn Tang.

SOLUTION: FIRST LEED PLATINUM-CERTIFIED RETAIL STORE IN THE EU

When Lidl was to build a new retail store in the Copenhagen suburb of Valby, it set up a project group consisting of its main contractors as well as the engineering consultants at COWI.

"We wanted to do something extraordinary, and therefore it was crucial to the success of our project to keep all the stakeholders on board and engaged at all times. This ensured implementation of the best technical solutions to our challenges," explains Per Haugaard, Chief Specialist at COWI.

The aim was to test a truly holistic approach to a sustainable retail store that not only aimed at minimizing energy consumption, but also created incentives for customers to act sustainably. This involved installing chargers for electric bicycles and cars, for example, as well as providing ample parking for bicycles.

By employing and combining existing technologies, Lidl managed to bring down energy consumption considerably. The store is partly heated by geothermal energy, while a heat exchanger recovers heat from fridges and freezers. 285 square meters of solar panels on the roof cover 20 percent of the store's energy needs.

At its inauguration the new store was awarded the first ever LEED (Leadership in Energy & Environmental Design) Platinum certification for a retail store in Europe.



Lidl's groundbreaking new retail store at its inauguration in January 2015. Photo by Lidl.

RESULTS: CLIMATE ADAPTATION AND RECYCLED BRICKS

After just five months in operation, the new store had already shown results. Compared to Lidl's own newest traditional energy-efficient stores, the new store uses 20 percent less energy. By using geothermal energy and excess heat from coolers, the store was able to stay disconnected from the district heating grid. The roof also plays a role in securing the city against heavy rainfalls. An area of 300 square meters of grass absorbs and delays rain during heavy downpours. Some of the rain is captured and used for irrigation as well as to flush the store's toilets. By collecting and reusing water from precipitation, the store is expecting to reduce groundwater consumption by 40,000 litres per year.

The store in Valby not only minimizes its carbon footprint by reducing electricity and heat consumption. The store was built from recycled bricks from decommissioned air force buildings and the wood in the building is exclusively FSC certified (Forest Stewardship Council).

"By building Europe's greenest retail store, we want to inspire the retail industry to tackle the common challenges we are all facing," says Finn Tang of Lidl Denmark.

"As a retail chain, we feel we have an obligation to develop and deliver solutions to the common challenges we face ..."

Finn Tang

FURTHER FACTS ABOUT THE FIRST EVER LEED PLATINUM-CERTIFIED RETAIL STORE IN EUROPE

- The building plot for the store was subject to complete soil remediation before construction began.
- The store has all its goods delivered by a biogas-powered lorry.
- The store was inaugurated in early 2015.

THE WORLD'S BEST RESIDENTIAL DEVELOPMENT

Building sustainably is more than just ensuring the building's energy performance – it is also about the materials that go into the building. The new residential complex, Krøyer's Square, in the middle of historic Copenhagen, is the first apartment building to receive the Nordic Ecolabel.

One can well imagine that, more than once during the building process, the contractor, NCC, silently regretted its decision to aim for the Nordic Ecolabel (The Swan Label) for its development at Krøyer's Square. To get the label, the contractor had to go through a laborious process of documenting that only materials without dangerous substances have been used.

“Everything from sealants to floorboards had to be approved, and as many of these materials aren't even ecolabelled themselves, we've had to seek approval for them individually. Had even one subcontractor used a material that hadn't been approved, our label could have been revoked,” explains Peter Riber, senior contract manager at NCC.

Krøyer's Square is a prestigious development, not just to NCC, but also to the City of Copenhagen. The square sits right in the heart of historic Copenhagen in an area that used to house a naval base and a commercial harbour. The building's architecture has been carefully designed to blend in with the old harbour area.

SOLUTION: ENERGY-EFFICIENT AND LUXURIOUS APARTMENTS

From its inception in 2012, the Krøyer's Square project has pushed many boundaries. The contractor aimed for the ambitious BR15 building code with strict requirements for insulation, windows and ventilation. The heat-recovery system in the ventilation is especially worth highlighting:

“There are strict requirements for the ventilation system to recover as much air as possible. This means that we exploit

the used and heated air from the building to heat the fresh air entering the building,” says Peter Riber.

A further parameter is the airtightness of the building. To determine this, a so-called “Blower Door Test” was conducted using a special fan to check for potential air leakage in the building.

The resulting 38 apartments sold quickly and Marianne Levy was one of the first residents to move in:

“We obviously picked the spot for its gorgeous location right on the harbour front, but we're really pleased with the energy performance of the building as well,” she says. She adds, however, that remembering to air out from time to time has taken some getting used to in a building this airtight.

RESULTS: THE WORLD'S BEST RESIDENTIAL DEVELOPMENT

The high ambitions behind Krøyer's Square paid off in March 2015, when the development was awarded a MIPIM award in the category ‘Best Residential Development’. The award was given for both the sustainable profile as well as the building's world-class architecture.

“With Krøyer's Square, we've pushed innovation within the building industry. We believe in increasing demand for energy-efficient and ecolabelled buildings, so we view this as pioneer work that is a sound investment,” says Peter Riber.



The residents of the 38 apartments at Krøyer's Square have a unique view of the Copenhagen harbour. Photo by NCC.

“We obviously picked the spot for its gorgeous location right on the harbour front, but we’re really pleased with the energy performance of the building as well ...”

Marianne Levy

KRØYER'S SQUARE

- Krøyer's Square is a significant location in the centre of the Copenhagen harbour area.
- The project was commissioned in 2011 and construction began in 2013. The building was completed in 2015.
- The building houses 38 apartments – a second phase will house a further 67 apartments.
- Several other proposals for development of the area were rejected, mostly by the local population.
- The final solution is based on a hyper-democratic and contextual approach.
- Krøyer's Square was designed by Vilhelm Lauritzen Architects and COBE, while COWI were consulting engineers. NCC was the main contractor.

