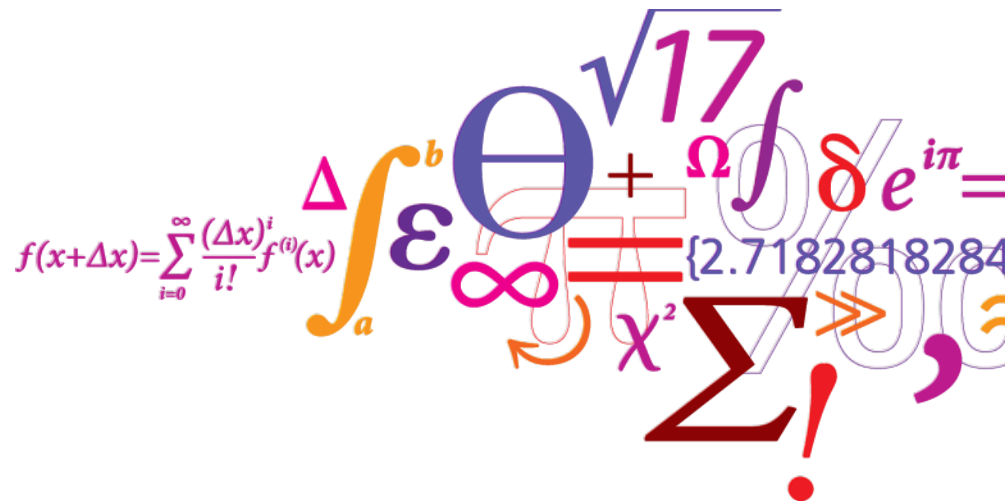


CITIES Smart energy systems and solution

Per Sieverts Nielsen



Centre for IT Intelligent Energy Systems in Cities – Funded by Innovation Fund DK

- 45 partners including
- 5 DTU Departments and AAU
- 35 commercial partners

- 2014-2020 (6+1 years)
- Total budget: 75 mio Dkr

- > 100 journal and conference papers
- > 20 workshops
- > 20 solutions

EU climate targets

EU's climate and energy targets for 2020 and 2030

	2020	2030
Reducing greenhouse gas emissions	↓ -20% compared to 1990 levels	↓ -40% AT LEAST compared to 1990 levels
The share of renewable energy	↑ to 20% of final energy consumption	↑ to 27% of final energy consumption
Improving energy efficiency	↑ 20% compared to the estimated development in 2007	↑ 27% compared to the estimated development in 2007*

*Indicative target

Danish national energy plan

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.

2020

Half of the traditional consumptions of electricity is covered by wind power

2030

Coal is phased out from Danish power plants
Oil burners phased out

2035

The electricity and heat supply covered by renewable energy

2050

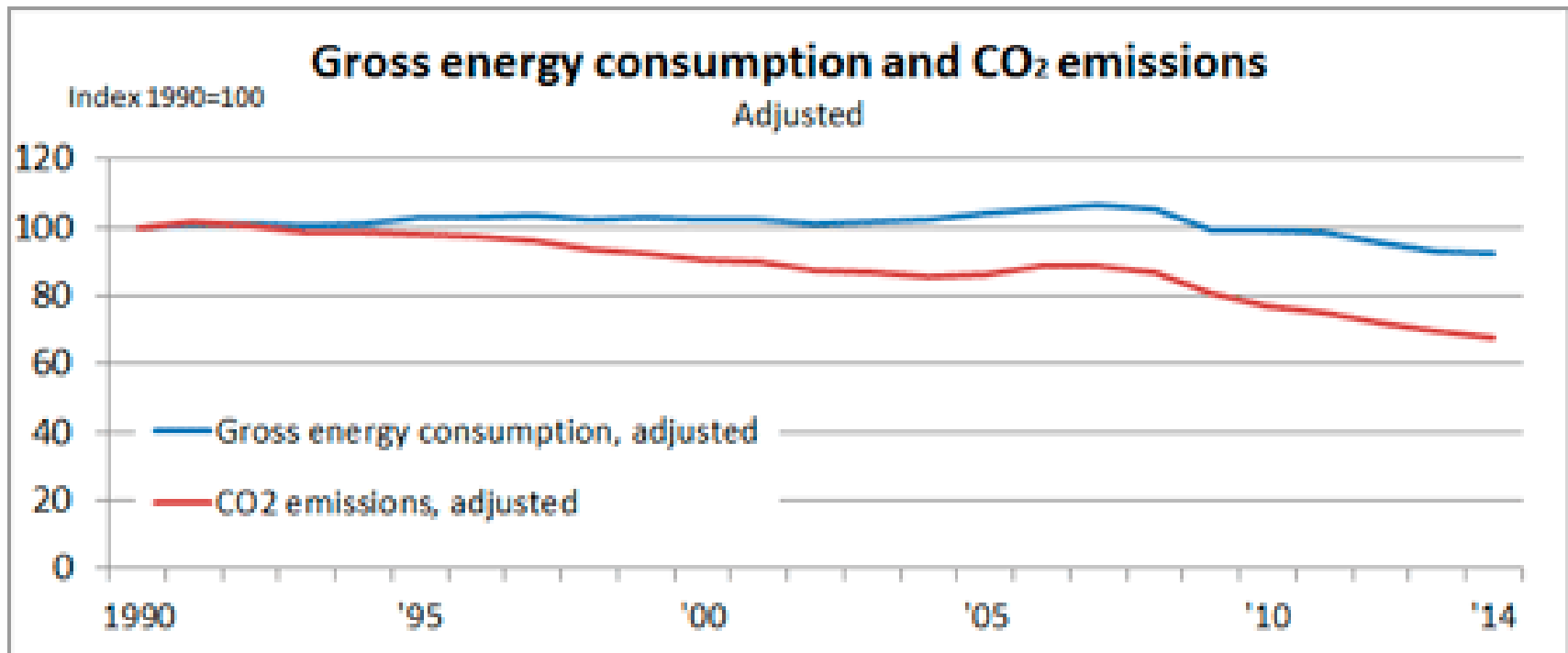
All energy supply – electricity, heat, industry and transport – is covered by renewable energy

