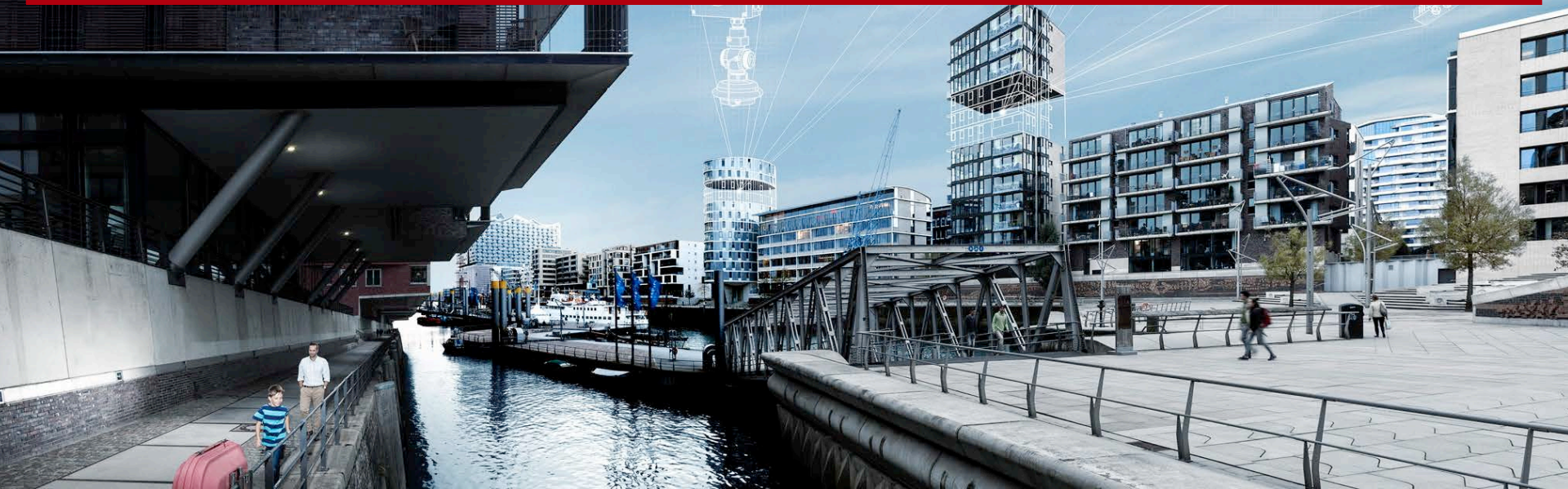
ENGINEERING TOMORROW

Putting Energy Efficiency First

Flemming Lynge Nielsen, Sustainability Director



Setting the scene

- **Putting energy efficiency first** – 38% of emissions reductions needed by 2050 should come from energy efficiency
- **Building efficiency** represents half of the needed measures
- Energy efficiency is the most **cost-effective way** to decarbonize our economy
- Energy-efficient technologies are **ready for implementation** and is a good business case
- **Cities** are key to unlock energy efficiency
- **Urban efficiency**: Buildings, energy systems, industry, water, food, infrastructure

Is energy efficiency obsolete?

- Energy efficiency is obsolete if:
- Power from the wind and the sun is free and endless
- In the future renewable-based new world we will have unlimited resources of cheap energy sources

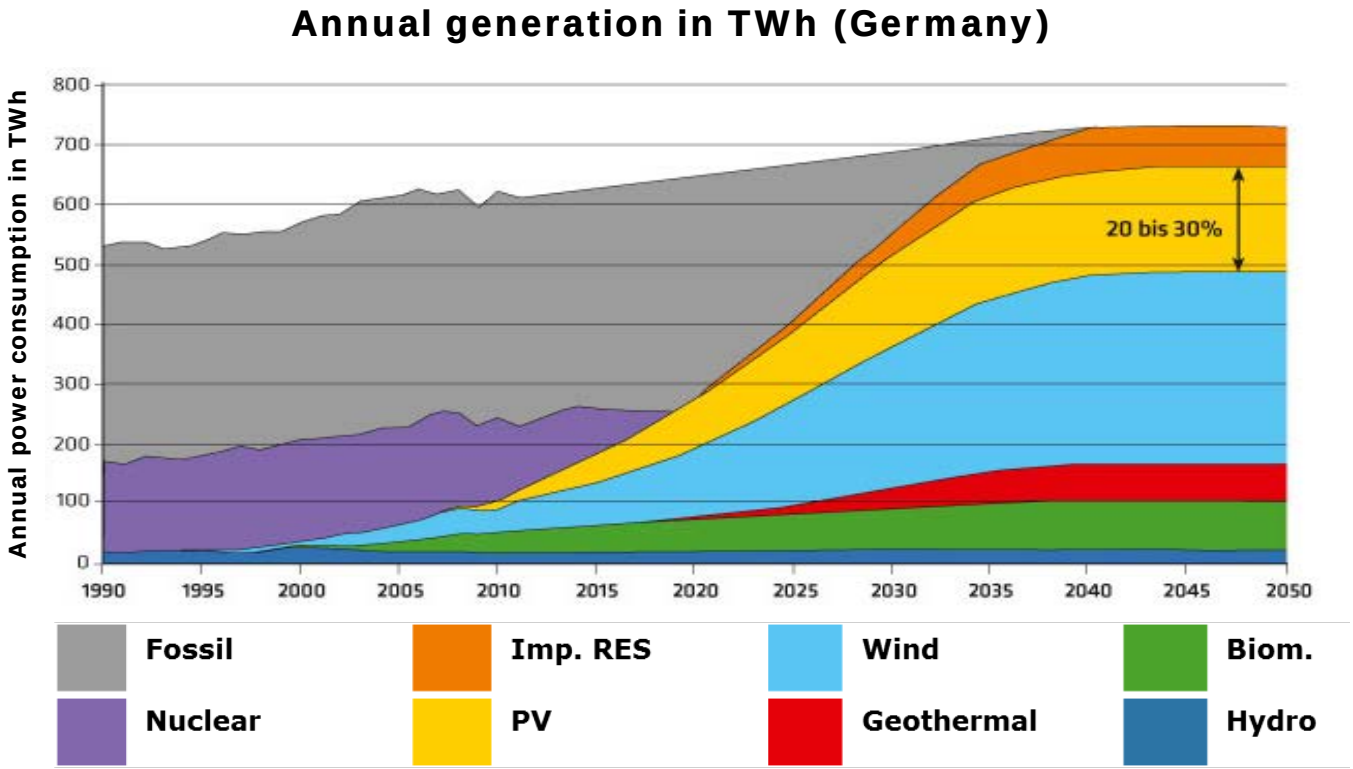
Preconditions if this argument is true:

I. Wind and sun directly generate power – the future energy-system would have to be a power based one

II. Unlimited quantities of power would have to be available

III. Power would have to be cheap

I. Will the future be electric?



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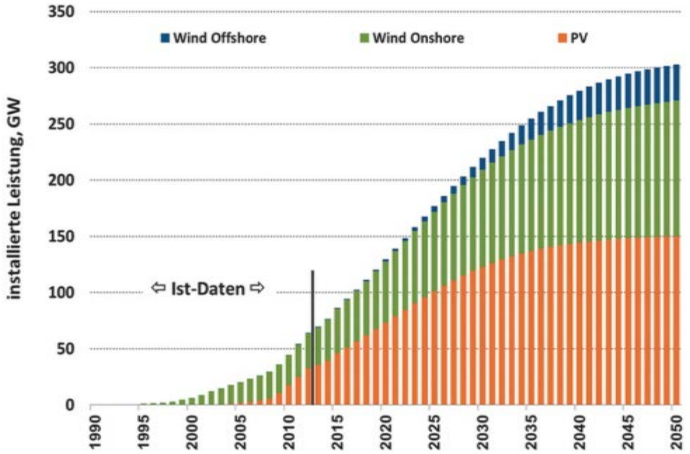
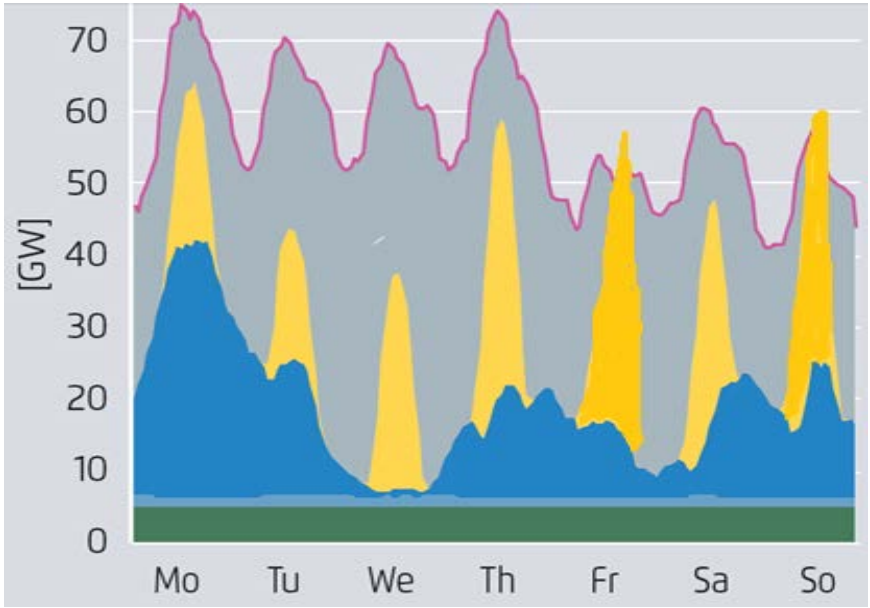
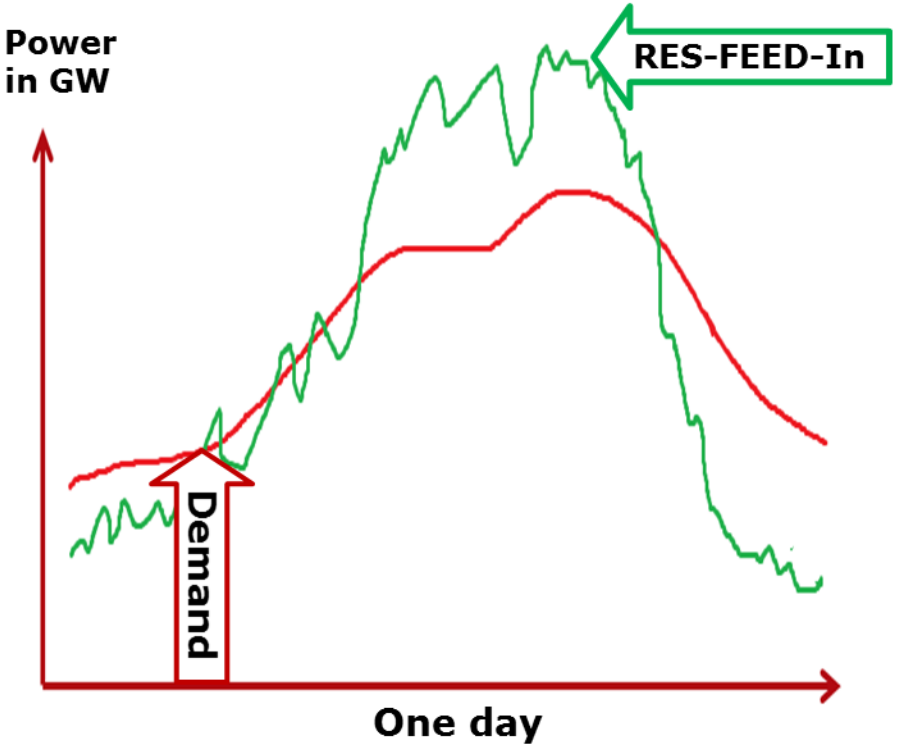
II. Will power be unlimited?
Few hours with excess power today