THE NORDIC ECOLABEL (The Swan Label)

The Swan Label sets requirements for energy efficiency and use of wood and timber from sustainable sources, and they prohibit use of certain substances considered harmful to human health (Phthalates, brominated flame retardants, CMR substances and more).

GREEN LEASES BOOST ENERGY RETROFITTING

For a long time, owners of buildings have had little or no incentive to energy retrofit their buildings. This is because, although the investment cost of retrofitting lies solely with the owner, the subsequent savings end up with the tenants. A new concept of green leases is working to change that.

If the City of Copenhagen is to make good on its promise to become carbon neutral by 2025, it needs to convince owners of commercial rental buildings to complete necessary energy retrofitting. However, owners have traditionally been reluctant to investment in energy efficiency, as the benefits of reduced operating costs end up with the tenants.

“There’s a huge potential here. In Copenhagen, companies within trade and services account for as much as 58 percent of the city’s total commercial electricity consumption. We estimated the overall energy savings potential to be between 14 and 44 percent of energy consumption, depending on the financing of the investment and accepted length of the payback time,” explains Kasper Kläning from Smith Innovation who ran the pilot project to develop a model for so-called “green leases”.

However, research suggests that one of the primary barriers to energy retrofitting in office buildings is the lack of solid business cases that can convince both owners and tenants. Furthermore, a large number of tenants often make it very difficult for an owner to negotiate terms to share financing.

SOLUTION: A BUSINESS CASE FOR GREEN LEASES

To reverse the trend and encourage building owners to invest in energy retrofitting, the City of Copenhagen commissioned a project to develop a new model.

First off, Smith Innovation gathered input from all the relevant players. Many more are involved in the value chain than just the owners and the tenants. There are also the building administrator, consultants within the field of energy efficiency, the contractors and the building operators.

What the project discovered was that to carry out significant retrofitting of commercial buildings, the entire value chain needs to be on board.

“If the tenants don’t understand the benefits of new windows, or if the building operators don’t know how to operate them, the effects on energy consumption will always be limited. That’s why we developed ‘The Copenhagen Model’,” says Kasper Kläning.

‘The Copenhagen Model’ is a blueprint for local authorities wishing to boost private-sector energy retrofitting. It aims to provide every player in the value chain with just the right incentive to get on board with retrofitting. That means, for instance, providing owners, administrators, consultants and contractors alike with compelling business cases. Or giving owners and administrators an overview of financing opportunities. Not least it means providing tenants with a simple cookbook that describes the process from early dialogue to evaluation of energy consumption after the project has been implemented.



New windows with built-in shading in Norrportens Building, Kalvebod Brygge 45. Photo by Ulf Areskoog.

“Perhaps unsurprisingly, one of the most important factors in convincing tenants to back a retrofitting project is the prospect of guaranteed energy savings and improved indoor climate,” says Kasper Klänig.

RESULTS: CO-FINANCING OF NEW WINDOWS WITH BUILT-IN SHADING

‘The Copenhagen Model’ has already been tested successfully on projects in Copenhagen. The Scandinavian property company, Norrporten, owns a large number of office buildings in Copenhagen, and it could see that there was large electricity consumption in one of its buildings on the harbour front. Especially during the summer, the building consumed electricity for cooling and ventilation. Therefore, Norrporten set about reducing its environmental footprint as well as improving the indoor climate.

“We ran calculations and weighed different technological solutions against each other. Substituting the existing windows with new ones with micro blinds proved the best solution. After installation, the ventilation system was recalibrated to get the maximum savings,” explains marketing director at Norrporten Denmark, Thomas Wenzell Olesen.

The project was financed from the energy savings, rent increases and prolonged contract periods.

“We believe tenants are increasingly looking at the total costs associated with renting offices, and not merely the monthly rent. Furthermore, the indoor climate is of tremendous importance to employers, so we believe these investments give us a competitive advantage,” says Thomas Wenzell Olesen.

WHAT IS ‘THE COPENHAGEN MODEL’?

- A blueprint to motivate building owners and tenants to perform energy retrofitting in commercial buildings.
- The model provides each player in the value chain (owner, administrator, consultant, contractor, building operator and tenant) with incentives to participate in energy retrofitting.
- Incentives range from strategy tools for owners and administrators, to case material and a cookbook for tenants detailing the process of an energy-retrofitting project.
- ‘The Copenhagen Model’ was developed by Smith Innovation and commissioned by the City of Copenhagen.

ENERGYLAB NORDHAVN – TESTING THE FUTURE OF ENERGY CONSUMPTION

How do we persuade people to delay their energy consumption for hours when energy prices are low and renewable energy is abundant? In a major new project in the heart of the new urban development, Nordhavn, researchers are building a test facility for groundbreaking ways to combine new and existing technologies and incentives to create a shift in consumer behaviour.

In July 2015, Denmark's wind energy production reached an all-time high. Due to unusually strong winds, the country's wind turbines were able to generate enough electricity to cover 140 percent of the nation's electricity demand. If Denmark had had time-differentiated electricity tariffs, this would have been a golden opportunity for consumers to use cheap electricity.

"However, Denmark doesn't; which means that the private incentive to use energy when it's most abundant remains weak," explains the project manager behind EnergyLab Nordhavn, Christoffer Greisen:

"Today, there's no financial benefit from heating your house, running your dishwasher or washing your clothes at night. And frankly, we believe that the potential personal financial gains will never be sufficient to convince people to change their energy consumption patterns. Only by combining financial incentives with state-of-the-art building automation and increased climate awareness will we see real progress in curbing the environmental impact of our energy consumption," he explains.

A shift in consumer behaviour is also needed if the increasing amount of wind and solar power is to be successfully integrated into the energy system.

"We're still looking for ways to place as much of our energy consumption where the renewable energy is abundant and

as little as possible where we are dependent on fossil fuels. But looking at the electricity system alone will not do the job," says Christoffer Greisen.