The initiatives up to 2020 will result in a greenhouse gas reduction by 35 pct. in relation to 1990.

Electricity production (green) and electricity consumption (grey) - 3 weeks period



Development in Danish energy consumption



<http://www.ens.dk/en/info/news-danish-energy-agency/renewables-cover-more-half-electricity-consumption>

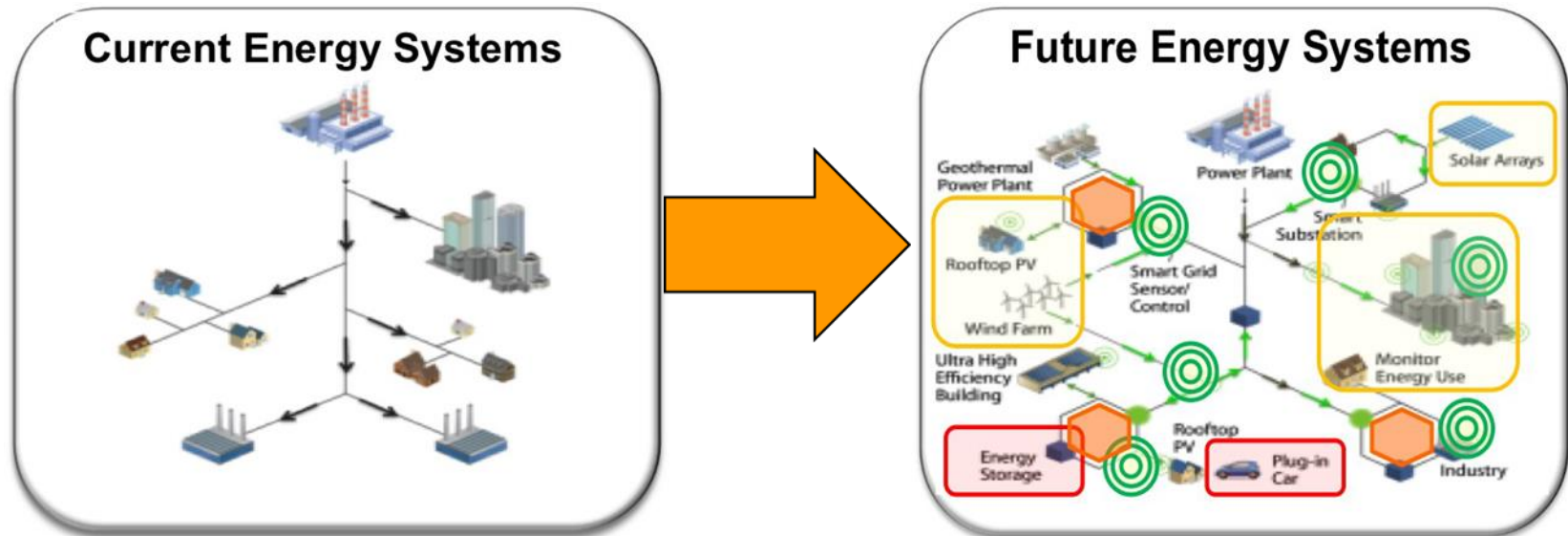
Supply Solutions – Renewable energy sources

- Power from wind
- Power from solar PV
- Heat from solar thermal
- Heat and power from Biomass
- Etc.



Change towards smart networks or decentral solutions

- From centralised to decentralised production



Flexibility characteristics

- Balancing of the power grid: **0-2 seconds**
- Control and automation (IT solutions): **0-30 minutes**
- Supermarket refrigeration can provide storage **0.5-2 hours**
- Buildings thermal capacity can provide storage up to **5-10 hours** + local water storage **2-12 hours**
- District heating/cooling systems can provide storage up to **1-3 days** (DH systems with thermal solar collectors can often provide seasonal storage)
- Gas systems can provide seasonal/long term storage solutions, **1-6 months**

Definition of Smart City

Copenhagen had a cross department process in 2013 for deciding their definition of Smart Cities

- Use of data
- Use of new technologies/using old technologies in new ways
- Efficient use of resources
- New ways to involve citizens and stakeholders
- Innovation or technology-based growth
- Public-private partnerships
- Solve more than one problem at a time.

Else Kloppenborg et al, 2015: Transformation agenda for Copenhagen (D2.2)