- Today ca. 30% RES-power lead to few hours with excess power.
- The power system starts to need flexibility

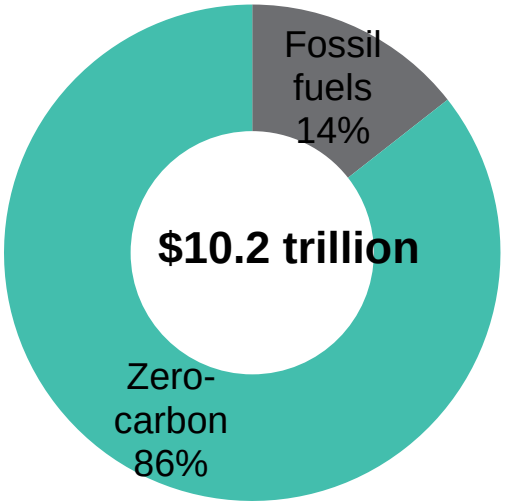


II. Power will not (always) be unlimited

- But sometimes it will be
- Due to the fluctuating nature of RES and the very high capacities built up there will be more and more hours with excess power
- Flexibility storage options needed
- On the other hand new demand is evolving

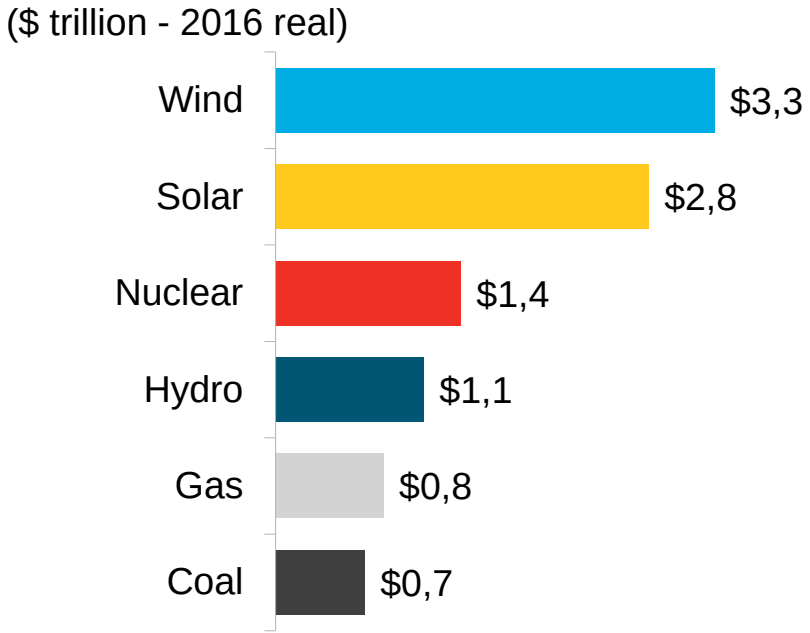
Solar and wind attract 60% of new investment in power generating capacity

