COPENHAGEN
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# DANISH SMART CITIES: SUSTAINABLE LIVING IN AN URBAN WORLD

An overview of Danish
Smart City competencies

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# Foreword

‘Smart cities’ is the latest concept when it comes to building the cities of the future. Smart cities are expected to be the key to combining a sustainable future with continued economic growth and job creation.

But what exactly is a smart city? What makes a city smart? As this report will show there are many definitions of a smart city including sustainable, liveable, intelligent and green. However, the common denominator seems to be access to data and intelligent tools to connect knowledge and people to drive change. It is this issue that we are aiming to explore from a Danish perspective in this report.

The report is published by Copenhagen Cleantech Cluster (CCC). The purpose of the report is two-fold: first of all, it aims to describe specific Danish competencies and strengths within smart city development, and provide some general recommendations to foreign companies and stakeholders who wish to enter the Danish smart city market. Secondly, the report aims to provide an overview of the challenges facing further smart development in Denmark.

> “Cities play a decisive role, not only in Denmark but throughout the world. Cities are driving the economy. Cities are where people want to live, invest and work. That is why cities are focal points in a future sustainable economy.”
>
> Claus Bjorn Billehoj, Sustainable City Development, Municipality of Copenhagen

The report is divided into three sections: the first section provides a general introduction to smart cities in a global context, focusing on the questions of a) why is there a need to develop smarter cities, b) what does it mean to be a smart city, c) how is a smart city developed, and d) what are the global smart city market prospects? This then serves as a background to the second section, which gives an introduction to Danish competencies within smart city development, and points out a number of investment opportunities. Finally, the third section describes a number of challenges facing further smart city development in Denmark.

The report is based on a number of academic publications, reports, and online material. Furthermore, interviews have been conducted with several Danish experts working with smart cities both at a practical and theoretical level. These include Tyge Kjaer, Associate Professor at the Department of Environmental, Social and Spatial Change at Roskilde University; Jonas Kroustrup, Project Manager at the Smart Region project in the Central Denmark Region; Claus Bjoern Billehoj, Head of Division at the City of Copenhagen’s Department of International Affairs and Sustainable City Development; Kurt Othendal Nielsen, City Account Manager at Siemens’ Infrastructure and Cities Section; Søren Smidt-Jensen, Senior Project Manager at the Danish Architecture Centre, who among other things is responsible for the online platform SustainableCities.dk; Trygve Skjotskift, Senior Manager at Accenture; and Line Gerstrand Knive, Consultant at the Municipality of Aarhus and member of the secretariat of the Smart Aarhus initiative.

We would like to express our sincere gratitude to these people, without whom this report would never have been possible.

Please note that the editing team is solely responsible for the contents of the report.

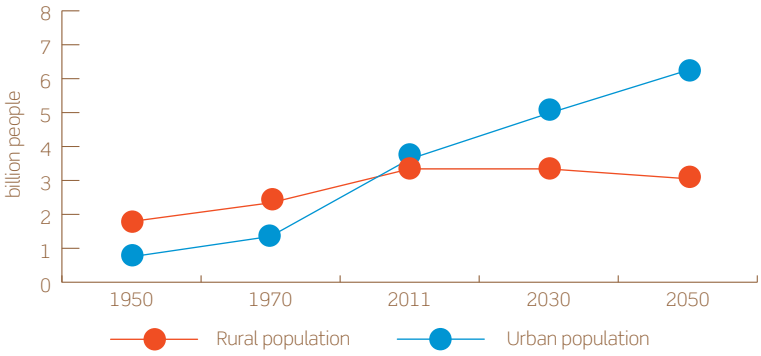
# Introduction

In recent years, the question of how we can live 'smartly' in a city has become the focus of policymakers and private industry alike. Millions of euros are being invested in research, development and pioneer projects which contribute to the construction of truly smart cities. But why is there a need for developing smarter cities?

## Why is there a need for smarter cities?

First of all, a rapid urbanization process is taking place on a global scale. Every week, one million people move from rural areas into urban areas, driven by the economic opportunities that the cities of the world offer see Figure 1 and Figure 2. In fact, close to 4 billion of the world's current population of 7 billion now live in urban areas. This number is expected to increase to 6 billion people by 2050, most of whom will live in developing and less-developed countries see Figure 1. The global trend of urbanization and population growth, which puts ever increasing pressure on the world's cities, is not likely to stop. As the cities continue to grow, so too will the focus on smart and sustainable solutions within them.

Figure 1. World urbanization prospects
Source: United Nations. World Urbanization Prospects: The 2011 Revision




Secondly, cities around the world have become hubs for the global economy. By 2025, the 600 biggest cities in the world are projected to account for 60% of global GDP[1]. The 30 largest cities alone are projected to drive 20% of global GDP growth from 2010 to 2020[2]. Furthermore, cities play a crucial role in the transition towards a knowledge-based economy which is occurring in many places, not least in Europe. This is because of the fact that cities contain an increasingly large share of the world's highly skilled, entrepreneurial and creative population. This means that they are home to concentrated and diverse pools of knowledge, which spur new economic development.

Finally, as growing economic activity has historically gone hand in hand with increased greenhouse gas emissions, cities have become major contributors to the climate problem which the world is currently facing. Around 70% of global CO2 emissions derive from cities, which are also facilitating unprecedented consumption levels among their inhabitants. This means that cities consume as much as 80 percent of total global energy production[3]. Furthermore, social divisions are often larger within the cities, where slums and business centres are likely to be situated within the same small geographical area. To sum up, the cities of this world are far from sustainable.

The growing demographic, economic, social, and environmental importance of the world's cities creates both challenges and opportunities. On the one hand, the world's growing cities can easily become chaotic and disordered places which contribute further to climate change and social inequality. On the other hand, having many people living closely together in a city may have certain benefits. For instance, the density of the city may have a positive effect on the climate and the economy as it leads to less transport and a

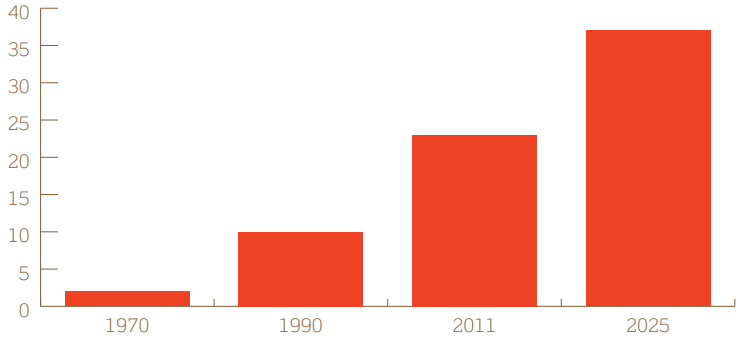
1 Urban World: Mapping the Economic Power of Cities. McKinsey Global Institute 2011

2 The Global Cleantech Report 2012 p. 4. Copenhagen Cleantech Cluster

3 Cities and Climate Change: An Urgent Agenda. World Bank 2010

higher level of mobility. The average carbon footprint of a New York City resident, for instance, is around 30% lower than the average American's. And residents of Manhattan have an even smaller footprint simply because the urban density of Manhattan is greater than any other New York borough[1].

Figure 2. Total number of cities with more than 10 million inhabitants
Source: United Nations, World Urbanization Prospects: The 2011 Revision




Besides the benefits of urban density, the city provides an excellent opportunity to integrate the many systems and networks it contains into one another (e.g. transportation, business, education, communication, infrastructure), thus creating more sustainable living.

However, in order to make the growing importance of the world's cities a positive force in the quest to develop sustainable living, smart and innovative solutions for cities are needed. The concept of the 'Smart City' has been developed as a natural response to the process of urbanization, the economic importance of cities, and the increasing demand for sustainable living. But what is a Smart City?

## What is a Smart City?

The concept of a 'Smart City' can seem elusive and vague, first of all because of the fact that there are many ways to be smart; secondly, because there is a tendency to use the concept as a tool for self-promotion, rather than a strategy for actually becoming smarter. Indeed, it might prove easier to describe what the Smart City is not than coming up with an accurate definition of the concept.

First of all, a city is not smart when there is too much of everything in it. An excess of cars, food, water, energy consumption etc. is the sign of an unsustainable city defined by inefficiency. Instead, the waste streams and the surplus of the city should be used as a valuable input in new production or as a source of energy. The waste of the city must be converted and used in sustainable ways. A Smart City turns its surplus into resources.

Secondly, a city is not smart when the different networks which define it are not able to communicate and function together in systems. When the power grid, for instance, is not able to communicate with the electrical devices of the city, how can they know when it would be smartest to use electricity? Likewise, when the parking spaces of the city are not equipped with smart parking meters, how can car owners know where to go in order to find a parking space? Such a city has developed separate solutions to common problems. This does not only lead to a duplication of work, but is time consuming and expensive as well. Instead, the solutions of the Smart City must be integrated and multi-functional.

Thirdly, a city is not smart when the systems and networks which it contains are static and immobile. Having to wait in long lines of cars during rush hour is not smart. Instead, the mantra should be 'fewer cars and more mobility'. Furthermore, a stagnant city is not just an inefficient city; its lack of flow impedes innovation and creativity among its many stakeholders. A Smart City is characterized by a high level of mobility allowing people, information, capital, and energy to flow together easily.

1 www.planetnext.net

Lastly, a city is not smart when it does not include all its stakeholders in the decision and planning process leading to new development. Public authorities, private companies, knowledge institutions and the city's inhabitants all possess valuable knowledge and information about the city. A city which does not make use of the vast amount of valuable data is made up of a number of disconnected 'silos of knowledge', which do not learn from and inspire one another. Instead, the Smart City is based on knowledge sharing and collaboration across all levels of society. It is an open source community, where the ideas of one actor can be borrowed, improved and ultimately returned to the community by another.

"The city contains a lot of valuable information. Citizens, agencies, transport companies, and energy companies which do not share their knowledge, but keep it to themselves – that truly is a barrier for a Smart City."

Søren Smidt-Jensen, the Danish Architecture Centre

### What makes a Smart City "smart"?

Now that we know what a Smart City is not, let us take a closer look at the characteristics which define a Smart City. What is central to the concept of the Smart City and what makes it differ from 'sustainable cities' or 'ECO cities' is the use of Information and Communication Technologies (ICTs) in the process of creating a more sustainable city.

According to Søren Smidt-Jensen from the Danish Architecture Centre (DAC)[1], the concept of the Smart City started to really proliferate sometime during 2009: "We had probably already encountered the concept before 2009, but around this time we could see that the Smart City concept kept popping up on international blogs, in the media, and at the conferences which we attended. Besides this, many of the leading people within city planning and development started to use and refer to the concept." Søren Smidt-Jensen thinks the concept of the Smart City has become popular because there is a limit to the more traditional approaches to sustainability represented by the sustainable city or ECO city concepts: "The sustainable city and the Smart City are not mutually exclusive. The way I see it, the Smart City approach is a way of developing a sustainable city. It is possible to get a long way in terms of developing sustainable cities using more traditional planning tools. However, the more high-tech solutions which are part of Smart City thinking are also necessary." In this way, the Smart City has the same goals as the sustainable city or ECO city of becoming more sustainable and liveable. However, its strategy for achieving this is by implementing high-tech solutions in the city fabric.

1 The role of DAC includes grasping what is cutting edge abroad and communicate that knowledge to the decision makers and planners in Danish cities.

### The digital revolution

We live in a time of digital revolution. In less than two decades digital devices have not only become common, but are now playing a central role in almost every aspect of our lives. The internet, smart phones, cloud computing, social networks such as Facebook, Twitter and LinkedIn, iPads, and PCs all connect us with the surrounding world and each other in a way never experienced before.