SOLUTION: NEW NEIGHBOURHOOD AS A TEST LAB

There are plenty of technologies available to shift energy consumption in time; from smart meters to programmable appliances. In Copenhagen there is now a golden opportunity to test these technologies in the new development of Nordhavn.

"Nordhavn is ideal for researchers because we both have inhabited residential and commercial buildings, as well as a large number of buildings that are still on the drawing board. That means, we can collect consumer data from existing residences, test solutions and employ technologies in new buildings," explains Christoffer Greisen.

The project, EnergyLab Nordhavn, brings together researchers, utilities, urban developers and private companies to study and develop new solutions to the energy challenges of tomorrow.

"We are not looking to test just one technology, but many. But equally importantly, we'll be working to create systems to monitor and distribute private and commercial energy consumption and production in urban areas," says Christoffer Greisen.



EnergyLab Nordhavn is situated in the new waterfront city district in Copenhagen, which is expected to house 40,000 residents and an equal number of work places. The objective is to study and develop new solutions to the energy challenges of tomorrow. Photo by Ursula Bach, City of Copenhagen.

For instance, researchers will test a system that allows an electric heating element to supplement the default heating source, district heating, right at the individual household. Contrary to some established perceptions, in some situations electric heating is the most environmentally friendly.

“We will be looking to persuade residents and businesses to surrender control of parts of their energy consumption. Instead, the consumer will specify certain comfort levels. For instance, a service provider could be deciding when to heat your apartment and with what kind of energy source or at what time of the night to charge your electric car,” says Christoffer Greisen.

To convince consumers, the project will be working with market designers to create the right financial incentives for consumers to relinquish control of their energy consumption.

RESULTS: A BLUEPRINT FOR DECISION MAKERS

Starting in 2015, EnergyLab Nordhavn will begin collecting consumer data from residents and businesses. The data will be used to plan and execute between 50 and 100 projects concerning urban energy consumption. What happens next will be up to decision makers, private companies and utilities:

“For this project to succeed, we need to demonstrate new and intelligent ways to change energy consumption. But our solutions have to be feasible, so lawmakers, businesses

and utilities will want to test them on a commercial scale,” explains Christoffer Greisen.

ENERGYLAB NORDHAVN

- The project duration is 2015-2019.
- The project has an overall budget of DKK 143 million.
- The project is being supported by two grants from the Danish Energy Technology Development and Demonstration Programme (EUDP), contributing DKK 84 million to the total budget.
- EnergyLab Nordhavn will establish a showroom in the new urban development of Nordhavn, where visitors can peek into real-time energy-consumption data for the area.
- Behind the project is a consortium composed of the Technical University of Denmark (DTU), the City of Copenhagen, the capital area's utility company HOFOR, the national energy company DONG Energy, CPH City & Port Development as well as the private companies, ABB, Balslev, Danfoss, CleanCharge, METRO THERM, Glen Dimplex and PowerLab.

PROGRESS AS IMPORTANT YEAR LOOMS

2014 saw Copenhagen – through its utility company, HOFOR – acquire the muscle to compete for large offshore concessions. Combined with the decision to convert a large coal-fired block to biomass at one of the city’s major CHP plants, Copenhagen is in a good position to take a giant leap towards carbon neutrality.

There was cause for celebration in the City of Copenhagen on the 10th of June 2015. This was the day that the Danish Energy Agency announced that Copenhagen’s municipal utility company, HOFOR, had been prequalified to bid for the construction of 350 MW of offshore wind turbines. Offshore turbines are an important part of the Copenhagen wind strategy.

HOFOR evaluated a number of potential partners and finally settled on the German company, wpd. Wpd brings solid experience within the offshore field, both in terms of planning and execution. Being prequalified for the offshore contract proves that the wpd-HOFOR Danish Offshore Consortium makes a powerful team.

The consortium of HOFOR and wpd will be up against two further tenderers for the contract. The tender is the result of a broad political agreement in 2012 to earmark 350 MW of offshore wind power for so-called “nearshore” projects in which turbines can be erected as close as 4 kilometres from the shore. The Danish Energy Agency has screened a number of sites and designated six suitable sites for the turbines.

Winning even parts of this contract will obviously make a huge contribution to the goal of becoming carbon neutral. In the plans, the City of Copenhagen estimated 360 MW of wind power would be needed.

The shift to biomass

While wind power accounts for more than 30 percent of the targeted emission reductions needed in Copenhagen’s plan, the shift from coal to biomass is equally important.

2014 saw Copenhagen moving a large step closer to phasing out coal, when the plans for the new biomass-powered unit at the Amagerværket combined heat and power plant (CHP), were concluded. The new unit, called BIO4, will be

ready by 2020 and will replace the coal-fired block 3. BIO4 will run on wood chips from sustainable sources. That means using only residue from felling as well as trees felled in forest thinning operations. At the same time another major CHP plant, Avedøreværket, will convert a coal-fired unit to wood chips.

Shortfalls and increased target for wind power

Although BIO4 boasts new and efficient combustion technology (read more in the article about BIO4), and the unit will run entirely on wood from sustainable sources, it has less capacity than previously estimated. Together with e.g. less than expected carbon reduction from transport and congestion, this leaves the City of Copenhagen with a shortfall in reaching carbon neutrality by 2025.

To make up part of this shortfall, different measures are considered e.g. an increased target for installed MW wind.

However, as Copenhagen’s wind targets are already very ambitious (360 MW installed by 2025), realization of a possible increased target will continue to depend on the city’s focus, and especially on the results of the tender processes for the large offshore wind contracts.

In 2016, the City of Copenhagen will present the results of a comprehensive evaluation of the CPH 2025 Climate Plan. This review is intended to provide input for new initiatives and adjustments of the plan in the period 2017 to 2020 and ensure that the climate plan is on track to reach carbon neutrality in 2025.

The post-biomass city

Using biomass as an energy source is only an interim step on Copenhagen’s journey towards carbon neutral energy production.



Visualization of the new biomass-powered unit at the Amagerværket combined heat and power plant (CHP). BIO4 is expected to be adopted in 2016. Photo by Gottlieb Paludan Architects.