Investment, by technology, 2017-2040



Source: Bloomberg New Energy Finance

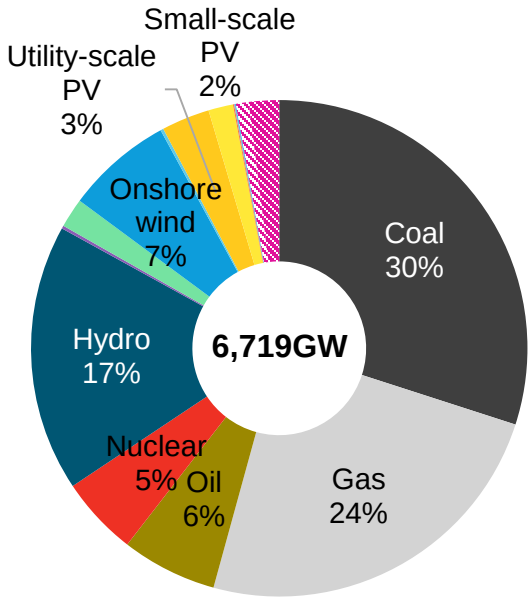
Investment, by technology, 2017-2040



Source: Bloomberg New Energy Finance

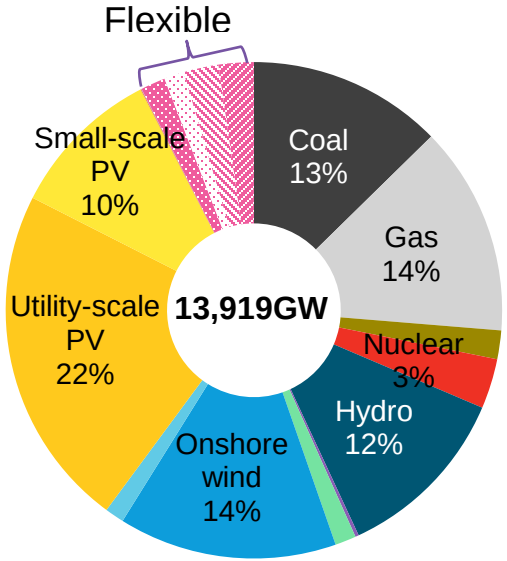
Solar and wind dominate the future of electricity

Global cumulative installed capacity: 2016



Source: Bloomberg New Energy Finance

Global cumulative installed capacity: 2040



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Preconditions if this argument is true:

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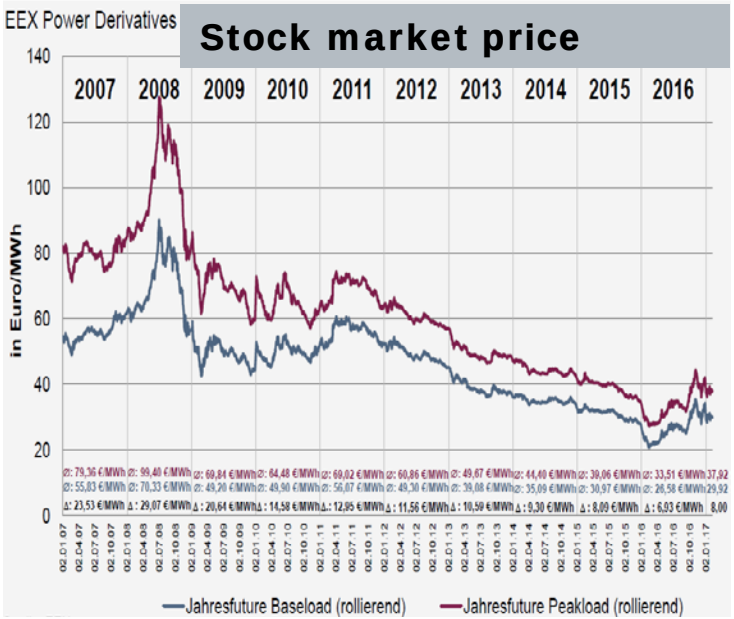
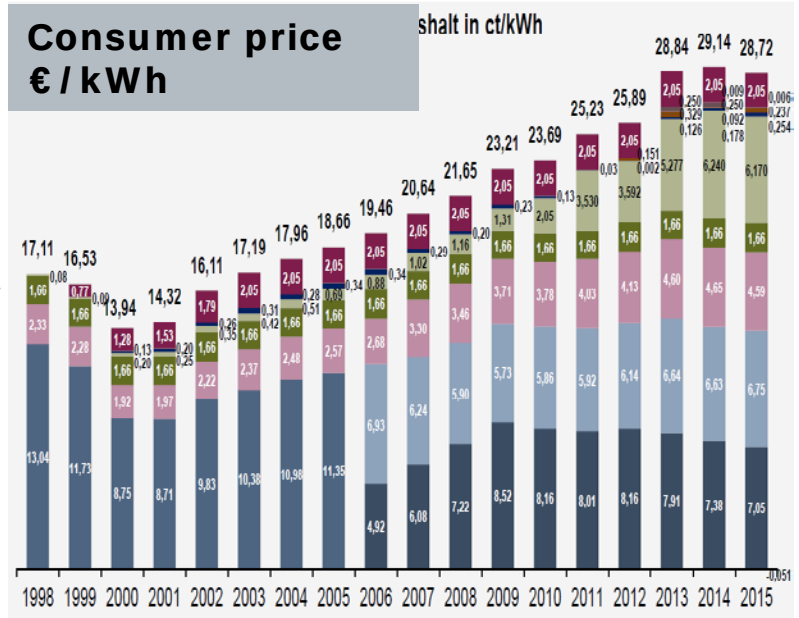
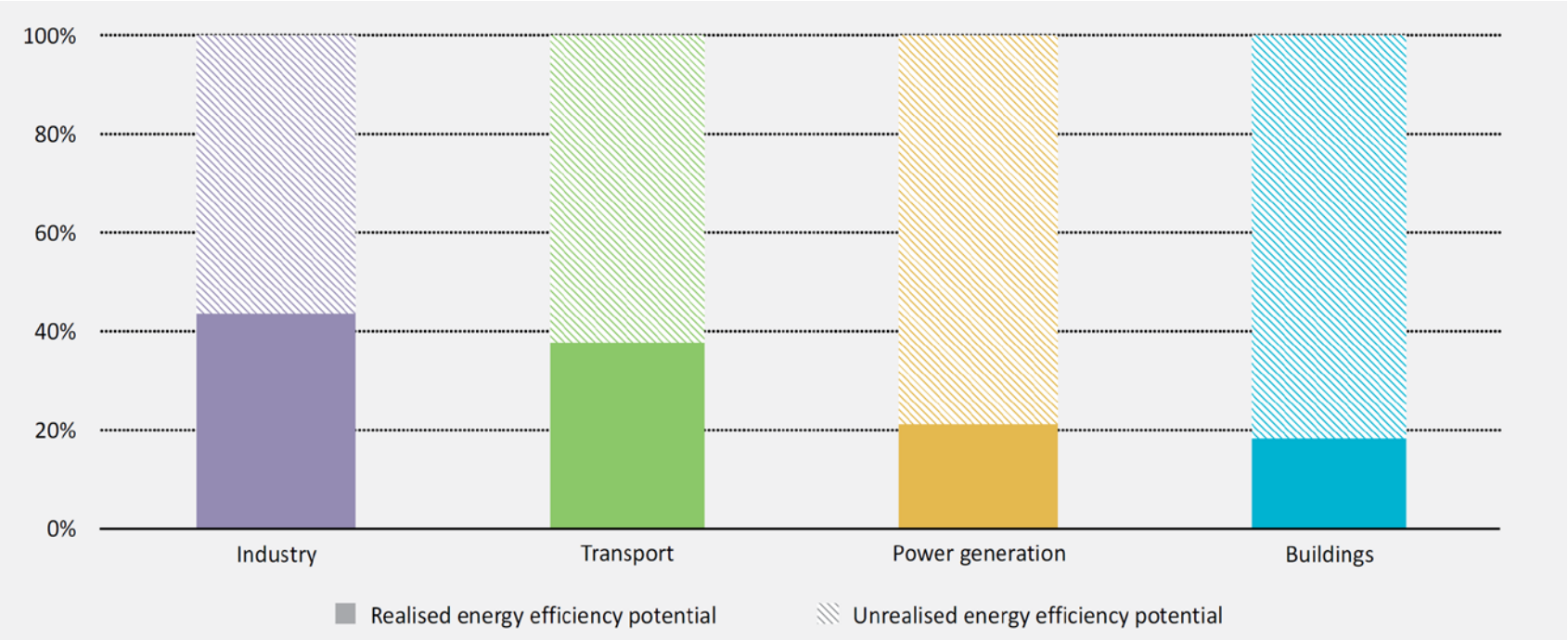
III. Will power be cheap?
…but not for consumers