Modern cities are hubs for these smart devices, which are either embedded in the infrastructure of the city as smart meters, sensors, cameras etc. or constantly moving around the city on buses, trains, or people on the streets. The strength of these smart devices lies in their ability to collect, store and provide data about their surroundings. In

## The Internet of Things

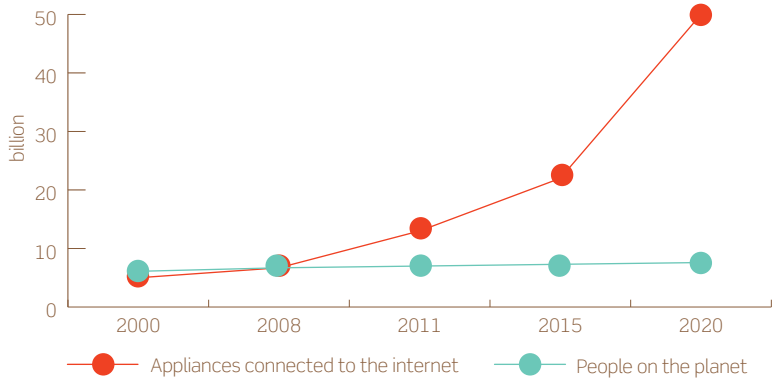
In 2008, history was made as the number of appliances connected to the internet surpassed the number of people on the planet for the first time ever, foreshadowing a future where it is not only the people on this planet which are connected, but also the things see see Figure 3. The ever increasing number of digital devices and appliances being connected to the internet do not only allow an increasing flow of information between man and machine; the devices and appliances themselves are becoming interconnected and able to communicate without the interference of people. Referred to as the 'Internet of Things', this system of technology has almost infinite possibilities when it comes to developing sustainable solutions for cities. A recent report from the Alexandra Institute, which was produced by a number of experts in the field of technology and urban development, describes 60 different scenarios ranging from intelligent waste treatment, city planning or transport to emergency response and healthcare where the Internet of Things might help to create more efficient solutions. One example is the intelligent waste bin, which uses ICT to measure its contents. This allows it to inform the waste collectors when it is nearly full, thus optimizing the waste collection routes of the city. Furthermore, it provides information to the consumers about the environmental footprint of their waste[1].

1 The Alexandra Institute 2011: Tegneserien om Tingenes Internet

a way, they constantly feel the pulse of the city, providing real-time data about the state of the city. The potential for using this data to create efficient and smart solutions in the city is almost unlimited.

In terms of carbon emission savings alone, ICT has the potential to save 15% of total global emissions by 2020. Translated into economic terms, these savings would amount to around 600 billion euros. But the potential of ICT is not limited to carbon reduction; the greatest potential of ICT lies in its ability to enable more efficient solutions based on system-thinking rather than a piecemeal approach[1].

Figure 3. World population vs. Number of appliances connected to the internet
Source: The Alexandra Institute 2011: Tegneserien om Tingenes Internet




## How is a Smart City developed?

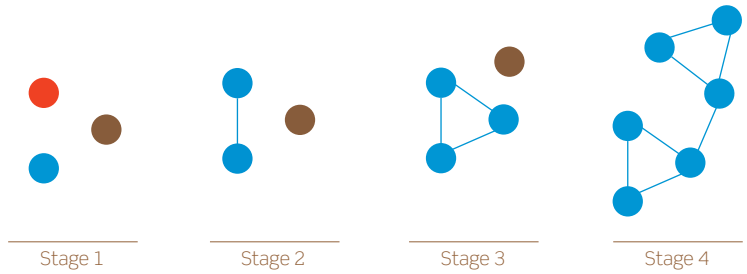
Cities are made up of vast networks of people, businesses, technologies, infrastructure, consumption, energy and spaces. In a Smart City, these networks are linked together, supporting and feeding off each other see Figure 4 on page 8.

As every city is unique, so too will be their transition towards becoming a Smart City. For instance, becoming a Smart City does not mean the same thing in Mumbai as it does in Copenhagen, as the barriers and opportunities are not the same in the two cities. Furthermore, the development towards becoming a Smart City can take many forms. In certain places in Asia, whole new cities are built from scratch. This means that there is a need – and a possibility - to think holistically from the very beginning. In most European cities, however, the development towards becoming a Smart City will happen in stages.

1 The Alexandra Institute 2011: Tegneserien om Tingenes Internet

The process of linking the many different networks of the city together in a system presents a number of technological as well as governance-related and social challenges.

Figure 4. Smart City development
Source: Information Marketplaces.The New Economics of Cities. 2011




## Releasing the enormous potential of digitalization

Starting with the technological challenges, most of the solutions which are needed in a Smart City have already been developed[1]. Solar panels, electric vehicles, wind turbines, smart grids, building management systems etc. all have the potential to become part of the Smart City. Being a smart technology, however, is not just about using less energy or being made of smart and reusable materials. It is about being able to function as an integral part of a larger system. The problem therefore lies not so much in the individual technology, but in the fact that the Smart Cities demand that this technology should be integrated into a system – an internet of things.

There are at least three main technological challenges to overcome before this can be realized:

1. Enabling the technology to gather data
First of all, being a type of Smart City technology means being able to constantly gather information about the city which can be used by the technology itself in order to adapt to the most sustainable and smart behaviour. An example of this is a Smart Building System, which constantly gathers data about the performance of a building, which it then uses to optimize energy use.

2. Enabling the technology to communicate
Secondly, a type of technology is not smart just because it is able to gather data. It should also be able to share that data with people or other technologies or borrow relevant data from elsewhere. In this sense, smart technology should be able to communicate with the rest of a Smart City system. For this to be the case, it needs to be able 'speak the same language' as the other devices in the Smart City system. Furthermore, it needs to be connected to a common communicative platform where information can be shared and interoperability can be promoted (e.g. a smart grid).

3. Making the technology multi-functional
Thirdly, although technology which is able to gather data and communicate with other technologies is indeed smart, truly smart technologies are multi-functional. This means that they provide solutions to multiple problems. One example could be the electric vehicle. This not only leads to less congestion; in connection with a smart grid it can also serve as an energy buffer, which would help level out the energy supply and demand curve.

It is of course impossible to link all the devices of the city together overnight, and the process must be regarded as a step-by-step development.

1 DTU Risø Energy Report 10. Energy for Smart Cities in an Urbanized World. 2011

# Global Smart City development at a glance

The global trends within urban development have been monitored in a recent report by the McKinsey Global Institute (MGI). This concludes that the centre of gravity of the earth's urban landscape is changing rapidly. Within the next 15 years, 136 of the cities from the developed world listed in the top 600 cities index[1] will be replaced by cities from developing countries. Not surprisingly, more than 100 of these will be Chinese[2]. While this implies the dawn of a new era where non-OECD cities will play a decisive role in the world's economy, it also points to the fact that a very substantial part of Smart City developments are taking place outside of Europe and North America.

1 The index is based on the MGI Cityscope, a global database containing information about more than 2,000 cities.

2 Urban World: Mapping the Economic Power of Cities. McKinsey Global Institute 2011

## CASE STUDY LIVE Singapore! – A technology-enabled Smart City

Singapore is one of the leading smart cities in the world when it comes to using urban data to give radical new insights into how a city works. The 5-year research project, LIVE Singapore!, which is being led by MIT's SENSEable City Lab, has an explicit focus on collecting, combining and distributing the enormous amount of real-time data which is generated in the city. This valuable data provides information as to how the city works, which parts of the physical space of the city are used by its inhabitants, how services are functioning etc. The project promotes open innovation through a platform that enables communities, companies, and the city's inhabitants to make use of the city's data to generate applications. So far this has led to the development of a number of applications and propositions including weather forecasts given 10 minutes in advance, which can direct the city's many taxi-drivers to the areas of the city where it is raining; GPS, speed and accelerometer data on vehicle fleets, which provides valuable information about traffic flows within the city; and smart meters allowing home owners to monitor their energy consumption. The pool of available data is constantly growing, and with it the possibility of becoming even smarter.
www.live-singapore.com.sg / www.senseable.mit.edu/livesingapore

## CASE STUDY Rio de Janeiro – Integrated knowledge for the benefit of all

Rio de Janeiro is as a city vulnerable to heavy rain, which in the past has caused floods and landslides. Recently, on 5th April 2010, torrential rain brought the city to a standstill and killed more than 70 residents. This catastrophic event prompted the mayor, Eduardo Paes, to take action to prevent situations like this in the future. This led to the creation of an advanced operations centre, which has access to data feeds on weather, traffic, water, energy, police, and medical services. With the level of information displayed on the centre's 300 screens, the city is not only able to predict heavy rain up to 48 hours in advance, but to tackle a whole range of potential social, economic, and environmental problems before they develop.

The centre was designed and created by IBM, and is considered ground-breaking because of its ability to integrate data from more than 30 of the city's public agencies. With the real-time data and visualizations available, the operation centre is able to make accurate analyses, helping with anything from fans exiting soccer matches to traffic accidents. Furthermore, all this information is shared with the inhabitants of Rio through Twitter and other applications, providing them with real-time information on traffic and weather. In case of severe weather, text messages are sent to key people in the affected communities. The centre will undergo further development, with more departments and information being integrated in the future. This means that the advanced operation centre will eventually be able to do advanced pattern and trend analysis using computer algorithms.
www.rio.rj.gov.br / www.ibm.com

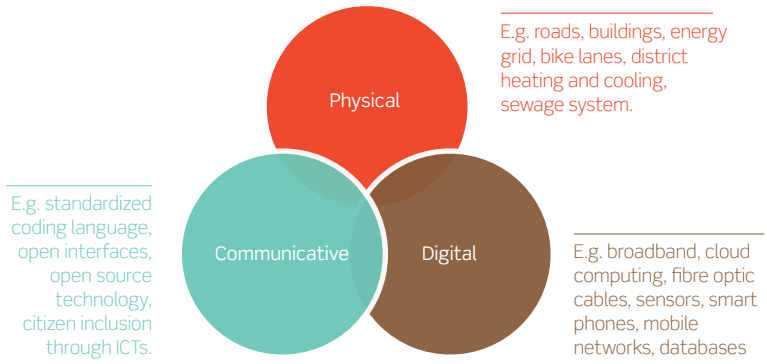
However, the more connections are made between the different networks of the city, the smarter this city will become. In this regard, the Smart City can be compared to a brain; the more neurons that are connected inside the brain, the more beautiful, creative and intelligent thoughts this brain will generate.

## Integrating smart technologies in the city's infrastructure

The infrastructure of a city is crucial for the way that city operates as it supports the movement of people, energy, money, goods, ideas etc. within the city. Historically, emphasis has been put on the physical infrastructure of the city enabling cars in huge numbers to enter the city centre. Recently, this predominant focus on the physical infrastructure of the city has resulted in widespread efforts to create green areas like pocket parks, green roofs, and green building facades. From a sustainability perspective all this is good. However, the Smart City is not just about the leaves above; it is also about the networks below. In this regard, the digital infrastructure and not least the communicative infrastructure of the city have received less attention.

Figure 5. The integrated infrastruture of the Smart City

Source: Copenhagen Cleantech Cluster 2012




This is a problem as people of the modern day world move in a digital and communicative space perhaps more than they move in physical space. Emails, phone calls, video conferences, social networks etc. are all dependent on a number of 'digital highways' transporting data through digital space (e.g. broadband, cloud computing, fibre optic cables). The communication between - and ultimately the actions taken by - the different people of the city is deeply dependent on these highways. Likewise, the many smart devices present in the city, which are often integrated parts of the city's physical infrastructure, rely on a digital infrastructure to be able to communicate and improve their efficiency.

In a Smart City, the physical infrastructure of the city is integrated into the digital see Figure 5. Sensors and smart meters deployed throughout the city can provide digital information about traffic flows, vacant parking spaces, energy use, car crashes, weather conditions etc. This information can then be accessed by the city's inhabitants via smart phones or other smart devices and thereby inform them about the smartest options for moving around the city. This makes the physical infrastructure much more flexible and customized.

