Smart Low-carbon city development

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Presented at:
Smart Low-carbon City seminar/workshop
Quality Hotel, Manado
21 March, 2018, Indonesia
Thanks to

• Angreine Kewo, LPDP (PhD student at DTU with LPDP scholarship)
• Centre to IT Intelligent Energy System, CITIES, which pays the cost of me being here
• InnovationsFond Denmark (main funder of CITIES)
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- Summary
What are we doing which is smart?

Maybe you work in teaching and research?
Maybe you work in the energy sector?
Maybe you work in an IT department of a company?
Maybe you work in a software developing company?
Maybe you work in a company developing IoT solutions?
Maybe you work in the city/municipality/local government? Implementing smart city solutions?
Maybe you work on Blockchain solutions? Robotics?
Maybe you work on Data security? --- a Hacker!!!???
Maybe you do machine learning developing autonomous vehicles?
Maybe you do machine learning in developing autonomous businesses?
University locations across the kingdom
- centered in the capital region
"Global Internet Device Forecast"
There will be as many as **40 to 80 BILLION** connected objects by 2020.

There will be **10 connected objects** for every man, woman, and child on the **PLANET**.

Through the power of smart devices, people will not only consume data, but contribute observed data to the IoT through their phones and tablets as **human sensors**.

http://visual.ly/future-internet-things
Five global mega trends shaping the future

1. **Rapid urbanisation**
   - Expected increase in global food demand by 2030: 35% more

2. **Demographic and social change**

3. **Climate change and resource scarcity**
   - 50% of the world’s population growth between now and 2050 is expected to come from Africa.

4. **Shift in global economic power**
   - In 2015 the size of the middle class in Asia Pacific is expected to overtake Europe and North America combined.
   - The world’s 85 richest people own as much wealth today as the poorest 3.5 billion.

5. **Technological breakthroughs**
   - We predict that seven of the world’s biggest 12 economies in 2030 will come from emerging markets, the ‘E7’
   - Around half of US jobs are at risk of being computerised over the next two decades.

Source: PwC via @mixequidazzle
Translation
Definition of a smart city

“The Smart Energy City is highly energy and resource efficient, and is increasingly powered by renewable energy sources; it relies on integrated and resilient resource systems, as well as insight-driven and innovative approaches to strategic planning. The application of information, and communication technology are commonly a means to meet these objectives. The Smart Energy City, as a core to the concept of the Smart City, provides its users with a liveable, affordable, climate-friendly and engaging environment that supports the needs and interests of its users and is based on a sustainable economy.”
What does it mean that we try to connect all aspects of Smart City?
National energy planning in Denmark

- The **first official energy plan** was made in 1976 – as a response to the first oil crisis 1973-1975 – focus on energy supply – it was challenged by an alternative energy plan from academia
- From 1979 -1989 an **investment subsidy** on installation of wind turbines was introduced
- An important policy was introduction of **feed-in tariffs** on wind power in 1992.
- Since 2000 we have had quite a number of studies on developing **100% renewable energy scenarios for Denmark**
- Denmark has a history of energy agreements across all parties in the parliament
The government’s energy policy milestones up to 2050

In order to secure 100 pct. renewable energy in 2050 the government has several energy policy milestones in the years 2020, 2030 and 2035. These milestones are each a step in the right direction, securing progress towards 2050.

<table>
<thead>
<tr>
<th>Year</th>
<th>Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>Half of the traditional consumptions of electricity is covered by wind power</td>
</tr>
<tr>
<td></td>
<td>Coal is phased out from Danish power plants</td>
</tr>
<tr>
<td></td>
<td>Oil burners phased out</td>
</tr>
<tr>
<td>2030</td>
<td>The electricity and heat supply covered by renewable energy</td>
</tr>
<tr>
<td>2035</td>
<td>All energy supply – electricity, heat, industry and transport – is covered by renewable energy</td>
</tr>
</tbody>
</table>

The initiatives up to 2020 will result in a greenhouse gas reduction by 35 pct. in relation to 1990.
## The Danish governments energy policy

<table>
<thead>
<tr>
<th>The governments targets on energy policy</th>
<th>Results for 2020 of the latest energy agreement 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% of energy consumption covered by renewable energy in 2050</td>
<td>A significant step towards reducing the use of fossil fuels and transition to 100% renewable energy sources – requiring a reduction of fossil fuels of 25% from 2010 to 2020.</td>
</tr>
<tr>
<td>100% of electricity and heating covered renewable energy in 2035</td>
<td>On the way to half the use of fossil fuel for power and heating from 2010 to 2020.</td>
</tr>
<tr>
<td>No coal by 2030</td>
<td>Use of coal will be reduced with 60% I 2020 from 2010 – mainly replaced with biomass.</td>
</tr>
<tr>
<td>No oil (for heating) by 2030</td>
<td>Ban for allowing new oil boilers in new building from 2013. Other initiatives for changing exiting ones.</td>
</tr>
<tr>
<td>Wind will cover half of the electricity consumption in 2020</td>
<td>Wind is expected to cover 49.5% of electricity consumption in 2020</td>
</tr>
</tbody>
</table>
Strategic energy planning

The government decides on the overall rules in the energy sector

The government define policies which encourages/pushes municipalities to implement low-carbon initiatives