Copenhagen is also focusing on changes in energy production beyond 2025, and the CPH2025 Climate Plan aims to prepare for these. Within the time period of the climate plan (to 2025), parts of the biomass-based heat supply will be phased out, while other energy technologies, like geothermal energy and heat pumps will be gradually phased in.

So beyond 2025, Copenhagen expects geothermal energy, combined with heat pumps, biomass and waste incineration, to constitute the foundation of heat supply.

To ensure this transition and the continued development of a flexible energy system, it is important that the energy sector has the right incentives through taxes and subsidies.

Getting the plastic out of waste

Copenhagen has vowed to bring down the amount of plastic in waste used for incineration. That means launching initiatives to support technologies to recycle as much plastic as possible and reduce the use of plastic (prevention).

Furthermore, the City of Copenhagen is analysing possibilities to expand the REnescience project. REnescience is an enzyme-based technology that can recover organic waste from household waste for use as biogas.

THE MAJOR GOALS FOR ENERGY PRODUCTION BY 2025 IN COPENHAGEN

- District heating in Copenhagen is carbon neutral.
- Electricity production is based on wind and biomass and exceeds total electricity consumption in Copenhagen.
- Plastic waste from households and businesses is separated.
- Biogas from organic waste.

DISTRICT COOLING WITH SEAWATER

Even in a relatively temperate climate like Denmark's, businesses need cooling, both to provide the best working conditions for employees and to keep machines like servers from overheating. However, cooling is energy-consuming, which is why Copenhagen is successfully offering an alternative source of energy-efficient cooling to businesses.

During the summer, office workers in central Copenhagen can be caught staring out of the window at the cool water in the harbour and dreaming of taking a refreshing swim. Since the beginning of the decade they have been able to do just that, since now the water is so clean that you can swim in it. But the sea water is not only used to swim in, it is also being used to cool down offices and public buildings in Copenhagen.

“We are offering district cooling using seawater as primary cooling resource, to businesses in central Copenhagen,” says Henrik Lorentsen Bøgeskov, head of district cooling at the municipal utility company, HOFOR.

Business demand for cooling has risen steadily over the years. A part of the explanation lies with modern architecture and its use of large windows that increases indoor temperatures. Another reason is the increased number of employees working in open-plan offices. More people in less space means bigger cooling needs. Thirdly, computers, servers, printer and photocopiers all drive up temperatures.

“Electrically powered air-conditioning is very energy-consuming and obviously a real expense for companies as well. Local air-conditioning compressors also take up space in offices and they're noisy,” says Henrik Lorentsen Bøgeskov.

SOLUTION: AN ABUNDANT SOURCE OF COOLING NEARBY

To reduce emissions from cooling, since 2010 the municipal utility company, HOFOR, has been building an infrastructure to deliver cooling, using seawater as primary cooling resource, to businesses in central Copenhagen.

“We've built two cooling plants that cool down water and distribute it to the customers in insulated pipes. We've estimated a total savings potential of 150 MW in the inner city area and we're looking to expand operations with a third

cooling plant in the new Nordhavn development,” says Henrik Lorentsen Bøgeskov.

District cooling with seawater typically replaces local, electrically powered air-conditioning compressors. All that customers need is a heat exchanger in their basement through which the heated air from the building can be cooled. The cooling water arrives at the customer at 6 degrees Celsius and returns to the central cooling plant at 16 degrees.

“Obviously the system is most effective during winter, when the seawater is around 3 degrees, but even in the summer, when we switch to traditional coolers we save energy by cooling the compressors with seawater,” says Henrik Lorentsen Bøgeskov.

RESULTS: A THIRD OF THE POTENTIAL UNLOCKED

With an estimated savings potential of 150 MW from businesses in the city centre of Copenhagen, HOFOR is already well on its way after signing contracts for 42 MW.

“We've got a good start. This solution is primarily a good idea for businesses with an electric air-conditioning installation or planning to install one. However, even businesses that already have cooling with seawater have shown interest in our service. A decentralized seawater cooling installation has high operating costs, as the seawater easily corrodes and marine organisms clog up the system. These businesses find it easier to sign an operating contract with us,” says Henrik Lorentsen Bøgeskov.

As for the price, HOFOR has three levels of payment for its customers. For new customers there is an up-front payment. The customers then pay a charge based on the amount of cooling capacity they require. Finally, customers are charged a rate based on how many cubic meters of water they actually use.



Pumps in the cooling plant in Adelgade in the inner city of Copenhagen. Photo by HOFOR.

“We’ve estimated a total savings potential of 150 MW in the inner city area ...”

Henrik L. Bøgeskov

DISTRICT COOLING WITH SEAWATER

- The municipal utility company, HOFOR, started construction of its first cooling plant in 2010.
- HOFOR now has two cooling plants covering the inner city. A third cooling plant is planned in the new Nordhavn development.
- The water in the system runs in a perpetual loop between the cooling plant and the customers.
- The water is 6 degrees Celsius when it reaches the customers and 16 degrees when it returns.
- HOFOR has estimated the savings potential for the inner city area at 150 MW (HOFOR has already signed contracts for 42 MW).

BIO4 – HEATING THE CAPITAL WITH SUSTAINABLE BIOMASS

The Danish capital is getting ready to phase out coal. The combined heat and power plant (CHP), Amagerværket, will replace fossil fuel with a new block running on biomass. However, there are still obstacles to be overcome before the full emission reductions can be achieved.

When a city the size of Copenhagen decides to become carbon neutral by 2025, challenges are inevitable. The Amagerværket CHP plant is a central pillar in the district heating system in the capital region. In 2013, the plant was purchased by the municipal utility company, HOFOR, from the energy company, Vattenfall.

Its two blocks keep both Copenhageners and citizens in neighbouring municipalities warm. Block 1 runs on wood pellets, while block 3 runs on coal. However, in a few years, block 3 will be heading for retirement. Its replacement is BIO4.