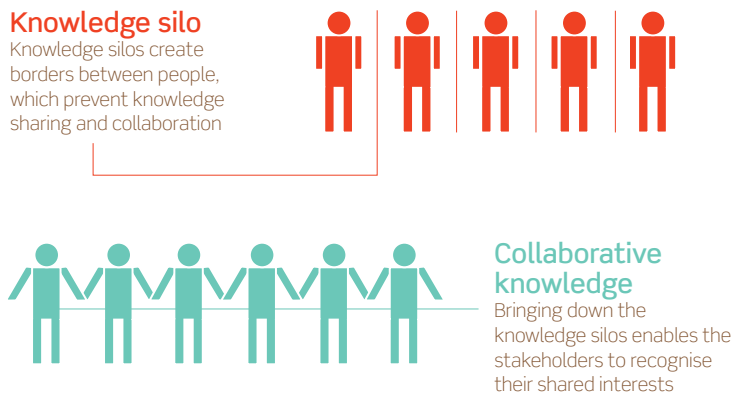
Besides the integration of the physical and digital infrastructure, the communicative infrastructure needs to be integrated as well. In order for the Smart City system to work, all people and devices have to be able to communicate with each other via the same language. This not only calls for standardization within the coding language of digital devices, it also calls for a common communicative platform on which the people and the technologies of the city can meet and share their knowledge (e.g. smart grid). Furthermore, the computer systems and databases of the public and private sectors should be able to communicate and feed into each other, enabling a smooth and efficient information flow between the different stakeholders of the city.

When the physical infrastructure is integrated into the digital and the communications infrastructures, the mobility of the city will be far greater. This will not only lead to huge efficiency gains, it will also spur creativity and innovation among the city's many stakeholders.

### Breaking down the silos of knowledge

Besides the development and integration of new and smart technologies in a Smart City system, the Smart City requires new modes of governance to be developed. These must be less 'top-down' than traditional governance policies and instead focus on more horizontal governance solutions which spur collaboration and networking between different actors across society[1].

Figure 6. Bringing down the silos of knowledge
Source: Copenhagen Cleantech Cluster 2012




As things stand now, much of the knowledge needed to create Smart City solutions is clustered in different 'silos of knowledge' see Figure 6. These silos are often separated from each other, so that the knowledge of one does not benefit that of the other. This is one of the reasons why many of the individual technologies already mentioned are not able to function together in a single Smart City system as they were developed in separate spheres. In order for future, multi-functional Smart City solutions to be developed, these silos of knowledge need to be opened up and integrated into one another. In other words, smart cities require different stakeholders (producers, knowledge institutions, citizens, municipalities etc.) to collaborate.

Cities are home to an abundance of individual people, companies, institutions etc. all with their own agendas and purposes and all with their own place in the city system. On one hand this means that there are many different stakeholders with many different perceptions of the city which need to collaborate in order to develop smart solutions for the city. This, of course, is a difficult task as the different stakeholders of the Smart City have very different ways of assessing value. While businesses tend to focus on driving shareholder returns and maximizing profits, city municipalities and politicians strive to deliver high quality services for the benefit of the city's inhabitants. Moreover, city dwellers value greater choice, service improvements and opportunities to save money[2]. The Smart City requires collaboration between all these stakeholders.

On the other hand, as the collective intelligence of a larger group of people exceeds that of a few, modern cities are hubs of knowledge and creativity. Cities are by definition home to a large group of people whose collective intelligence about the city often exceeds the knowledge of the individual city planner. This collective intelligence is still in many ways an untapped resource, and harvesting it is what will ultimately make the city smart.

1 E.g. Smart Growth, Smart Cities, and the Crisis at the Pump A Worldwide Phenomenon. (Eger, John M. 2009)

2 The Climate Group et al. 2011: Information Marketplaces. The New Economics of Cities

### Creating integrated business models

The challenge, then, is to find ways to enable cooperation between the city's different stakeholders without compromising their value creation potential. In order to overcome this challenge, a whole new way of thinking – 'Smart City thinking' – is required.

> "Cities are communities of shared capital, technology, and knowledge. A Smart City is able to both create and harvest these shared resources."
>
> Jonas Kroustrup, Central Denmark Region

This new paradigm demands new business models to be developed which enable different stakeholders to align their interests and collaborate on finding the smartest solutions. Claus Billehoj, Head of Division at the City of Copenhagen's Department of International Affairs and Sustainable City Development, provides one example of a case where the interests of different stakeholders could be aligned and their business models integrated – the electric vehicle. "If you stop looking at electric vehicles as cars, but instead see them as batteries on wheels, then they become interesting for the electricity companies, who are in need of batteries to store their energy." In this way, both the public and the private sector will have something to gain from the use of electric vehicles. For the public sector, the electric vehicle creates value through energy savings and improved health, and for the electricity companies it creates value through more flexible energy use and storage.

### Harvesting the collective knowledge of citizens

In order for the technological and political ambitions of Smart Cities to be implemented successfully, citizen acceptance and inclusion is vital. Citizens are the primary reason for the existence of the city and its policies; it is only by their support that political goals for smarter cities can be achieved.

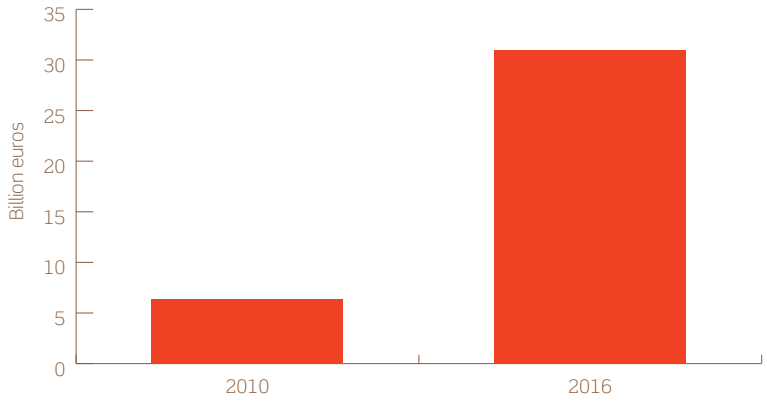
A key element in the development of smarter cities, therefore, is the inclusion of citizens in the Smart City vision. In this regard, ICTs like smart phones and social media can be used to create feedback systems between the town hall and the citizens, allowing input from citizens to be collected and assessed. One example of such an ICT-enabled feedback system is the 'Giv et praj' app, which was launched in Copenhagen in 2012. This makes it possible for the citizens of Copenhagen to report graffiti, damaged roads or signs, or full litter bins directly to the municipality using smart phones. The app represents an initiative of the municipality of Copenhagen in which the municipality and the citizens take care of the city collectively. When delivering input the citizen will instantly be informed about the expected repair or response time.

Another example is the "Change By Us" urban innovation platform, which was first launched by local residents of New York City in 2011. It consists of a webpage on which the citizens of New York can crowdsource their ideas as to how the city can be improved. In this way, citizens become partners with local government in developing solutions for the future. Since it was launched, several thousand ideas have been posted on the webpage's noticeboard. A couple of hundred of these have led to actual city development projects, which have been set in motion. Examples include a composting platform, a local chicken hatchery, and taxation on plastic bags. The platform is now run by the City of New York. Although the project is little less than a year old, it has already spread to other US cities such as Philadelphia and Seattle.

## Living Labs and Open Innovation

In a world of ever more complex problems and widely distributed knowledge, it is hard for a company to rely entirely on its own research and skills, not least if it is to develop the smart solutions needed for future cities. Therefore, many companies open themselves up to include external partners in the innovation and development process of new products or services. This process is called open innovation. There are many ways of achieving open innovation. One approach, which is widely used in connection with Smart City developments, is the living lab approach. In a living lab, researchers, firms, users, public partners and other stakeholders in emerging technologies collaborate on innovation processes in a real-world setting, such as a city. As was pointed out by Line Gerstrand Knive, member of the secretariat at the Smart Aarhus initiative, it is important not just to focus on the technological aspects of Smart City solutions as these have to be able to function in the real-life, social setting of the city: "If you only focus on technology and not on human behaviour, you will not become smart." In this regard, living labs are unique tools in the innovation process leading to smart solutions as they have a user-centric approach to innovation, which involves the citizens of the city in their everyday use. This allows for user influence on the innovation process. Many of the current cities working to become smart, such as Santander or Aarhus, are designed as living labs, where data from the citizens' use of the city create a solid base for informed political decisions and technological developments. www.lltoolbox.eu / www.livinglabs-global.com

Figure 7. Expected global Smart City market value
Source: www.abiresearch.com




## Global Smart City market prospects

The Global Cleantech Report 2012 points to the fact that the number of profiled ECO city projects has grown significantly during recent years[1]. As the implementation of smart technologies plays a crucial role in many of these projects, the demand for such technologies has grown accordingly.

This trend is reflected in the expected development of the Smart City market in the coming years see Figure 7. Expected global Smart City market value" on page 13. According to the ABI research institute, the market for technologies that feed into and support Smart City programs and projects is expected to grow on a global basis from 6.4 billion euros in 2010 to exceed 31 billion euros in 2016, accounting for 92 billion euros in cumulative spending during that period[2]. A substantial part of this market consists of cleantech technologies, such as smart grid, wind turbines, solar panels, smart buildings, and electric vehicles. Furthermore, Cisco estimates that the market for ICT-based smart solutions will be worth at least 32 billion euros over the next 10 years and that a global investment of around 980 billion euros in ICT and smart urban infrastructure will be needed over the same period of time[3].

Although these huge numbers are not definitive, they do point to the fact that Smart City development presents a substantial new and growing market with a potential to create in-

1 The Global Cleantech Report 2012 p. 426

2 www.abiresearch.com

3 www.fool.com/investing/general/2010/06/23/cisco-joins-a-trillion-dollar-gold-rush.aspx

creased revenues for those companies in the cleantech industry which are able to develop the smart solutions needed.

## Requested and implemented Smart City solutions

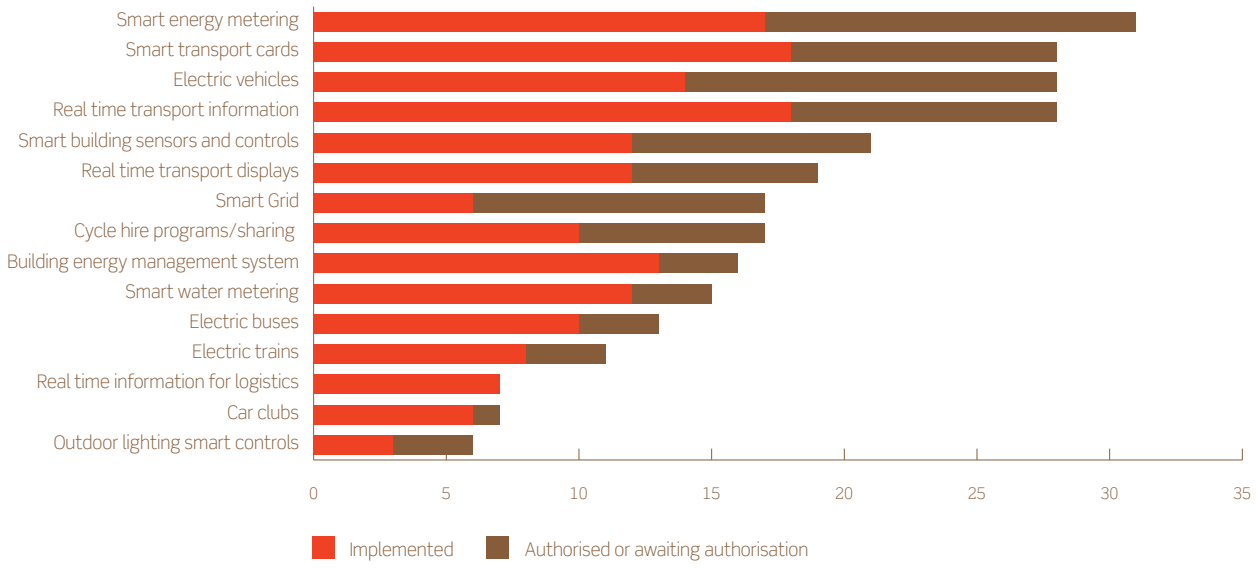
So which smart solutions are needed? A study done by Arup in 2011 on the action taken by 36 members of the C40 network to combat climate change gives a good indication of the most prevalent areas of focus when it comes to implementing smart solutions in the city fabric[1] see Figure 8. 'Smart energy metering', 'smart transport cards', 'electric vehicles' and 'realtime transport information' top the list, followed by other initiatives such as 'smart grid', 'smart water metering' and 'smart building sensors and controls'. The market for Smart Metering technologies alone is set to increase rapidly. In 2009, 76 million smart metering devices were installed around the world. A recent report concludes that this number is expected to increase more than fourfold to 302.5 million smart meters by 2015[2].