Rising RES levy and taxes overcompensate low stock-prices

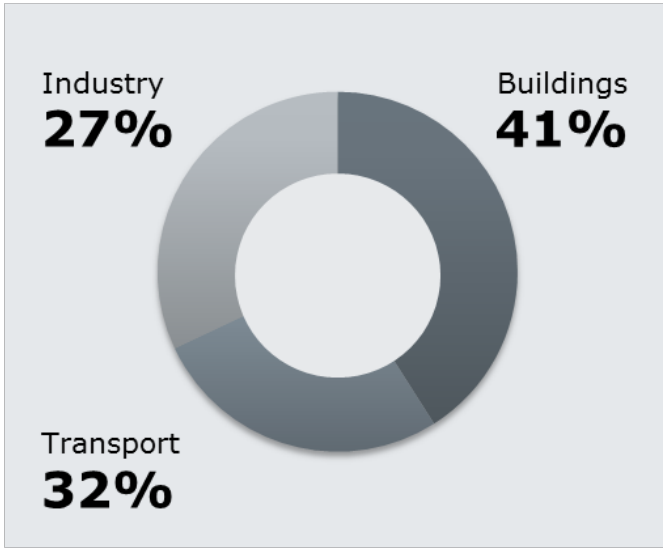
The potentials of energy efficiency



Large potential for energy efficiency in buildings

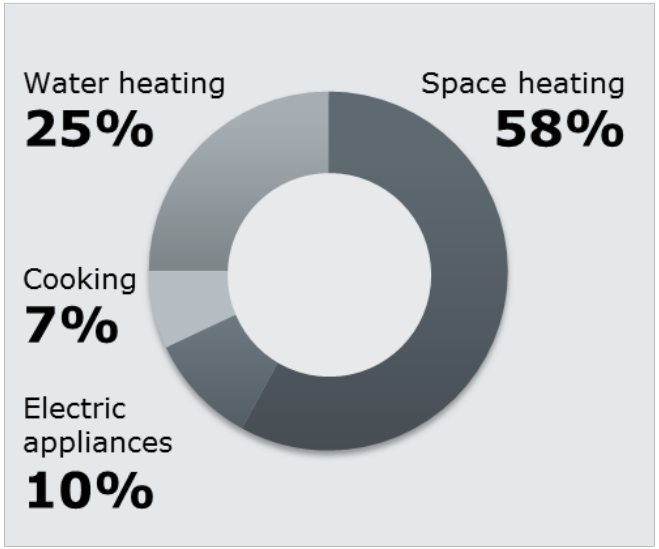
Buildings account for one-third of total final energy consumption in the world …

EU example:



Globally, space heating and cooling account for over one-third of all energy consumed in buildings…

EU example:



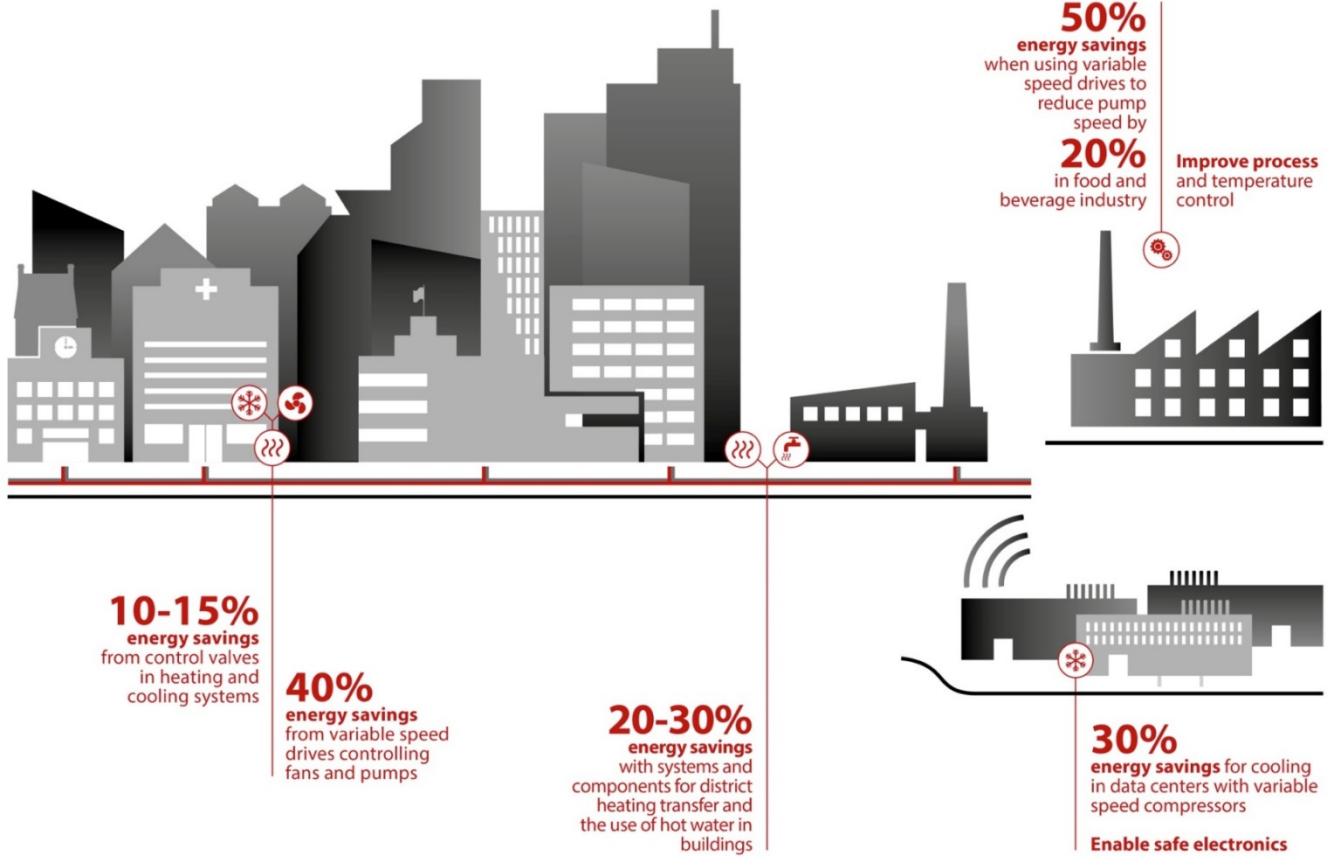
Cities Key to Sustainable Growth

- Cities account for 85% of the global Gross Domestic Product (GDP)
- More than half of the world's population lives in cities
- By 2050 another 2.3 billion inhabitants are expected to join the urban population
- Benefits of compact, connected and not least efficient cities
- → generate growth and create jobs, reduce greenhouse gas emissions, and improve the health of the world's population