“If large urban areas are to phase out coal fast, there is really only biomass to turn to,” explains Morten Stobbe, Senior Vice President of the municipal utility company, HOFOR.

SOLUTION: CIRCULATING FLUIDIZED BED

The new block, BIO4, will be ready by 2020 and running on wood chips.

The combustion technology in BIO4 is the relatively new, but well tested, “Circulating Fluidized Bed” (CFB) technology. Normally the chips are burnt on grates, but in CFB

the chips are blown into a cloud of sand at high temperature, creating much better combustion and lower emissions of pollutants.

The use of chips instead of pellets has numerous advantages:

“Pellets need to be ground, dried and compressed before use, while wood chips are ready to use,” says Morten Stobbe. He stresses that the wood chips used in BIO4 will come from sustainable sources.

“We’re members of the Sustainable Biomass Partnership and we’ve developed rigorous standards for wood chips, much in line with the FSC label. This means that we use only wood chips from logging residues or trees felled as part of forest thinning, so we don’t deplete the forests. Forests can replenish the wood we take within a year,” says Morten Stobbe.

However, a city like Copenhagen needs lots of wood chips for its heating needs. Only using branches, logging residues and trees felled during thinning means that Copenhagen needs 3,100 square kilometers of forest to cover its heating needs for a year.



Visualization of the new BIO4 unit at the combined heat and power plant, Amagerværket. The project awaits final approval in 2016. Photo by Gottlieb Paludan Architects.

RESULTS: SIGNIFICANT EMISSION REDUCTIONS

The transition from coal to biomass in Copenhagen's district heating is a crucial component of the city's plans to become carbon neutral by 2025.

The transition to biomass in Copenhagen is expected to contribute more than 40 percent of the total emission reductions of 850,000 tonnes carbon from energy production. BIO4 at Amagerværket as well as conversion of a coal block at Avedøreværket to wood pellets will make a significant contribution to this end.

"Biomass is still a transitional fuel. In the long term we're expecting to heat the city with geothermal energy and heat pumps, but right now biomass is the only technology that can deliver the base load we need," says Morten Stobbe.

"If large urban areas are to phase out coal fast, there is really only biomass to turn to ..."

Morten Stobbe

BIO4

- Amagerværket currently has two blocks in operation – block 1 running on wood pellets and block 3 running on coal.
- BIO4 will replace block 3 and run on wood chips.
- BIO4 is still in the planning process, and the project is expected to receive final approval in early 2016.
- The design for BIO4 was decided in an architectural competition in May 2015.
- The project is expected to cost DKK 4.5 billion.

CITIES AS DRIVERS FOR THE CIRCULAR ECONOMY

“If Copenhagen and other cities really want to support the transition to a low-carbon economy, they should launch initiatives to promote a circular economy,” says Ida Auken, former minister for the environment and now MP with the Danish Social Liberal Party.

“A Denmark without waste” was the name of the government strategy presented by then minister for the environment, Ida Auken, in 2013. The strategy laid out plans to reduce the amount of waste incinerated in Denmark, in favour of recycling. The strategy was followed by a strategy for waste prevention in 2015, and Ida Auken has long been a strong champion for the circular economy.

“Throughout the entire 20th century, we all got used to ever-falling resource prices, but since 2000, global resource prices have risen more than in the previous 100 years. This change is gradually affecting the business models of most companies: and it should,” says Ida Auken.

She sees the world at a crossroads, where the businesses that are quick to adapt will gain access to new markets, while the businesses insisting on ‘business as usual’ will soon be extinct.

“Take a company like Xerox. They have discovered that it makes perfect business sense to lease their photocopiers to customers instead of selling them. Customers are happy to save the big capital outlay, while Xerox has a clear incentive

to make products that last and that contain materials that can ultimately be recovered when the product reaches the end of its useful life. Not to mention the fact that this kind of relationship builds customer loyalty as well,” says Ida Auken.

Cities have a role to play as well

As the name implies, the circular economy is a break with the linear thinking of the past, in which resources are mined for use in production of goods that are then consumed before ending their life as waste. Enter the circular economy, where little or no resources are lost. Where products are designed to be repaired and finally dismantled and used in new products. And where we as consumers are used to leasing or renting instead of owning.

“Like cities all over the world, Copenhagen has an opportunity to drive this transition. Cities can inspire people like no nation state, as they are a more direct part of people’s lives. Copenhagen has already built on this by creating a strong brand and identity as the world’s leading bicycle city. But they need to go further,” says Ida Auken.



Photo by Ursula Bach, City of Copenhagen.



Photo by Kim Vadskjer.

“The next step for cities is to become leaders in reuse. Cities should help their companies focus on reuse and cities should build an infrastructure to support it. For example, a city like Copenhagen could serve as a facilitator to match two companies where one has a by-product that can be used by the other. Cities can also encourage their citizens to lease equipment, and cities can show a good example by leasing products themselves. In this way, cities can create new markets and incentives for manufacturers to produce lasting products,” says Ida Auken.

Thinking outside city limits

But cities should be prepared to go even further.

“A city like Copenhagen could play a vital role in a greater resource vision for the entire region by planning and developing the entire region to support local trade and trade in resources. That would really be a big step towards a circular economy,” says Ida Auken.

CV FOR IDA AUKEN

- Member of Parliament for the Danish Social Liberal Party.
- Minister for the environment from 2011 to 2014.
- Member of the environmental and energy committees in the Danish Parliament.
- World Economic Forums Young Global Leaders
- Co Chair for Young Global Leaders’ Taskforce for circular economy
- European Young Leaders: “40 under 40 European Young Leaders”

THE BATTLE FOR URBAN SPACE

Already the world's most bicycle-friendly city, Copenhagen's bike lanes are about to become even more crowded. Projections forecast a 27 percent increase in bicycle traffic in the city by 2025. The success is crucial to Copenhagen's plans to become carbon neutral, but it also poses challenges to the continued popularity of the two-wheeler as well as other forms of transportation.