1 Climate Action in Megacities (Arup 2011); Information Marketplaces. The Climate Group et al. 2011: Information Marketplaces. The New Economics of Cities

2 Smart Mobile Cities: Opportunities for Mobile Operators to Deliver Intelligent Cities. Accenture & Cisco 2011

Figure 8. Smart City solutions in 36 member cities of the C40 network

Source: Climate Action in Megacities (Arup 2011); Information Marketplaces. The New Economics of Cities. (The Climate Group et al. 2011)



"We expect significant growth within the Smart City market, and a big part of this growth will be activated through use of data and data management."

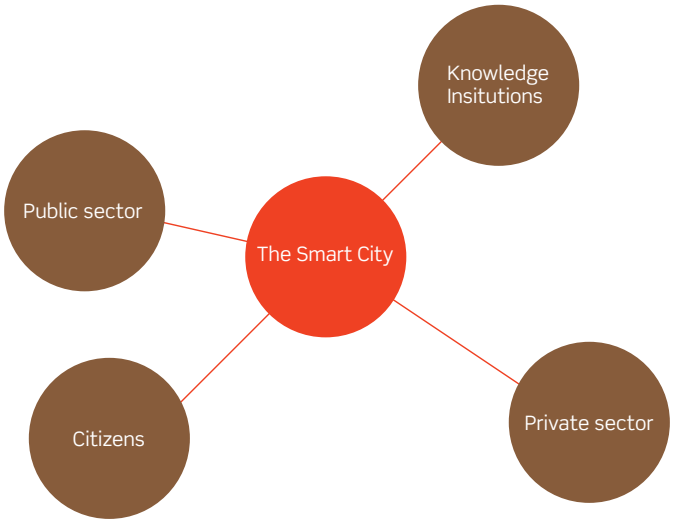
Kurt Othendal Nielsen, Siemens' Infrastructure and Cities Section


**Summary**

To sum up the first part of the report, the increasing social, economic, and environmental importance of the world's urban centres have created a need for smarter cities. The Smart City approach is a response to this need. The Smart City has the same goals as the 'Sustainable City' or 'ECO city' of becoming sustainable in a broad sense.


Figure 9. Smart City stakeholders

Source: Copenhagen Cleantech Cluster 2012




However, what makes the Smart City different is its strategic use of new and high-tech, ICT-based solutions to connect the citizens and technologies of the city on a common platform.

In this way, the Smart City can be defined as a city which systematically makes use of ICTs to turn its surplus into resources, promote integrated and multi-functional solutions, and improve its level of mobility and connectedness. It does all this through participatory governance based on collaboration and open source knowledge.

The development of smart cities presents a number of technological, infrastructural, and governance-related as well as social challenges. From the technological perspective, the biggest challenge is to re-engineer existing technologies and to develop new ones which are able to function together in systems. Furthermore, the physical infrastructure of the city must be integrated into the digital and communicative infrastructure in order to increase the mobility and effectiveness of the city and the administrative systems which connect its many stakeholders see Figure 9. The smart city is not just characterized by a smart infrastructural system of systems, however; it is above all a smart community of people. In this regard, the challenge consists of breaking down the silos of knowledge through cross-sectoral collaboration. For this to happen, new and integrated business models which are able to align the interests of the city's many stakeholders need to be developed through new forms of collaboration. Furthermore, it is important to include the inhabitants of the city both in the political decision-making process and in the business innovation process. For those companies able to succeed in creating integrated business models which take all these variables into account, the global Smart City market presents enormous business potential. This is especially true within the areas of transport, energy management, and smart buildings.

# European Smart City development at a glance

Europe is home to many of the world's leading Smart City initiatives. This is not just because of the strict demands that the EU has made in regard to carbon reductions (80% by 2050) and sustainable production and consumption, but is also supported by the fact that the EU itself supports and funds a range of different initiatives relating to Smart Cities. In 2011, the European Commission launched the latest of these initiatives called Smart Cities and Communities in order to address the European cities' role in creating a more sustainable and energy-efficient future. The initiative focuses on five key elements of a Smart City: active buildings, energy supply technologies, smart energy grids, low-carbon mobility, and urban energy planning. In 2012, the European Commission launched yet another initiative: "Smart City and Communities European Innovation Partnerships". This initiative aims to pool European resources relating to Smart City developments in order to support the demonstration of energy, transport and ICTs in urban areas. The funding opportunities for new projects are substantial; in 2013 alone this initiative has been granted 365 million euros.

## CASE STUDY Santander – Spain's first Smart City

In Santander, the EU "SmartSantander" project has been launched to facilitate a city-scale experimental research facility supporting and testing applications and services for Smart Cities. The project will stimulate the development of new applications through research into Internet of Things technologies in a real-life context. The result of the project could provide valuable input on how to make cities more intelligent and efficient for the benefit of their citizens.

The Municipality of Santander has set up 12,000 sensors collecting relevant information from all parts of the city, which can be used to make the city run more efficiently. For example, the sensors are able to collect data on traffic, allowing users to know the location of street parking spaces, and informing users of public transport when the next bus is coming. Furthermore, the city is experimenting with an automatic management of light intensity based on different traffic flows.

With the sensors, the city is now able to control and test many aspects of life in the city, making it a living lab for innovation in a real-life setting. The density of data will enable developers, citizens, researchers, organizations and the business sector to experiment with developing new applications which will make the city smarter. The result of the SmartSantander experiment will provide valuable insights into how future Smart Cities should look.
www.smartsantander.eu

## CASE STUDY Amsterdam Smart City – Building a Smart City through citizen involvement

Amsterdam's transition to becoming a Smart City began in 2009 when the independent organization, Amsterdam Innovation Motor, and the grid operator, Liander, launched the Amsterdam Smart City project in close collaboration with the Municipality of Amsterdam. The project has as its explicit aim the reduction of carbon emissions and energy use, thus creating a more sustainable and efficient city. This is done through unique collaboration between governmental agencies, private companies, knowledge institutions and the citizens of Amsterdam. Together, all these different actors develop and implement innovative new technologies in the city fabric, which will not only help to directly reduce the use of energy and CO2 emissions, but also stimulate behavioural change amongst the city's inhabitants. All new initiatives are tested in local, small-scale projects. The initiatives which prove to be the most efficient and smart are implemented on a large scale. So far this has led to a vast amount of new projects ranging from smart school education with a focus on sustainability, to smart transport, to larger smart grid, smart metering and smart electrical vehicle charging projects. To support the innovation process taking place in the city, the Municipality of Amsterdam is constantly opening up and sharing their data. This has resulted in an "Apps for Amsterdam" concept, where data about life in the city is shared, ranging from crime rates to refuse collection routes. This access facilitates open innovation as citizens/developers are able to create applications based on city data. The result is not only economic growth, but more importantly new solutions which make life in the city smarter.

Whereas the Amsterdam Smart City project started out with few partners, it has grown rapidly and it now involves over 70 different partners, including big players like IBM and Cisco. All knowledge and insights gained from the Amsterdam Smart City initiatives will be openly shared with other cities both nationally and internationally. The city's groundbreaking efforts to become smart have made Amsterdam well known as a frontrunner for Smart City development worldwide.
www.amsterdamsmartcity.nl

# AT THE CENTRE OF POSITIVE CHANGE IT'S ALL PERFECTLY CLEAN

# Denmark – a smart society

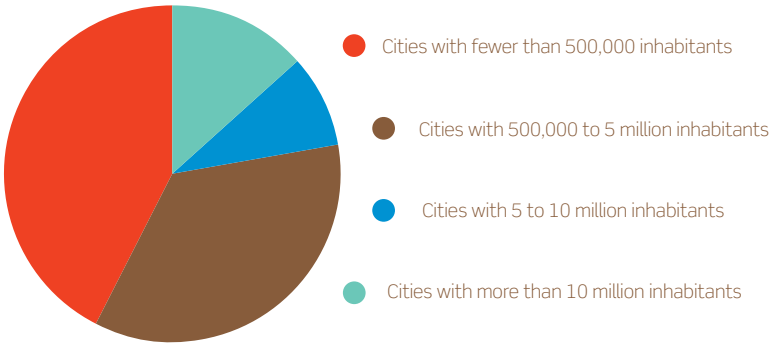
There are many reasons why Denmark can be regarded as a smart society. The following section points out some of these, and discusses a number of current trends and policies affecting Smart City development in Denmark.

In spite of the fact that there are no megacities in Denmark, the Danish Smart City market is very interesting from a commercial point of view. This is because of the fact that most of the world's future urban areas will be of a similar size to typical Danish cities. Therefore, Danish cities in general serve as excellent test beds for new Smart City technologies see Figure 10.

Several Danish municipalities have already launched Smart City programs or are working systematically to employ ICTs in the city fabric[1]. A recent study of European medium-sized cities places three of them - Aarhus, Aalborg and Odense – in the top five smart cities in Europe, testifying to the fact that Denmark has particularly good conditions for cities working to become smart[2].

Figure 10. Distribution of urban population in 2025

Source: World Urbanization Prospects: The 2011 Revision




1 e.g. Vejle, Copenhagen, Aarhus, Aalborg, Odense, Kalundborg, Randers

2 smart-cities.eu, the survey only deals with medium-sized cities with a population of 100,000 to 500,000 inhabitants

### A stable and ambitious political climate

Denmark has a long tradition of involving many different stakeholders in its decision and planning processes regarding environmental and urban development. Among other things, this led the country to become the first in the world to pass an environmental protection law[3]. Furthermore, the country's first urban planning legislation dates all the way back to 1925. This tradition of holistic and inclusive planning continues today, and is one of the main reasons why Denmark is a smart society.

Besides this, the Danish political climate supporting green solutions is both ambitious and stable. The 'State of Green' consortium, which is a public-private partnership, gathers all leading players in the fields of energy, climate, water and the environment under the common vision of making Denmark the first carbon-neutral country in the world by 2050. Furthermore, the State of Green consortium fosters relations with international stakeholders interested in learning from the Danish experience. Denmark's role as a leader in promoting the green growth economy is recognized internationally, and the country has been ranked in the top two of the Global Green Economy Index in 2010, 2011 and 2012[4].

### A strong position within cleantech

Besides having great ambitions for a smarter and greener future, Denmark has great potential for solving the technological challenges presented by the Smart City. First of all, the country has a leading role within the test and development market for key green technologies which can be used in the Smart City.

3 The law was passed in 1973

4 The Global Green Economy Index 2012

CASE STUDY **Smart City Copenhagen – A leader in smart development**

The city of Copenhagen's quest to become a smart city has developed from the ambitious vision of becoming the world's first carbon-neutral capital by 2025. In order to reach this ambitious goal, the city is determined to implement new and innovative solutions within transport, waste, water, heating, and alternative energy sources. Carbon neutrality will result in a better quality of life, innovation, job creation and investment. The Danish capital has been awarded on various occasions for its targeted work to create a greener, more sustainable and liveable city. Recently Copenhagen was awarded the prestigious European Green Capital Award 2014 by the European Commission.