The government supports project on local strategic energy planning – but in the end of the day the investments will have to come from the local municipalities or utilities
Revision of the local municipal plan

We have a 1 year cycle – which is part of a 4 year cycle – which is part of a 12 year cycle
## The phases in developing a district plan

<table>
<thead>
<tr>
<th>Step</th>
<th>Details</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarification</td>
<td>Preliminary dialogue</td>
<td>4-8 weeks</td>
</tr>
<tr>
<td>Initial description</td>
<td>Preparation of initial description</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>Political reading of initial description</td>
<td>4 weeks</td>
</tr>
<tr>
<td>District Plan proposal</td>
<td>Preparation of plan proposal incl. internal hearing</td>
<td>6-8 weeks</td>
</tr>
<tr>
<td></td>
<td>Political reading of the proposal</td>
<td>5-6 weeks</td>
</tr>
<tr>
<td></td>
<td>Announcement and publication</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>Public hearing</td>
<td>8 weeks</td>
</tr>
<tr>
<td>The final district plan</td>
<td>Processing objections</td>
<td>2-4 weeks</td>
</tr>
<tr>
<td></td>
<td>Adjustment of changes</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>Political reading of final plan</td>
<td>5-6 weeks</td>
</tr>
<tr>
<td></td>
<td>Announcement and publication</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>Period of appeal</td>
<td>4 weeks</td>
</tr>
</tbody>
</table>
Du er cyklist nummer 4292 i dag.
af sammenlagt 1258919 cyklister siden 1. maj 2009 på denne strækning.

Translation
Danish Power production – Import/Export

Power right now
Measured in MW:
- Central power stations: 1,575
- Local CHP plants: 401
- Wind turbines: 4,088
- Solar cells: 113
- Net exchange export: 1,845
- Electricity consumption: 4,331
- CO2 emissions: 179 g/kWh

LEGEND

- Power right now
- Natural gas right now
- Locations

Last updated: 15. Februar 2014 12:41
Power flow systems in Manado (PLN, 2017)

Main stations: 19 interconnected locations
Transmission line: 1,447,68 kms

Power supply capacity: 409.7 MW
Peak load: 358.3 MW
Electricity production (green) and electricity consumption (grey) over three weeks in Denmark
Change towards smart networks or decentral solutions

- From centralised to decentralised production
Centre for IT Intelligent Energy Systems - CITIES

Scientific Objective

To establish **methodologies and ICT solutions for design and operation** of integrated electrical, thermal, fuel pathways at all scales.
Key Outcomes

- Modular **forecasting and control models/tools** for a variety of energy system components, including their interactions
- **Market structures** that support energy systems integration
- Operational **methods and scenarios** for energy systems integration and management, scenarios towards a fossil free future (Power and heating sectors fossil fuel free in year 2035)

- **2014-2019, 10 €Mio** (Innovationfond Denmark 6 €Mio, 38 partners)
- **18 Demo Projects** finished, ongoing and planned.
- **80 published papers**
- **Setting up an Innovation Centre**
- **www.smart-cities-centre.org**
Open Data for Smart Cities: what are the benefits?

- Transparency
- Accountability
- Efficiency
- Public Service Delivery
- Engagement
- Data Improvement
- Societal value
- Economic value
The Danish DataHub solution

From decentralized market management to centralized market management

Keywords: Digitization, unbundling, efficiency and transparency
Upcoming European protection of personal data (May 2018)

Regulate the use and protection of personal data. Major changes:

- Elaborates the **rights** of the registered
- **Right to be forgotten**
- **Data portability**: Take ALL your data from one social media to another.
- Stricter **documentation** requirements: Must be able to document the effort in securing data
- **Higher fines**: % of global sales

Intended to harmonize

- But approximately 50 areas where each country can make own legislation
- The area is still going to be **complicated** to rule
IoT sensors for monitoring air quality
Analytics and visualization

Model the correlation between traffic jam factor and CO2
Copenhagen to become carbon neutral

![Graph showing CO₂ emissions from different sectors in Copenhagen from 2005 to 2025. The graph indicates a significant reduction in emissions, particularly in the areas of Town gas incl. process heat and Individual heating.](image-url)
Copenhagen to become carbon neutral

![Graph showing CO2 emissions](image)

- New initiatives
- Energy savings
- Solar cells
- ITC and mobility
- Public transport
- New fuels
- City of cyclists
- Municipal organisations
- Sorting of plastic
- Combined heat and power based on renewables
- Wind turbines

Result of the climate plan

CO2 emissions (kilo tonnes)
Some projects

Tranform: http://www.transformyourcity.eu/

CITIES: www.smart-cities-centre.org

ClairCity: http://www.claircity.eu/

Smart City Accelerator: www.skoleklima.dk

ESPON: https://www.espon.eu/sites/default/files/attachments/ Locate_draft-final-report_0.pdf

CITIES Innovation Center: https://www.citiesinnovation.org/
Summary

Development of Smart cities is about smart people working with smart stakeholders with smart cities with smart solutions. Everyone needs to work together.

Everyone should see it as an opportunity to engage with the citizens, the customer, the smart people out there to develop solution for the good of the society. The idea is not to be in full control of what is going on – but let the initiative take over.

Each smart city solution may look small and insignificant but each small solution makes a different in the big picture – when it all works together.