The well-known bridge, Dronning Louises Bro, across the Inner Lakes in Copenhagen is remarkable for various reasons. Not only does the bridge and related street, Nørrebrogade, carry the most bicycle traffic in Copenhagen (more than 42,000 bicycles every day). The bridge is also the place in Copenhagen with the highest 'share' of cyclists. 86 percent of traffic on the bridge stems from bicycles while only 14 percent is from cars. The sheer number of bicycles can be overwhelming and is testament to the success of the two-wheeler in the city awarded the title "World's Most Bicycle Friendly City".

Since 2012, the share of Copenhageners taking their bicycle to work has risen from 52 percent to 62 percent. So far, numbers suggest that the City of Copenhagen has been able to keep up with this rise and upgrade the bicycle infrastructure to match the increased demand. Since 2012, the average speed on Copenhagen's bike lanes has climbed from 15.5 km/h to 16.4. This reflects continued investments in infrastructure – from closing "missing links" to upgrading bike lanes for commuters (called Cycle Superhighways).

However, the crowded central station also illustrates a challenge arising from the triumph of the bicycle in Copenhagen.

Monitoring bicycle congestion

Bicycles take up space. Whether it is space for parking or at traffic signals or for bicycle lanes, bicycles use their fair share of the public space. The City of Copenhagen is continuously monitoring potential bottle-necks or possible congestion issues. This is because the way Copenhageners and visitors perceive the experience of riding a bicycle in the capital could eventually determine whether or not the two-wheeler will continue to displace the car as a means of transportation.

Already today, Copenhageners are less than pleased with parking facilities for bicycles at train stations and stores.

Only a third express satisfaction with parking inside the city, while 79 percent are happy with parking at their home. Still, the overall trend is that a 74 percent majority of Copenhageners feel secure while riding on the city's bike lanes.

However, projections show that by 2025 bicycle traffic will have risen by 27 percent – mainly due to an influx of new citizens. This increase in traffic will put strain on the infrastructure. In fact bike lanes are expected to see a 36 percent increase in traffic during rush hours. In other words, Copenhagen has to continuously upgrade bike lane capacity and close "missing links" for cyclists in the capital.

However, keeping cyclists happy is just one of the challenges facing the City of Copenhagen in the transport area.

Increase in car and bus traffic

Other means of transportation compete for the same urban space as bicycles.

The same population projections that predict an increase in bicycle traffic, also foresee a 25 percent rise in car traffic. More citizens simply means a tougher struggle for the finite urban space.

For instance, dedicated bus lanes are an efficient tool to raise the attraction of public transport – but they too require space. Similarly, dedicated parking spots and charging facilities for electrical vehicles increase the incentives to switch from petrol-driven cars to electric ones. Not to mention ambitions to increase the amount of parks and recreational areas in the city.

To address the looming congestion challenge, the City of Copenhagen is working to increase coordination between sectors so as best to accommodate the needs of busses, electric vehicles and bicycles. The city is also developing a plan



Though many of Copenhagen's bike lanes can seem crowded, the City of Copenhagen is continuously working to develop new routes for commuters, tourists and recreational bicyclists. Photo by Ursula Bach, City of Copenhagen.

to optimize the entire bicycle network. The plan aims to provide relief for the six busiest Copenhagen streets.

For each of the six streets – or corridors – the plan will collect input and feedback from the daily users.

Switching to electricity and biogas

Meanwhile, the City of Copenhagen is making another transition of its own. As of August 2015, 60 percent of the municipal fleet of cars is electric or runs on hydrogen, and the target is for 85 percent to be running on alternative fuels by the end of 2015.

Furthermore, Copenhagen is set to begin large-scale collection of household waste with garbage trucks running on biogas. Since 2010, Copenhagen has been testing four biogas trucks, but from 2016 more than 60 biogas-powered trucks will be put into operation. With just one fuelling station, the city is scrambling to expand the fuelling infrastructure and another biogas fuelling station is expected to open shortly.

Finally, Copenhagen is drawing up plans to make the city's entire bus operation carbon neutral. The proposal will be part of the 2016 budget negotiations.

Copenhagen recently took a big step in this direction, when it unveiled plans to make Denmark's busiest bus line carbon neutral. Famous among Copenhageners, the 5A bus line transports about 20 million passengers a year in diesel-powered busses. However, as of 2017 the diesel busses will gradually be replaced by longer and more spacious busses running on biogas. In fact, the entire 5A route will receive an upgrade, as some of the busiest stops will be converted to platform stops for even speedier entrance and exit.

THE MAJOR GOALS FOR MOBILITY BY 2025 IN COPENHAGEN

- 75 percent of all trips in Copenhagen are on foot, by bike or public transport.
- 50 percent of trips to work or school in Copenhagen are by bike.
- 20 percent more passengers use public transport.
- Public transport is carbon neutral.
- 20-30 percent of all light vehicles run on new fuels such as electricity, hydrogen, biogas or bioethanol.
- 30-40 percent of all heavy vehicles run on new fuels.

DRIVENOW – THE ALTERNATIVE TO OWNING A CAR

Although it was recently named the best bicycle city in the world, Copenhagen is striving to limit carbon emissions from car traffic even further. A new service offers busy Copenhageners the comforts and flexibility of a car without them actually having to own one. It is hoped that the service will also bring down carbon and particle emissions.

It is not hard to see the attraction of the car as a popular mode of transportation. There is no need to check timetables or carefully plan the route to your destination, and you can fit more luggage in the boot than you would be able to carry on a bus. Furthermore, in recent years the selection of small and affordable cars has skyrocketed.

“Convenience driving is becoming cheaper and cheaper. Now micro cars (or City cars) account for 55 percent of car sales in Denmark. Furthermore, our habits and expectations to flexibility are changing as well, and that poses a challenge to public transport and city planners alike,” says Thomas Troels Smith Sales & Marketing Manager DriveNow (former business development consultant Arriva Denmark A/S).