The road to a smarter Copenhagen is based on a dual strategy: firstly, Copenhagen is to be the world's leading test-bed for smart and sustainable solutions. By turning itself into a living lab for new green solutions, the city is able to attract innovative companies. A very good example of this is seen in the creation of the new sustainable neighbourhood of Nordhavn, which is to house 40,000 residents and create a similar number of jobs. In order to facilitate new development, the city is focusing on collaboration (co-creation) between public authorities and private companies. According to Claus Billehoj, Head of the City of Copenhagen's Sustainable Urban Development Division, "It is about creating a common basis for decision-making in collaboration with private industry." Furthermore, he states that it is necessary to break down the barriers between the public and the private sector in order to succeed in creating a Smart City for the future. "We are taking great care to ascertain that the decisions we make are coordinated decisions made in collaboration with private stakeholders." This increases the chance of developing innovative and holistic solutions supported by everyone.

Secondly, Copenhagen is very much a believer in 'sharing is caring', as the successes and knowledge gained in the city are to be shared with other cities around the world, and vice versa. This has branded Copenhagen an interesting city to invest in, and through the strong brand of Copenhagen, companies are offered a co-branding if they create a solution in collaboration with the public authorities.

Due to the city's ambitious aims, Copenhagen is an ideal test bed for new and innovative solutions. Claus Billehoj proclaims that "... there are still thousands of different sources of potential, which when tapped will make the city of Copenhagen even smarter. Why are the street lights still on when there is no traffic? Why haven't we integrated sensors in the thousands of lampposts throughout the city which can measure air quality?" The possibilities seem almost unlimited, and Copenhagen still has a huge untapped potential, which Claus Billehoj hopes can be exploited in the years to come. The economic foundation for the future Smart City development of Copenhagen is strong. In 2012, a new budget deal was agreed earmarking 40 million euros for intelligent street lighting, transport, and solar energy projects in the city.
www.kk.dk

One example is the market for Smart Grid technologies, where Denmark is the leading European country hosting 22% of all European Smart Grid test and demonstratioprojects[1]. Another example is wind turbines, which will play a central role in the decentralized energy system of the Smart City.

According to the recently published Global Cleantech Report 2012, the global cleantech market will grow by 10% on an annual basis up to 2015. This growth will be driven by developments within the world's cities, which are expected to be "the key driver for the global cleantech market in the years to come"[2].The highest growth rates are expected within traditional Danish strength areas such as energy-efficient building materials, smart grid, and wind turbines. The global market for Smart Grid technologies alone will amount to 18.4 billion euros by 2014. This positive trend is reflected in the Danish forecast for the Smart Grid industry in Denmark.

The Danish Energy Association estimates the Smart Grid market will create around 8,000 new jobs and an increase in exports of 1.9 billion euros by 2020[3]. This makes it a very promising market for companies within the Smart Grid sector.

> "Companies which do not involve the end-users and think creatively about the question of how to engage, motivate, and retain the end-users will have a hard time getting a return on the consumer oriented Smart City investments that they make"
>
> Trygve Skjotskift, Accenture

1 www.danskenergi.dk/Aktuelt/Arkiv/2012/Marts/12_03_13A.aspx

2 The Global Cleantech Report 2012 p. 419-420. Copenhagen Cleantech Cluster

3 www.danskenergi.dk/Aktuelt/Arkiv/2012/Marts/12_03_13A.aspx

### 'Smart Grids'

IFor historical reasons, most energy distribution systems are centralized around a few big power plants. This poses a number of problems. First of all, the huge and inefficient electrical grids leading from the power plants into the cities lose power in the transmission process. Furthermore, as the supply of electricity needs to balance demand at all times, the power plants need to generate an overcapacity of electricity in order to cope with unexpected surges in energy demand. This, of course, is both highly inefficient and bad for the environment. Secondly, the integration of new and decentralized energy sources into the energy grid presents challenges as to how this energy grid is controlled. As Tyge Kjaer, Associate Professor at the Department of Environmental, Social and Spatial Change at Roskilde University, points out: "Our use of energy is three times bigger than what is realistically possible in the long run, which means that we need to develop far more intelligent energy systems. A prerequisite for this is that we take an energy system approach. We should ask ourselves how the individual source of energy fits into the bigger system." In other words, the energy grid of the future needs to be far more flexible and intelligent. The term 'Smart Grid' refers to a new kind of energy network which makes use of software and hardware tools to monitor and manage the transport of electricity from all generation sources connected to the network. This in turn provides for a more flexible and less wasteful energy transmission process, which is able to integrate decentralized and local power generation sources such as solar panels, wind turbines, and heat pumps[1].

1 For more information about the Danish smart grid market, see the report 'Denmark: A European Smart Grid Hub'. (Copenhagen Capacity 2011)

## CASE STUDY Smart City Kalundborg – Denmark's most intelligent energy city

In June 2012, a 3 year project to transform Kalundborg into a Smart City was launched. Behind the project is the Municipality of Kalundborg, SEAS NVE, the Danish Energy Association and the private Smart Grid company, Spirae. Inspired by the concept of open innovation, this project aims to turn energy distribution in Kalundborg into an open platform. The platform will make it possible for distributors of energy and services to offer their innovative solutions on a common platform. This means that the energy system of the city will be able to incorporate solar energy, wind, biogas and many other sources, and that citizens will be able to choose from a range of different energy solutions in a similar way to Google's and Apple's app platforms.

This approach makes the citizens of Kalundborg "prosumers", which involves them functioning both as consumers of energy, but also as suppliers of electricity back into the energy grid. It will be possible for citizens to control the period in which their electrical devices are recharged. For example, electric cars can be recharged in times of surplus energy or in times of low pressure on the electricity network - ensuring the cheapest price and the most sustainable solution.

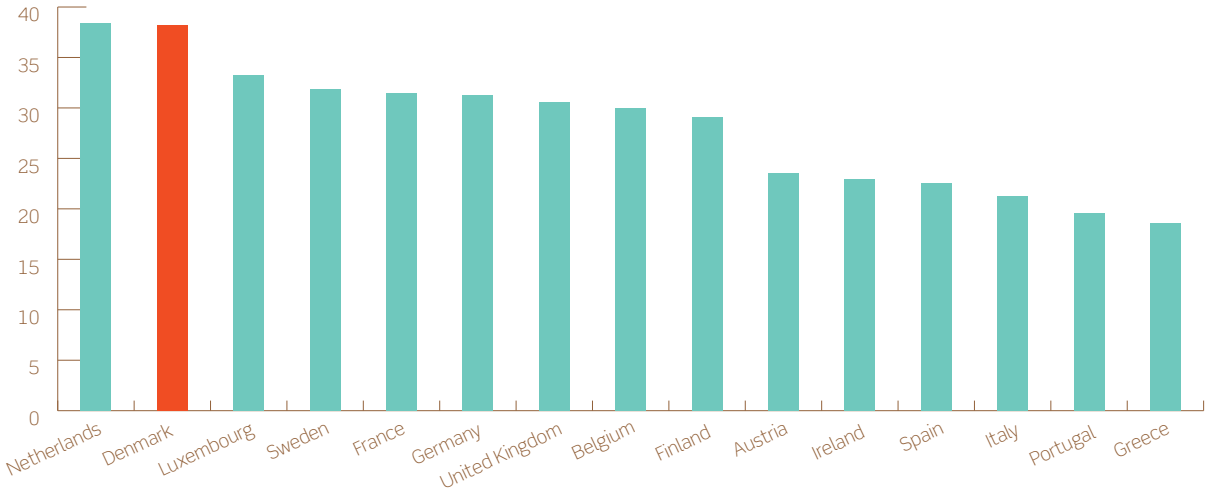
In order to ensure optimal exploitation of the various energy sources without any negative impact on the stability of supply, collaboration on intelligent consumption management between Spirae and Kalundborg has been established. If the energy from wind power is unstable due to a lack of wind, the missing power in the electricity grid will be counterbalanced by decentralized energy installations and through intelligent consumption management. Furthermore, the consumption management system will also be intelligent in exploiting surplus heat in the heating network so as to achieve a full balance without overloading the transmission system.
www.kalundborg.dk / www.spirae.dk

## CASE STUDY Bornholm – A bright green island

The Danish island of Bornholm is becoming one of the most popular test sites in the world for testing new green technologies. Because of its geographical location and well-developed water, heating, and electricity systems, the island is ideal for testing electric cars, solar panels, smart buildings, and intelligent systems, all of which will play an important role in future Smart Cities. Recently, the Bornholm Growth Forum formed a partnership with Vaeksthus Greater Copenhagen in order to develop a unique calculation model. The model will make it possible to translate the test results from Bornholm to other similar communities around the world. As an example of the unique opportunities on Bornholm, Østkraft, the energy utility company on the island, is involved in several international test projects aimed at discovering how stability of supply can be maintained once a far greater percentage of power production comes from renewable sources. One example is the 26.8 million euro project, EcoGrid EU, which has helped to install computers in 2,000 households on the island, testing smart management of electricity consumption. The project actively involves the end-user in the electricity market so that it is possible to control consumption based on the price of electricity. The specific household computer makes it possible for the household to switch selected devices on and off based on the price.
www.bornholm.dk

Figure 11. Broadband penetration rate in the EU 15

Source: Eurostat 2012




## A well-developed digital infrastructure

Besides having a strong cleantech sector, which contributes innovative technologies for the Smart City, Denmark is a highly digitalized society. In fact, the country is ranked second only to the Netherlands within the EU when it comes to broadband penetration see Figure 11. This makes Denmark ideal when it comes to implementing or testing new and smart solutions.

The well-developed digital infrastructure is the product of a targeted political action plan. Since 2001 the Danish government, together with the municipalities and the regions, have been engaged in a strategic partnership to transform Denmark into a smart and digitalized society. The work revolves around a national Digitalization Strategy, which aims to create a smarter, more efficient and cohesive public sector[1]. The strategy is based on three approaches: first of all, a targeted effort is being made to digitalize communication between the public authorities and the citizens and businesses. Secondly, new digital welfare solutions, such as telemedicine, are being developed and implemented. Lastly, the Digitalization Strategy focuses on ways to make the different Danish public authorities more digitally integrated. Work is being done to make public and private databases and computer systems compatible[2].

Denmark's well-developed digital infrastructure supports the country's smart transition as it makes it easier for companies, public authorities, researchers, and citizens to connect and share valuable data. However, Denmark still needs to integrate smart hardware into the infrastructure of many of the country's cities. As Søren Smidt-Jensen from the Danish Architecture Centre says: "We need to think more about the need for integrating sensors and different components in everything from buildings to our means of transport." The effective digital infrastructure combined with the need to implement smart technologies means that there is great business potential for foreign companies to test their smart products or services in Danish cities.

1 En enkel, effektiv og sammenhængende offentlig sektor. The Government, Danish Regions & Local Government Denmark 2011

2 www.digst.dk/Digitaliseringsstrategi/Den-faellesoffentlig-digitaliseringsstrategi-2011-15

CASE STUDY **Smart Aarhus – creating the city together**

Smart Aarhus is the name of a project launched in the Danish city of Aarhus in January 2012. The project's first aim is to lay out the visions of the future digital city of Aarhus. Jonas Kroustrup, who is part of the secretariat of the Smart Aarhus project, explains: "Instead of basing new development on narrow political decisions, we try to adopt a much more open and democratic approach to the big questions surrounding the development of the city. In the Smart Aarhus initiative this is done by creating a number of different working groups, which consist of citizens, researchers and businesses, who together try to address some of the common challenges we face." Examples of workshops are 'smart supply', 'open data', 'digital entrepreneurship', 'sustainable development', and 'public-private partnerships'.