Make cities smarter

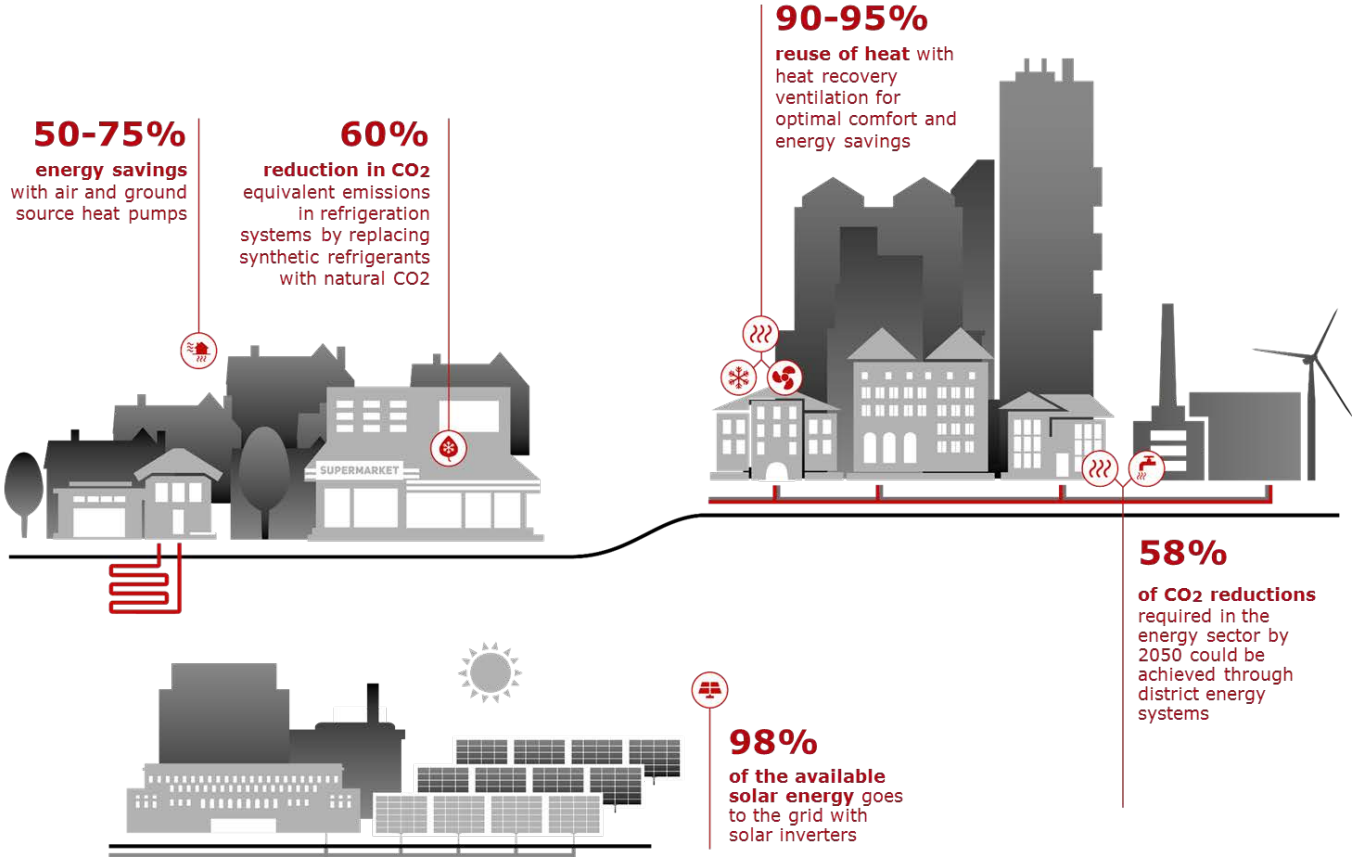
The technologies are already available

Energy



The technologies are already available

Climate



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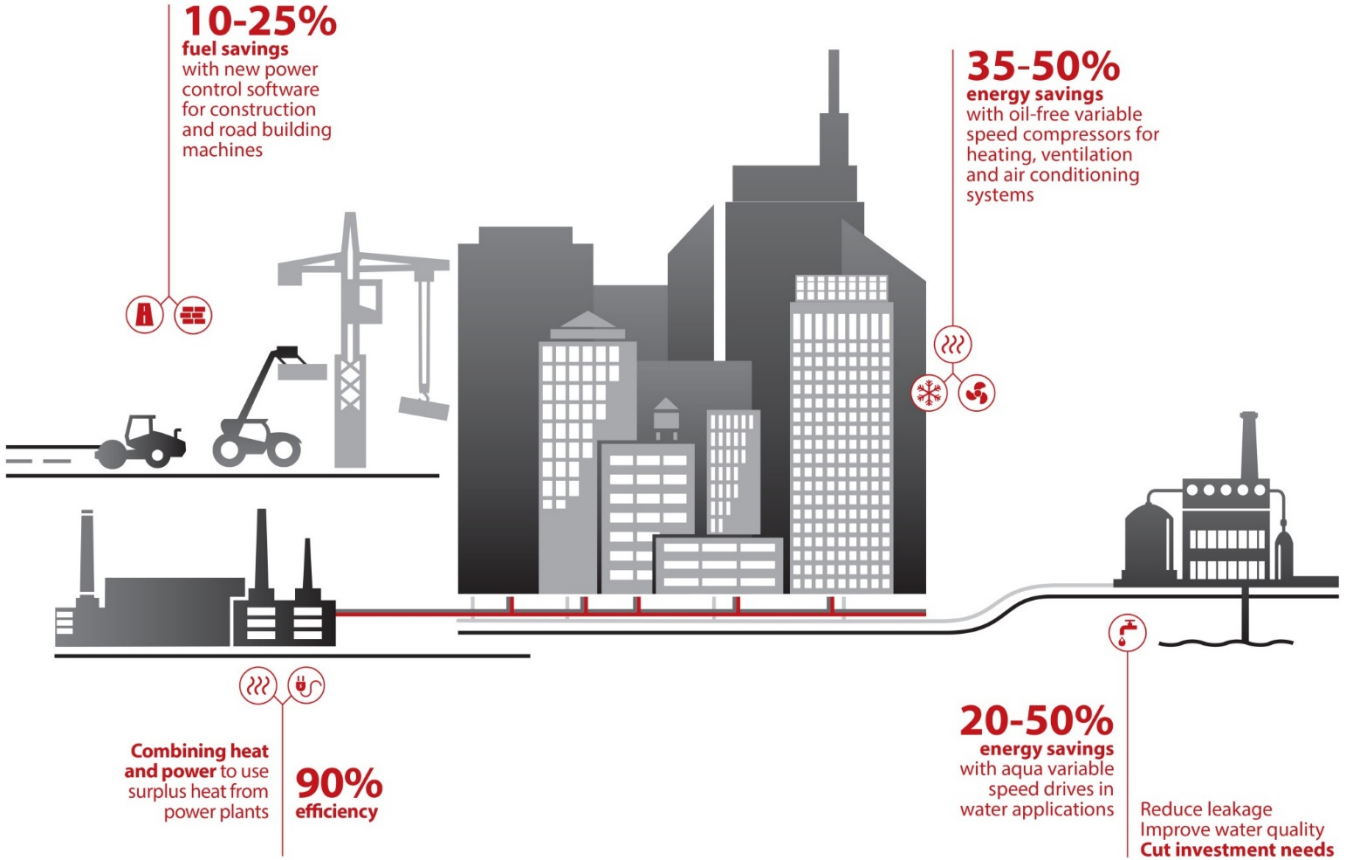
Infrastructure