Data suggests that, rather than people switching from a bigger car to a smaller one, the growth in micro cars is caused by an absolute rise in car ownership, as people who until recently could not afford a car now can.

“We need to offer a new type of flexible transport solution, so people who only rarely need a car, aren’t tempted to buy one,” says Thomas Troels Smith.

SOLUTION: A FREE-FLOW ELECTRIC CAR SOLUTION

Car sharing has existed for years in Copenhagen, with successful concepts like LetsGo and Hertz Delebil. However, the systems have not dramatically changed the way city dwellers transport themselves. For all its qualities, car sharing’s big breakthrough has yet to come, which may be due to inflexible booking or registration procedures, or perhaps the fact that you have to pick-up and return the car in designated spaces around town.

DriveNow aims to change that. Introduced in the autumn of 2015, a fleet of 400 electric vehicles are now available across Copenhagen. The system is somewhat similar of public bike-sharing systems across the world. The cars are available from a network of convenient spots across town as well as where earlier users have parked them. It is easy to register, and you only pay for the car while you are using it. More importantly, you can drop off the car at any designated public parking space across town.

“Booking a DriveNow car is extremely simple. You can find the nearest one and book it on your smartphone. You then have 15 minutes to pick it up until your booking expires,” says Thomas Troels Smith. Payment and booking is also easy – either via your customer card or the pre-existing national electronic ticketing system; Rejsekort. Another attraction of DriveNow is its easy access to parking, which can traditionally be daunting in most major cities.

“The City of Copenhagen has earmarked a number of parking spaces across town with charging facilities for electrical vehicles. This means that dropping off your car is as easy as picking it up”, says Kasper Brenøe Isbrand of the City of Copenhagen.

RESULTS: REDUCING EMISSIONS AND TESTING EVS AT SCALE

DriveNow is a joint venture between BMW & Sixt AG. The Danish operation is set up as a franchise model and operated in Denmark by the transport company, Arriva. To support the Danish operation, Arriva has received funding together with the Energy Supply company EON from the Capital Region. The City of Copenhagen, Frederiksberg and Tårnby has supported the operation by earmarked parking for the service and plans to offer reduced parking fees in their respective municipalities.



DriveNow-cars share charging and parking spaces with regular electric vehicles in Copenhagen. Photo by Arriva.

“We need to offer a new type of flexible transport solution ...”

Thomas Troels Smith

“The DriveNow service is intended to be the missing link in the existing public transport infrastructure, so users should notice an overall improved experience across all forms of transport. It will be easy to get to a metro station in a car or to pick up a car when you get off the bus. In short, DriveNow allows you to use a car when you need it, but without having to purchase one,” says Thomas Troels Smith of Arriva.

The hope is that DriveNow will make Copenhageners switch from petrol-guzzling cars to the electric alternative.

“If a DriveNow car replaces a normal car there is an instant reduction in both carbon and particle emissions. Furthermore, it’s our hope that a service like this will allow many Copenhageners to become familiar with electric vehicles and this could further accelerate the transition from carbon-fuelled cars to electric ones,” says Kasper Brenøe Isbrand.

THE DRIVENOW SERVICE

- DriveNow is a joint venture between BMW & Sixt AG.
- The DriveNow service is a franchise model and operated locally in Denmark by Arriva.
- To support the Danish operation, Arriva has received funding together with the Energy Supply company E.ON from the Capital Region.
- The City of Copenhagen, Frederiksberg and Tårnby has supported the operation by earmarked parking for the service and plans to offer reduced parking fees in their respective municipalities.
- The service was launched in September 2015 with a fleet of 400 vehicles.
- The City of Copenhagen has earmarked up to 500 parking spaces for electric vehicles that are also available to DriveNow customers.
- Arriva pays a licence for parking and a fee depending on how many parking spaces in crowded areas (areas with above 90 percent occupancy of parking spaces) DriveNow uses.
- The German concept is in operation in five German cities as well as in London and Vienna.

THE HARBOUR CIRCLE – TAKING CYCLING TO THE NEXT LEVEL

Though Copenhagen boasts the title of being the best city in the world for cyclists, it still has not solved the problem of how to get the majority of tourists on a bike – and more Copenhageners. A new scenic roundtrip through previously hidden areas of the capital aims to change that.

Anyone visiting Copenhagen in spring will witness the overwhelming success of the bicycle. Busy Copenhageners crowd the bike lanes to and from work, and one might think that the City of Copenhagen would be satisfied with this high level of cycling.

“More and more people cycle to work and that’s obviously a good thing. However, recreational cycling and cycle tourism haven’t been developed to the same extent,” says project manager at the City of Copenhagen, Ditte Møller Munch.

One reason might be that the busy bicycle lanes in Copenhagen are overwhelming to inexperienced tourists venturing into traffic for the first time.

“A street like H. C. Andersen’s Boulevard is like a busy freeway for bicycles during rush hours, and beside the cycle lanes there are six lanes of car traffic as well. Tourists need some relatively quiet and safe routes for this to become successful. We also know from cities like Berlin that signposted recreational routes, safe navigation supported by information material, cycling packages and marketing aimed at tourists can help,” explains Ditte Møller Munch.

SOLUTION: THE HARBOUR CIRCLE

The Harbour Circle is an ambitious project trying to create a shift in the way tourists and Copenhageners experience the capital. The project takes one of the city’s best assets – the harbour – and turns it into a unique experience for cyclists and pedestrians.

“Even most Copenhageners don’t know it, but it’s already possible to cycle along large parts of the harbour area in Copenhagen today. However, until now, canals, roads and the harbour entrance have made a roundtrip impossible. We

want to close the gaps and create The Harbour Circle – a beautiful ring route along the waterfront that only cyclists and pedestrians can access,” says Ditte Møller Munch.

The Harbour Circle will run for 13 kilometres through cultural landmarks, historical sites, and the preserved natural area of Amager Common; and it will showcase the everyday life of the Copenhageners.