In this way, the vision of the future Smart Aarhus is being created in close collaboration with the city's citizens. Line Gerstrand Knive from the secretariat of the Smart Aarhus initiative explains: "It is important to stress that the Smart Aarhus initiative is a city initiative, and not just another project from the municipality. What we try to do is to match citizens with those projects they feel strongly about." In this way, citizen inclusion and participation is an integral part of the Smart Aarhus initiative. This creates citizen engagement and facilitates a feeling of collective ownership for the development of the city among its citizens.

Even though they are the first undertaking officially labelled a Smart Aarhus project, the working groups are only the latest step in an ongoing process which Aarhus has initiated in order to become a Smart City. Since 2010 the city has actively promoted research on how to integrate ICTs into the city fabric. This is being done through a research program called Digital Urban Living at the University of Aarhus. Another crucial player in Aarhus' quest to become smarter is the Alexandra Institute, which is a private company working in close collaboration with the municipality and the university to promote research-based, user-driven innovation in the field of ICT. Among other initiatives, the Alexandra Institute has set up a Smart City Lab with the explicit aim of promoting Smart City solutions and strategies. Furthermore, the Smart City Lab is engaged in several EU-backed projects relating to Smart City developments, such as the OUTSMART project, the Internet-of-Things project, and the Smart City Santander project.

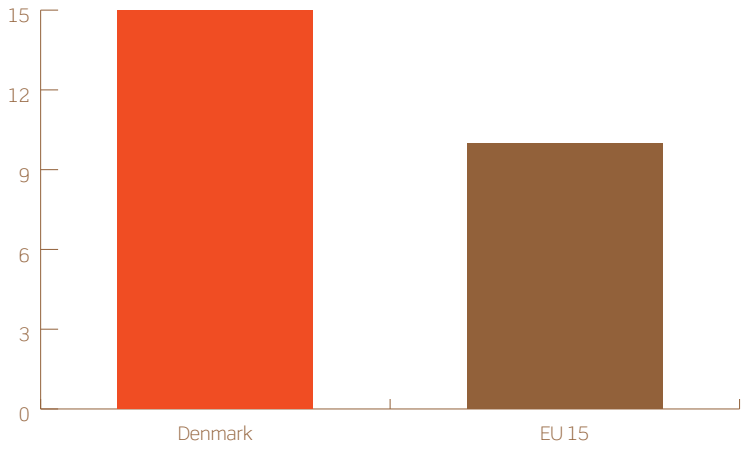
According to Line Gerstrand Knive, member of the secretariat of the Smart Aarhus initiative, the ultimate aim of Smart Aarhus is to inspire the citizens of Aarhus to take responsibility for their city: "In the long run, we hope to move some of the responsibilities of the public sector and the services that the municipality delivers onto society. We want to create a city together, where it is natural to take responsibility." The effort made by Aarhus to become smarter was recently rewarded when the city was ranked second in Europe only to the city of Luxembourg in a survey of seventy medium-sized European cities.
www.smartaarhus.dk / www.digitalurbanliving.dk / www.alexandra.dk

## A digitally connected society

The Danish efforts to improve the digital and communicative infrastructure between the public authorities, companies and citizens have led Denmark to become one of the leading countries in the world when it comes to e-governance. According to the United Nations E-Government Survey 2012, Denmark is ranked as the fourth most developed country in the world when it comes to e-governance opportunities[1]. Denmark's leading position within this area is further supported by the European Statistics Agency, which shows that Denmark is the leading country in the EU when it comes to internet-based interaction between the citizens and the public authorities. In fact, within the last 12 months 81% of all Danes aged 16 to 74 have interacted with the public authorities over the internet by obtaining information from websites, or by downloading or submitting completed forms[2].

In general, Danish citizens are ready to contribute to Smart City developments. This is not just because of the fact that they are some of the most frequent users of the internet, social media, and smartphones in the entire EU[3] see Figure 12; they are also very willing to share valuable data about their lives, which can be used in the innovation process for new smart products or services. As Søren Smidt-Jensen from the Danish Architecture Centre points out: "In general, Denmark has a really good opportunity to become smarter. We are willing to contribute to society by sharing information, and we see the greater good in doing so. I think that is more difficult in other countries." One example of the open attitude towards personal data-sharing is the Danish Civil Registration System. The system contains personal information about all Danish citizens and is a vital pillar supporting an efficient Danish public sector.

Figure 12. Percentage of population aged 16 to 74 using internet on mobile phones
Source: Eurostat 2012




1 United Nations Public Administration Programme 2012: www2.unpan.org/egovkb/global_reports/12report.htm

2 www.epp.eurostat.ec.europa.eu

3 www.epp.eurostat.ec.europa.eu

## Great access to open data

The general positive attitude towards sharing data is also reflected in the decision-making process at a political level, where open data is seen as a new way of organizing the public sector. Jonas Kroustrup from Central Denmark Region explains: "Instead of giving individual project funding we will begin to invest in new forms of infrastructure like open data."

> "Half of the world's population live in the cities, and half of these people live in cities the size of Aarhus or Copenhagen. This means that there is a huge market potential for companies able to provide solutions which answer the challenges of the public sector."
>
> Line Gerstrand Knive, Smart Aarhus

In 2009, a new strategy called "Public Data in Play" (Offentlig Data i Spil, ODIS) was initiated in Denmark. The initiative presents a whole new way of thinking about digital content and ways to include citizens and consumers in creating new solutions by giving them access to public data. The ambition of the project is to create an access point where public data is aggregated and all economic, legal and practical aspects are taken care of.

As part of the ODIS initiative, municipalities are beginning to arrange so-called data-camps, where representatives from the public authorities meet up with a number of private IT application developers in order to develop new IT-solutions based on public data-sets. In 2010, a data-camp was held with a focus on creating apps built on public data from the city of Copenhagen. At the data-camp public data was made available to 40 creative developers, which resulted in the creation of sixteen new apps. Examples include a parking app for finding available parking spaces in the city of Copenhagen (using data from the Municipality of Copenhagen) and an online electricity meter app (using data from the Danish Business Authority)[1].

The increased emphasis on open public data will inevitably play a decisive role in future Danish Smart City projects. This is because of the fact that a lot of the data which can be used to create smart solutions is generated in the public sector. Private sector use of public data can generate substantial value. In fact, the business reuse of public data in Denmark alone has been estimated to amount to around 80 million euros per year. Meanwhile the EU Commission estimates that access to public data on an EU-wide scale is worth 27 billion euros[2]. In this regard, the great access to public data in Denmark presents a business opportunity for foreign stakeholders wishing to develop new smart city applications.

1 For a presentation of all apps, see www.digitaliser.dk/resource/584902

2 Information Marketplaces. The New Economics of Cities. (The Climate Group et al. 2011)

CASE STUDY **Öresund Smart City Hub**

Oresund Smart City Hub is a recently launched project consisting of partners from Denmark and Sweden working together to identify cleantech solutions for specific problems relating to Smart City development in the Oresund Region. The project partners include the Capital Region of Denmark, the Municipality of Copenhagen, Region Zealand, Copenhagen Cleantech Cluster, the University of Lund, the University of Aalborg, the Danish Technological University (DTU), the Municipality of Malmo, and Region Skåne.

The project will focus on identifying climate and environmental issues existing across the border between Denmark and Sweden. Once an area is identified and evaluated, based on both the actual need and possible business case, innovation platforms based on a triple helix model will be facilitated by Copenhagen Cleantech Cluster. This means that stakeholders from research institutes, private companies and public authorities will be invited to give their input and collaborate in planning the road ahead to future solutions.

The aim of the project is to develop innovative solutions that will help solve some societal issues, while at the same time creating commercial opportunities. The project has a demand-driven approach to innovation, and will strive to combine the regions' strengths. Among other things, this will be done through intelligent use of IT and private-public data to develop Smart City solutions that could be transferred to other regions and cities with similar projects. It is the ambition and prerequisite of the project that solutions are scalable to the rest of EU and the world.
www.oresundskomiteen.org

CASE STUDY **SmartCityDK – Solutions built on common experience**

SmartCityDK is a network of leading companies and knowledge institutions within the Danish building sector. The network, which is anchored in the North Denmark Region, aims to facilitate the development of a number of new and smart business models needed for the Smart City. In order to do this, close collaboration between businesses, research institutions, and public authorities is needed. The companies represented in SmartCityDK count for more than 43,000 employees and the research organizations represent more than 300 researchers. Together, all these innovative forces form a common platform, where the different stakeholders can meet and share their ideas on how to create the smart solutions of the future building sector. The network is organized as a trader fund with representation from the University of Aalborg, the Danish Building Association, and a number of private companies.
www.smartcitydk.dk

## An innovative approach to new forms of collaboration

In order to create smarter technologies and cities, Denmark is working systematically to foster new and innovative ways of breaking down the silos of knowledge and facilitating collaboration across society. One example of how this is done is the 'innovation platform' approach, which has been adopted by the City of Copenhagen in collaboration with the Copenhagen Cleantech Cluster. The aim of the approach is to explore how public procurement can be used as a driver for innovation.

"In my opinion, the Nordic cities in general have a lot to offer. Our recipes for planning and developing cities can definitely inspire some of the faster-urbanizing big cities around the globe."

Søren Smidt-Jensen, the Danish Architecture Centre

This will be done through a number of 'innovation platforms' which will engage experts and entrepreneurs from across society in a creative process to identify problems and come up with smart solutions. The innovation platforms should serve as a basis for a smarter and more targeted procurement process which involves the most competent actors for solving the problem at hand. So far, innovation platforms have been successfully launched within the areas of 'Smart Cities in the Oresund Region', 'increased reuse of plastic waste', 'increased reuse of building waste', and 'better digital infrastructure in Copenhagen'.

## Summary

Ranked among the top Smart Cities in the EU, Danish cities provide an ideal test market for new smart technologies and solutions. Not only does the country occupy a leading position within several key green technologies needed for the Smart City, its long tradition of involving different stakeholders in the planning and decision-making process makes it an ideal living lab for smart solutions. This is backed by the fact that Denmark is a highly digitalized society, where all stakeholders are able to connect, share and collaborate in new and innovative ways. Furthermore, municipalities, companies and citizens provide a wealth of open data, which can be used in the development of new smart technologies. Finally, Denmark is an innovative country, where new forms of collaboration across society are constantly being developed and tested.

# CLEAN TECHNOLOGIES ARE ALL ABOUT COLLABORATING. SO LET'S MIND EACH OTHERS BUSINESS

# Challenges and recommendations for Smart City development in Denmark

In the last section of the report four main challenges relating to further Smart City development in Denmark are described. On the basis of these, recommendations are given both to Danish stakeholders wishing to support further Smart City developments and to foreign companies and other foreign stakeholders wishing to be part of the Danish Smart City market.

## Nurturing Smart City system-thinking

The first challenge facing further Smart City developments in Denmark will be to re-engineer existing green technologies and develop new ones with the Danish Smart City system in mind. As was pointed out in a recent report on energy sources for the future Smart City by the Danish Technological University (DTU): "The existing and emerging sustainable energy technologies need to be re-engineered for optimal performance in smart cities, a task that the Danish energy and IT industry together with the Danish research system should be encouraged to undertake based on their outstanding competences within these areas[1]." A part of this re-engineering will consist of digitalizing cleantech technologies so as to enable them to communicate with the rest of the Smart City system of which they are part.

The challenge for foreign stakeholders, then, will be to tailor their solutions to the Danish Smart City system. Kurt Nielsen, City Account Manager at Siemens' Infrastructure and Cities Section, has identified a first step for doing this. According to him, companies need to shift their focus away from selling already existing products and start to focus on how they can provide intelligent business delivery instead: "Companies have to improve their products and services, and by that I mean they have to think much more in terms of solutions rather than products."