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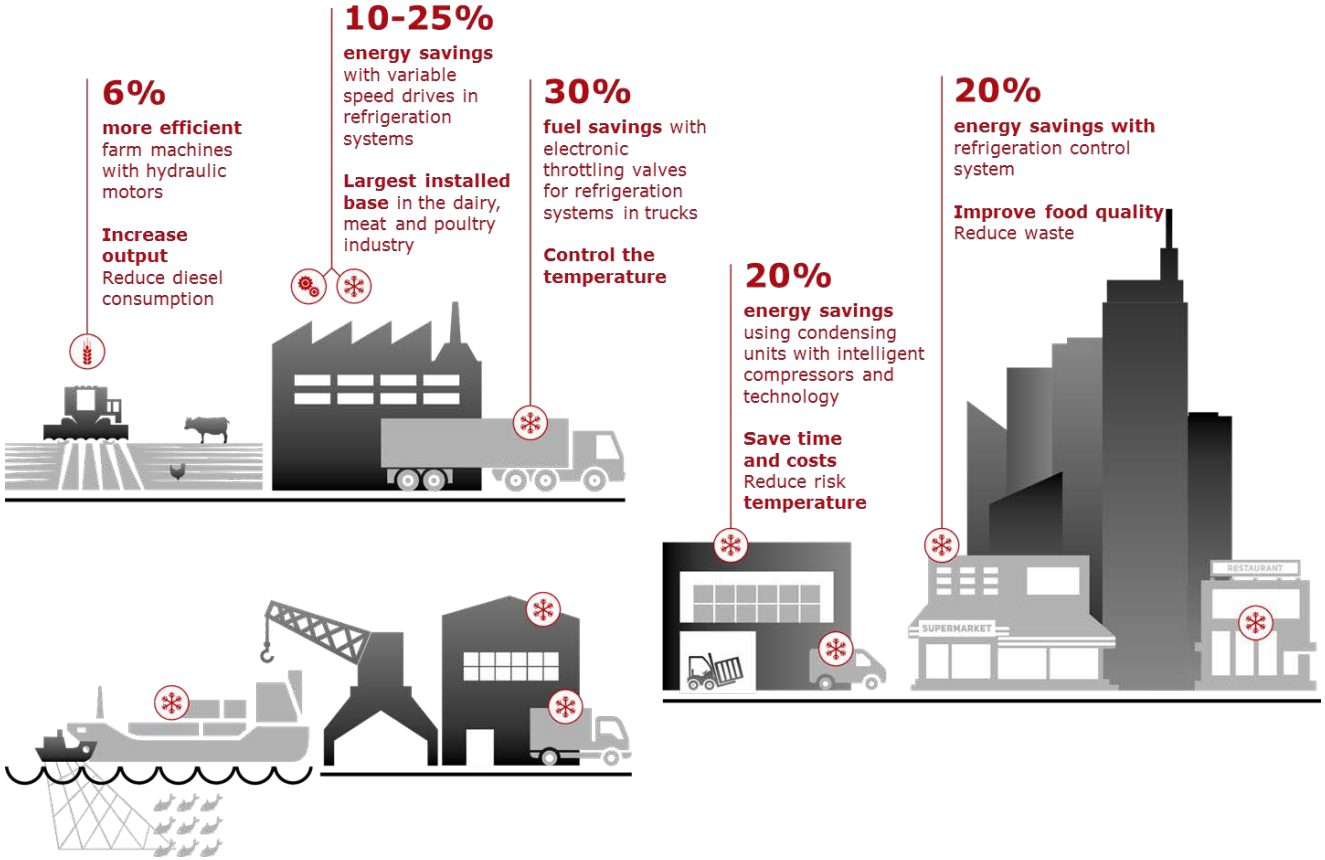
Food



Connected supermarkets as giant batteries

- Twenty Danish supermarkets already send their surplus heat into the local district heating networks.
- Results
  - Storage: Adding the potential of today's unused compressor capacity could add another 100% to the demand response flexibility in the event of overproduction of wind electricity.
  - Excess heat is used for local district heating. This saves CO_2 emissions and is a source of income for the supermarket.

Cleaning waste water with energy surplus

- In the Danish city of Aarhus, a water treatment plant not only ensures clean water – it also produces more energy than it consumes
- This is achieved through advanced process optimization and more than 120 drives
- Results
  - Produces 140% electricity (40% excess electricity) and 2.5 GWh excess heat used in the district energy system
  - Corresponds to energy production of 190-200%, which is 90% more than the plant consumes

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