Fuelling the decision to launch The Harbour Circle has been the decision to build two bridges (The Circle Bridge and The Inner Harbour Bridge) across the harbour entrance. The Circle Bridge is funded by the Nordea Foundation while the Inner Harbour Bridge is funded by A.P. Møller Mærsk and the City of Copenhagen. But the city will also build a new bridge crossing the Belvedere canal in Sydhavnen, improve access for passing under Knippel’s Bridge, and signpost the full route.

RESULTS: MORE TOURISTS AND BUSINESS OPPORTUNITIES

The route is expected to be ready for the summer season 2016, and the City of Copenhagen hopes to see at least a 10 percent increase in traffic from cyclists and pedestrians on the route within the first couple of years of its inauguration.

“We are cooperating closely with the two major tourist organisations, Visit Denmark and Wonderful Copenhagen, as well as the harbour bus operator, Movia, and private tourist agencies. We want to inspire the tourist industry to use The Harbour Circle and develop products around it. From guided tours to fishing trips and hotel stays along the route. So far we’ve received nothing but support,” says Ditte Møller Munch.



The Harbour Circle will open up parts of Copenhagen that were until recently inaccessible to cyclists and Copenhageners in general. Photo by Ursula Bach, City of Copenhagen.

“Even most Copenhageners don’t know it, but it’s already possible to cycle along large parts of the harbour area in Copenhagen today ...”

Ditte Møller Munch

THE HARBOUR CIRCLE

- A 13 km cycling and walking route from the centre of Copenhagen along the harbour towards the natural area of Amager Common to the south.
- The route is expected to open in the pre-summer season of 2016.
- The project is dependent on two new bridges across Copenhagen’s harbour entrance (The Circle Bridge and the Inner Harbour Bridge).
- The Circle Bridge is funded by the Nordea Foundation while the Inner Harbour Bridge is funded by A.P. Møller Mærsk and the City of Copenhagen.
- The isolated project of construction work, signposting and marketing of the Harbour Circle costs DKK 17.8 million, most of which is being spent on improving the route and providing proper signposting.

COLLECTING TRASH WITH GAS

To achieve carbon neutrality by 2025, Copenhagen must curb emissions from the transport sector. The City of Copenhagen has already substituted 60 percent of its fleet of cars running on fossil fuels with electric ones. Copenhagen is also shifting to waste trucks running on biogas.

Ordinary Copenhageners probably have not noticed much difference, but since 2013 four biogas-powered waste trucks have been collecting waste in the capital. The four trucks have been running on a trial basis, but from 2015 the trucks will have company – in fact a lot of company.

“We expect to put 60 new biogas-powered waste trucks on the streets next year,” says Kim Røgen, chief adviser at the City of Copenhagen.

The investment is part of Copenhagen’s effort to cut emissions from transport – specifically 30 to 40 percent of the emissions from heavy-duty vehicles.

The aim was to have at least half of the city’s waste trucks running on biogas by 2018. However, with the current rate of substitution, Copenhagen will have 90 percent running on biogas by as early as 2016.

SOLUTION: TRUCKS RUNNING ON BIOGAS

Where the first generation of trucks used modified diesel engines, the new generation of trucks were built from the start with biogas-combustion engines. However, apart from the difference in engine, the new trucks are very similar to their predecessors.

“Our waste collectors were concerned that biogas-driven waste trucks wouldn’t feel like the real deal. But the new trucks soon quelled all their worries,” explains René Larsen from one of the truck operators, City Container.

After running four trucks as a test project, in 2014 the City of Copenhagen added a general award criteria stipulating biogas trucks in their public tenders on waste collection.

The city still looks for the cheapest offer, but now they will only consider offers with trucks powered by biogas.

“We were pleasantly surprised to receive offers for three-times as many biogas trucks as we had anticipated. And the trucks only have a marginal impact on the total cost to the city,” says Kim Røgen.

With 60 new gas-powered waste trucks on the way, the refuelling infrastructure is scrambling to keep up. So far, the four test trucks have been able to refuel directly from the natural gas grid at a station located near the Amagerforbrænding district heating plant. A further natural gas station is expected close to another major district heating plant, Vestforbrænding, but further refuelling stations will have to be established to prevent bottle-necks.

RESULTS: REDUCED EMISSIONS TIMES THREE

The gas-powered waste trucks offer tangible emission reductions. For comparison, an ordinary family car running on biogas emits 25 to 30 percent less carbon than a diesel-powered one. To ensure that the investment results in real emissions cuts, the City of Copenhagen demands Biogas Certificates (like the RECs for renewable energy) for all the biogas it consumes. But carbon emissions are just one of the emissions being cut:

“Like any other large city, Copenhagen is working to reduce the environmental impact of traffic – like emissions of ultrafine particles, NOx and noise. The biogas-powered waste trucks offer real emission reductions,” says Kim Røgen.



The precursors to the coming wave of biogas-powered trucks in Copenhagen. Since 2013, four biogas-powered waste trucks have been collecting waste on trial basis in the capital. Photo by Ursula Bach, City of Copenhagen.

“We expect to put 60 new biogas-powered waste trucks on the streets next year ...”

Kim Røgen

THE MOVE TO GAS

- Copenhagen has set a goal that 60 percent of the municipal waste trucks should be running on biogas in 2018.
- With the current rate of substitution, Copenhagen will have 90 percent running on biogas by as early as 2016
- The city has been testing four biogas-powered trucks since 2013.
- In 2014, Copenhagen added award criteria to its waste-collection tenders, stipulating biogas trucks.
- The trucks have a maximum operating radius of 300 kilometres.
- Until recently, Copenhagen only had one fuelling station, owned by the energy companies E.ON and OK, but soon it will have two. The hope is that the rapidly increasing number of gas trucks will convince operators to build more fuelling stations.

Technical and Environmental Affairs
City of Copenhagen
Njalsgade 13
DK - 2300 Copenhagen
www.kk.dk
TMF Design
Cover by Ursula Bach, City of Copenhagen
2015