Tyge Kjaer, Associate Professor at the Department of Environmental, Social and Spatial Change at Roskilde University, explains what this means. According to him, the industry has a tendency to focus on creating 'acceptance' of those of their products which have already been developed and patented. Smart City solutions, however, are tailored solutions which need to be able to function in a certain system: "Instead of focusing on creating product acceptance, it is necessary to ask what is really needed and then create the technologies suitable for delivering the right solutions. And in order to answer this question it is necessary to cooperate with external stakeholders so that you open up to knowledge and solutions which might be new to you." In other words, partnerships with external stakeholders are of crucial importance when developing smart solutions. In this regard, companies wishing to be part of the Smart City market should consider engaging in new partnerships, even with other private companies which previously might have been considered competitors.

## Facilitating Public-Private Partnerships

A second challenge is to facilitate more public-private partnerships. Although Denmark has come a long way in regard to supporting public-private collaboration, there is still room for improvement. As was pointed out by Claus Billehoj from the municipality of Copenhagen: "If we look at Singapore for instance, the border between the public and private sector – and the universities as well – is not as sharply drawn as it is in Denmark. There, it is a lot more integrated." According to him, both the private and the public sector need to move away from a traditional customer-supplier relationship in order to develop common solutions.

1 DTU Risø Energy Report 10. Energy for Smart Cities in an Urbanized World. 2011

On one hand, for the public sector this means being better at understanding the world of business. According to Claus Billehoj, "We have a tradition in the public sector of thinking holistically; however, we need to be able to better understand business modelling as well." In this regard, a systematic upgrade of relevant public sector employees' ability to understand the needs and driving forces of the business sector would be recommended.

On the other hand, Claus Billehoj thinks that the private sector in general needs to be better at taking risks and engaging in public-private partnerships. In this regard, he mentions that the clusters (e.g. Copenhagen Cleantech Cluster) play a decisive role as they function as a platform where industry and the public sector can meet. However, another excellent way of facilitating more public-private collaboration is through initiatives, such as those presented in this report (e.g. SmartCityDK, the innovation platforms, Smart Aarhus, the Oresund Smart City Hub).

> "Denmark has a long tradition of thinking holistically. If we keep thinking this way and then improve our ability to think business as well, I think there is great potential for creating smarter cities."
>
> Claus Bjorn Billehoj, Sustainable City Development, Municipality of Copenhagen

For foreign stakeholders wishing to take part in the Danish Smart City market, it is important to recognize that the public sector plays a decisive role in most Danish Smart City projects. This is because of the fact that the infrastructure of Danish cities is most often publicly owned. Therefore, it is often the public authorities who need to invest in smart solutions. Besides this a lot of the data which can be used to create smart solutions is generated in the public sector.
Engaging in public-private partnerships is not just a way for foreign stakeholders to gain access to a specific project; it can also prove to be a good branding opportunity. As was pointed out by Claus Billehoj from the Municipality of Copenhagen, collaboration with the city of Copenhagen can be a way of entering other markets: "We can offer valuable co-branding for companies. If a solution has been created through a public-private partnership, this solution will spread through our entire network of cities."

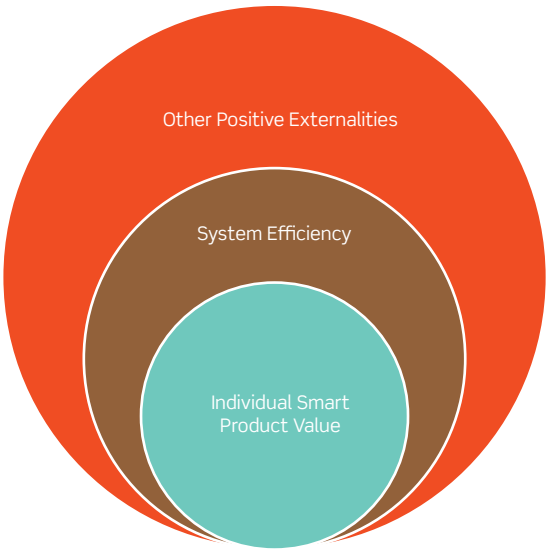
### Capturing the positive externalities of smart solutions

A third challenge to overcome in order to facilitate further Smart City development is to realize the positive externalities created by smart technologies and solutions. Besides having an intrinsic value, every Smart City project transcends its own individual value and contributes to something greater. However, it can be difficult to grasp the value see Figure 13 which lies beyond the individual smart project as this value cannot be ascribed to a single stakeholder, but is brought about by the system in which the smart project is integrated and to which it contributes. Furthermore, the added value of a smart project is often not realized right away, but takes some time to develop. This means that it can be hard to separate the cause and effect of the value created by Smart City solutions[1].

1 The Climate Group et al. 2011: Information Marketplaces. The New Economics of Cities

Figure 13. Layers of Smart City Value

Source: Inspired by The Climate Group et al. 2011: Information Marketplaces. The New Economics of Cities




Other positive externalities brought about by the smart product or service (e.g. use of electric vehicles leads to less noise pollution, air pollution, energy dependency)

The efficiency gains brought about by the smart product or service (e.g. use of electric vehicles leads to a more flexible energy system)

The intrinsic value of the individual smart product or service (e.g. use of electric vehicles leads to improved environment)

According to Kurt Nielsen from Siemens, Danish municipalities tend to have too much focus on achieving the lowest price possible, rather than adopting a wider perspective when deciding which projects to invest in: "The fact is that many municipalities consider the lowest price to be the most important issue when talking about new solutions. And the lowest price does not always lead to the best solutions in the long run. It is limiting the industry." Although there is no doubt that price is an important parameter, the positive externalities which arise from a Smart City project should also be taken into consideration as the lowest price does not always equal the smartest solution.

In order for foreign stakeholders to get access to the funding opportunities available for Smart City projects in Denmark they will have to be good at communicating the value of their service or product in a holistic way. Besides focusing on the intrinsic value of the Smart City products or services, companies will have to be good at articulating the positive externalities deriving from these. How does the specific product or service fit into the Danish Smart City system? How does it contribute to the solution of more than just one problem? How does it benefit the citizens? These are the kind of questions which are answered by the Smart City solution.

### Creating intelligent procurement processes

Lastly, a fourth challenge will be to create intelligent procurement processes. Denmark has chosen a very strict way of interpreting the European Union's procurement rules. According to Kurt Nielsen from Siemens this means that "whenever there is close dialogue between the city and a company, both parties have to be very careful not to disqualify themselves for a later procurement process." He thinks that a less strict and more flexible interpretation of the procurement rules would benefit public-private collaboration – a point which was made in several of the interviews undertaken for this report.

The strict interpretation of the procurement rules means that it can be difficult for small and medium-sized companies (SMEs) to take part in the procurement process due to lack of funding or resources. This may exclude possible smart solutions from some of the most innovative SMEs.

Even though it is difficult to change the actual procurement legislation, there is still room to think differently. As is pointed out by Trygve Skjotskift from Accenture: "It is difficult to change the procurement rules and the legislation. However, there is room for changing the evaluation criteria of the tender, for instance by creating requirements in terms of which constellation and variety of companies is required to bid. Furthermore, one idea could be to reduce the risk of bidding by offering compensation for each project proposal as in architecture competitions." This would reduce the risk in the bidding process and motivate partnership between small and medium-sized companies, academia and international companies.

For private companies, one way of dealing with this problem is to engage in the collaboration leading up to the actual procurement process (e.g. the innovation platforms). In this way, they will have a say in how the problem, which will ultimately form the basis of a tender, is being framed and what competencies should be part of the solution.

"In general, Denmark has a really good opportunity to become smarter. We are willing to contribute to society by sharing information, and we see the greater good in doing so. I think that is more difficult in other countries."

Søren Smidt-Jensen, the Danish Architecture Centre

## Conclusion

Whereas the previous centuries were dominated first by empires and next by nation states, the 21st century belongs to the cities.

The growing economic, social and environmental importance of cities has led to a global wave of urban development projects. The Smart City is part of this wave, and is defined in this report as "a city which systematically makes use of ICTs to turn its surplus into resources, promote integrated and multi-functional solutions, and improve its level of mobility and connectedness. It does all this through participatory governance based on collaboration and open source knowledge." What makes the Smart City differ from 'Sustainable Cities' or 'ECO cities' is its emphasis on creating connections and systems, not only between the millions of smart devices present in modern day cities, but also between the businesses, the public sector, the knowledge institutions, and the inhabitants of the city. In this sense, the Smart City represents a vision of a future characterized by collaboration, openness, and sharing.

Denmark is in a unique position when it comes to realizing the Smart City vision. First of all, the country has leading industry within the market for several key technologies needed in the Smart City, such as smart grid, wind turbines, and smart building materials. Secondly, the digital infrastructure of Danish society is very well developed, and will become even more developed in the years to come, as the government together with the regions and municipalities are working strategically on the digitalization of Danish society. This will not only enable further digital communication between citizens, private companies and the public authorities; it will also improve communication between the many databases, computer systems, and smart devices, which contain valuable information about Danish society. On top of this, municipalities and government agencies are working systematically to make their data publicly available for the benefit of the private sector, which can use this information to develop new and innovative smart technologies. Lastly, Danish citizens are ready to become active players in the smart transition. Among the most frequent users of the internet, smart phones, and social networks in the entire EU, the citizens of Denmark are the foundation of a well-connected smart society.

All these factors make Danish cities an ideal test market for new smart technologies and solutions. In this regard, four general recommendations for foreign companies wishing to be part of Danish Smart City developments have been given. First of all, the smart city requires tailored solutions which fit into a larger system. Secondly, public-private partnerships provide an excellent entry point into the Danish Smart City market as most of the cities' infrastructure is publicly owned. Thirdly, companies should be good at articulating the value of their solution in a broad sense, emphasizing the positive externalities which it creates. Lastly, it is a good idea for foreign stakeholders to engage in various forms of collaboration leading up to the actual procurement process, as this gives them a say in how the tender is formed.

Although Denmark can rightly be regarded as a smart society, a number of barriers still stand in the way of further Smart City growth. Municipalities and decision makers have to take the positive externalities created by Smart City projects into consideration when deciding which projects to support and fund. Furthermore, the Danish interpretation of the procurement rules needs to be more flexible in order to support further public-private collaboration. Both the public and the private sector need to be able to understand each other better. For the public sector, this can be achieved through improving employees' understanding of business modelling. The private sector, on the other hand, has to be better at taking risks and engaging in public-private partnerships. Lastly, as collaboration between the ICT industry and the cleantech industry could potentially benefit Smart City developments, it should be considered how further integration between these two sectors could be supported.

