Background

Paper and presentation based on the book:

*Architecture and Energy*

Winner of Danish Energy Association's *EltorskPrisen 2007*

The 2007 prize for the best Danish research project on effective energy consumption and savings
The Past
Since the 1970's oil crisis there has been a large effort to minimise buildings' heat consumption.

Social and technological processes of change have resulted in a large growth in electricity consumption.

Typical new housing 1975 - 2005:
- Heat consumption: -65% 
- Electricity consumption: +10%

Since the 1990's electricity consumption larger than heat consumption.

The Present
New Energy Regulations with holistic assessment method:
- Electricity consumption counts as primary energy
- Factor 2.5: equal to CO₂-emissions

Electricity consumption more important than heat consumption for most important types of new buildings:
- Electricity consumption: 60%
- Heat consumption: 40%

For new housing:
- Electricity to domestic appliances: 40%
- Space heating: 25%
The Future

From 2001 to 2006: five of the eight hottest years since 1874 in Denmark

Global warming and climate change will result in summer and winter temperature increases in Denmark:
- Greater demand for cooling
- Reduced demand for heating

For typical housing 2005 - 2080:
- Energy for cooling: + 50 %
- Energy for space heating: - 30 %
- Cooling larger than space heating in 30 - 40 years

Paradigm shift

The Past:
Heat reduction paradigm

The Future:
Electricity reduction paradigm
The New Paradigm
- Focus on electricity and heat reductions in a holistic perspective
- Focus on electricity savings and reducing cooling demand
- Focus on minimising the effects of climate change

Design Strategy

1 Functionality
User-orientated and functional strategies to reduce buildings’ electricity consumption beyond the requirements of the current Energy Regulations

2 Spatiality
Spatial proportioning and facade design to improve daylighting and indoor comfort, whilst electricity consumption to lighting, cooling and ventilation is reduced

3 Materiality
Design of structural and constructional elements optimised to reduce energy to heating, cooling and material production

4 Technology
Building integrated energy saving and producing technologies optimised in relation to future climate change and energy supply scenarios for buildings
Design Example: Energy Consumption
Cumulative effect of the new paradigm on the total primary energy consumption for housing

Following solutions compared:
- Typical terrace house
- Same house built after the so-called Passive-House standard which only reduces space heating demand
- Same house built after the New Paradigm with a focus on reducing electricity and heat consumption in unity

Design Example: Climate Change
Total primary consumption as a result of expected temperature changes in Denmark because of climate change between 2005 and 2080:
- Passive-House gives increasing energy consumption because of growing overheating problems and cooling demand
- New Paradigm with a focus on reducing electricity consumption and overheating has lowest energy consumption both now and in the future