# Smart City companies in Denmark

Below is a list of companies working in Denmark providing intelligent solutions suitable for the Smart City. The aim has not been to make an exhaustive list of all companies with a potential for contributing to Smart City development as this would have been an impossible task. Rather, the list should serve to give an idea of the different types of company profiles which – when combined - will lead the way to a brighter future.

| Company name | Products and Services | Website |
|---|---|---|
| ABB | ABB is a leader in power and automation technologies. ABB provides Smart Grid solutions. | www.abb.dk |
| Accenture | Accenture is a global management consulting, technology services and outsourcing company, which has expertise in Smart City development. | www.accenture.com |
| Amplex | An Aarhus-based company which provides Smart Grid solutions, advanced metering infrastructures, and energy management systems. | www.amplex.dk |
| Arup | Arup is a global firm of consultants, designers, planners, and engineers. Arup has done extensive work on smart cities. | www.arup.com |
| Atos | Atos is a global company providing information technologies for a whole range of smart solutions. | dk.atos.net |
| Bachmann | Bachmann is a world-leading company within automation technologies. | www.bachmann.info |
| Balluff | Balluf is a world-leading sensor manufacturer. | www.balluff.com |
| Better Place | Delivers technologies and solutions for electric vehicles. | www.danmark.betterplace.com |
| Bjarke Ingels Group | A world-leading group of architects and designers based in Copenhagen and New York. | www.big.dk |
| Cisco | Among other things, Cisco provides ICT solutions for Smart Cities. | www.cisco.com |
| CleanCharge Solutions | CleanCharge Solutions delivers charging technologies for electric vehicles. | www.cleancharge.dk |
| COWI | COWI provides consultancy within different sectors including building, transport and energy. | www.cowi.dk |
| Danfoss | Danfoss develops and produces a range of different products for the Smart City including everything from sensors and heating technologies to equipment for solar energy monitoring. | www.danfoss.com |
| Deif Wind Power | Deif Wind Power develops and produces control systems for wind power. | www.deifwindpower.com |
| DHI | DHI is an independent consulting and research organization with expertize in smart water solutions. | www.dhi.dk |
| EMD International | EMD International provides consultancy and software solutions for wind power and distributed energy management. | www.emd.dk |
| Envision Energy | A world-leading intelligent energy service expert, with expertise in wind turbines, software service of smart wind farms, and integrated project management. | www.envisioncn.com |
| Festo | Festo is a leading world-wide supplier of automation technology. | www.festo.dk |
| Force Technology | Is a leading consultancy company within different industrial sectors, including transport, energy, and production. | www.forcetechnology.com |

| Company name | Products and Services | Website |
|---|---|---|
| Grontmij | Grontmij is a leading consultancy company with expertise in water and energy, transportation and mobility, and planning and design. | www.grontmij.dk |
| Henning Larsen Architects | Henning Larsen Architects is a leading Danish architect company with great expertise in sustainable projects. | www.henninglarsen.com |
| IBM | One of the leading global companies providing IT-systems for smart cities. | www.ibm.com/smarterplanet |
| KK-electronic | Provides software and hardware for intelligent wind power control. | www.kk-electronic.com |
| Københavns E | Københavns E is one of Denmark's leading energy supply companies in charge of the energy supply for Copenhagen. | www.ke.dk |
| LM Wind Power Group | Development and production of wind turbine blades. | www.lmwindpower.com |
| Logica | Logica is a global company which among other things works to integrate smart technology into different systems (e.g. energy, transport, telecom) | www.logica.dk |
| NeoGrid Technologies | NeoGrid Technologies develop and deliver intelligent solutions for a more flexible energy market. | www.neogrid.dk |
| Mita-Teknik | Mita-Teknik provides software solutions for systems control of wind power. | www.mita-teknik.com |
| Nordic Energy Group | Nordic Energy Group has specialized in developing energy-friendly solutions for green buildings, such as solar panels and combined geothermal and solar heating. | www.nordicenergygroup.dk |
| Ramboll | Ramboll is a consultancy company delivering holistic solutions for a range of different sectors, including the transport, building, and energy sectors. | www.ramboll.dk |
| Realdania | Realdania is a philanthropic company organized as an association with member democracy. Realdania supports a range of different projects relating to Smart City development. | www.realdania.dk |
| SCADA International | Delivers consultancy and solutions for Supervisory Control and Data Acquisition (SCADA) used for industrial, infrastructural or facility-based processes. | www.scada-international.com |
| Schneider Electric | Delivers a wide range of Smart City solutions including smart grid and smart building technologies. | www.schneider-electric.com |
| SEAS NVE | SEAS NVE delivers energy and a fibre-optic network to 400,000 Danish customers. The company is a partner in the Smart City Kalundborg project. | www.seas-nve.dk |
| Sensor ECS | A leading company with an expertise in embedded computer systems. | www.sensorecs.dk |
| Siemens | Siemens is one of the world's leading cleantech companies, providing a range of solutions suitable for the Smart City. | www.siemens.dk |
| Spirae | Spirae is one of the leading companies within the Smart Grid market. The company is a partner in the Smart City Kalundborg project. | www.spirae.dk |
| Suzlon | One of the world's largest wind turbine suppliers. | www.suzlon.com |
| Vattenfall | A leading energy company with unique experience in system integration, such as smart grid, district heating and cooling, and decentralized energy production. | www.vattenfall.dk |
| Vestas | The world's leading wind turbine producer. | www.vestas.com |
| Vikingegaarden | Vikingegaarden develops and delivers intelligent management and tracking systems, which can be used to manage everything from industrial processes to vehicle fleets in real-time. | www.vikingegaarden.dk |
| Wind Estate | Wind Estate is one of Denmark's leading energy companies with an expertise in wind energy. | www.windestate.com |

# Smart City knowledge institutions and organisations in Denmark

Below is a list of knowledge institutions and organizations working strategically within areas relevant to future Smart Cities. The list is not complete, but gives a picture of the various initiatives encountered during our research on the Danish Smart City scene.

| Company name | Products and Services | Website |
|---|---|---|
| Dansk Byplan Laboratorium | A Foundation Fund which aims to spur debate and knowledge-sharing within Danish City Planning. | www.byplanlab.dk |
| Digitaliser.dk | Digitaliser.dk is a social network platform for stakeholders within the public and private sectors. The aim of the platform is to support the digitalization of Danish society. | www.digitaliser.dk |
| Digital Urban Living | Digital Urban Living is a strategic research centre located at the University of Aarhus. | www.digitalurbanliving.dk |
| Energinet.dk | Denmark's biggest Energy Group with the task of maintaining the overall security supply of electricity and gas. | www.energinet.dk |
| Green Growth Copenhagen | Green Growth is a strategic focus area for Copenhagen, which is working to become the world's first carbon-neutral capital. | www.kk.dk |
| Intelligent Cities in Smart Regions | Intelligent Cities in Smart Regions is the name of a project led by the Central Denmark Region. Among other things the project focuses on building synergies between the cities of the region and the rural areas surrounding them. | www.regionmidtjylland.dk |
| IT-Forum Midtjylland | A knowledge network for companies, organizations, public authorities etc. with an interest in IT-based solutions. | www.itforum.dk |
| Living Lab DK | The aim of Living Lab DK is to become an active participant in the collaboration between the building industry and the relevant knowledge institutions. | www.LivingLab.dk |
| Smart Aarhus | Smart Aarhus is the name of the Aarhus Smart City initiative. | www.smartaarhus.dk |
| Smart-cities.net | A web portal designed to promote interaction and collaboration between Danish and Asian cities in the field of environmental solutions. | www.smart-cities.net |
| SmartCityDK | The aim of SmartCityDK is to facilitate the creation of new and innovative business models within the building industry in Northern Jutland. | www.SmartCityDK.dk |
| Smart City Randers | The City of Randers' Smart City initiative. | www.randers.dk |
| SmartCity Vejle | The City of Vejle's Smart City initiative. | www.smartcityvejle.dk |
| State of Green | State of Green brings together all the leading players in the fields of energy, climate, water, and the environment and fosters relations with international stakeholders interested in learning from the Danish experience. | www.stateofgreen.com |
| Technical University of Denmark (DTU) | The Danish Technical University is one of the leading Danish knowledge institutions within the field of smart technologies and green solutions. | www.dtu.dk |
| The Alexandra Institute | Creates IT-based products and services that generate social value and contribute to economic growth. The Alexandra Institute has a Smart City Lab. | www.alexandra.dk |
| The Danish Agency for Digitalization | The Danish Agency for Digitalization coordinates the efforts to digitalize Danish society. | www.digst.dk/da/Servicemenu/English |
| The Danish Architecture Centre | The Danish Architecture Centre is a gathering point for all those stakeholders interested in architecture and sustainable city development. | www.DAC.dk |
| The Danish Energy Association | The Danish Energy Association is a commercial and professional organisation for Danish energy companies. | www.danishenergyassociation.com |

# International Smart City knowledge institutions, companies and organisations

Below is a list of the international knowledge institutions, companies and organizations encountered during our research on Smart Cities. Once again, the list is not complete, but should serve to provide a clear picture of the many different Smart City organizations and initiatives taking place at a global level.

| Company name | Products and Services | Website |
|---|---|---|
| C40 | A network of the world's megacities taking action to reduce greenhouse gas emissions. | www.c40cities.org |
| City Service Development Kit (CitysDK) | The aim of CitysDK is to help transfer Smart City applications from city to city using an open source service developer toolkit. Furthermore, the goal is to help make it easier for developers to create new and innovative applications. | www.citysdk.eu |
| CIVITAS | The aim of CIVITAS is to support cities in introducing ambitious transport measures and policies towards sustainable urban mobility. | www.civitas-initiative.org |
| Commons4EU | Commons4EU consists of a team of seven European cities (Barcelona, Amsterdam, Berlin, Helsinki, Manchester, Rome and UK-NESTA), working together to build digital platforms between citizens and smart cities. | www.commonsforeurope.net |
| CONCERTO | A European Commission initiative within the European Research Framework Programme (FP6 and FP7) which aims to demonstrate that the optimisation of the building sector in whole communities is more efficient and cheaper than the optimisation of each building individually. | www.concerto.eu/concerto |
| Digital Energy and Sustainability Solutions Campaign | Brings together information and communications technology (ICT) companies and associations, non-governmental organizations, customers and other stakeholders who recognize the enabling role that ICT plays in improving our environment and driving long-term economic growth. | www.digitalenergysolutions.org |
| EuroCities | A network of major European cities which offers members a platform for sharing knowledge and exchanging ideas. | www.eurocities.eu/eurocities/home |
| European Smart Cities | A stakeholder platform with the aim of accelerating the development and market deployment of energy efficiency and low-carbon technology applications in the urban environment. | www.eu-smartcities.eu |
| Global e-Sustainability Initiative (GeSI) | GeSI aims to further sustainable development in the ICT sector. | www.gesi.org |
| ICLEI | An international organization of local and regional governments which supports sustainable development at a local level. | www.iclei.org |
| Internet-of-Things | An EU-initiative focusing on all areas related to the Internet of Things. | www.internet-of-things.eu |
| JESSICA | JESSICA is an EU research program providing funding and insights for leading European cities. | www.jessica.europa.eu |
| Living Cities | Living Cities is an international research program, comprised of 22 of the world's largest foundations and financial institutions, which has the aim of developing practical guidelines for ECO cities. | www.livingcities.org |
| Living Labs Global | Living Labs Global is a non-profit association whose objective is to promote innovation in services and mobility in cities. | www.livinglabs-global.com |
| London Data Store | The London Data Store was created by the Greater London Authority (GLA) as a first step towards freeing up London's data. The aim is to make the data that the GLA and other public sector organisations hold publicly available. | www.data.london.gov.uk |

| Company name | Products and Services | Website |
|---|---|---|
| **Meshing.it** | The Mesh is a platform for knowledge sharing about the business models of the future. The platform includes more than 7,000 partners from 136 countries worldwide. | www.meshing.it |
| **MIT SENSEable City Lab** | The SENSEable City Laboratory is a new research initiative at the Massachusetts Institute of Technology. | www.senseable.mit.edu |
| **OUTSMART** | An EU-funded project with the aim of creating the foundations for a Future Internet (FI)-enabled innovation ecosystem in utilities and the environment in the context of smart cities and urban areas. | www.fi-ppp-outsmart.eu |
| **SmartCities** | The aim of the Smart Cities project is to create an innovation network between governments and academic partners leading to excellence in the development and take-up of e-services, setting a new baseline for e-service delivery in the whole North Sea region. | www.smartcities.info |
| **The Smart Cities Network** | A network of European smart cities sharing best practice in open data, the internet of things and co-production. Members include Aarhus and Copenhagen. | www.smartcitiesnetwork.eu |
| **The Crystal** | The Crystal is a centre for dialogue, discovery and learning, which focuses on the challenges that cities face, and the ways they can reduce their environmental impact using sustainable technology. The centre, which is located in London, is a Siemens initiative. | www.thecrystal.org |
| **WBCSD** | The World Business Council for Sustainable Development is a business-led organization with the aim of promoting a sustainable future for business, society and the environment. | www.wbcsd.org |

# DENMARK IS HOME TO 22 % OF ALL EUROPEAN SMART GRID TEST AND DEMONSTRATION PROJECTS

THE EUROPEAN UNION

The European Regional Development Fund

Investing in your future

VÆKSTFORUM SJÆLLAND

Growth Forum
Capital Region

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