

Development Overview of the Green Energy Industry in Denmark

The 2nd Taiwan-Denmark Economic Cooperation Conference

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LEADING ^{the} GREEN TRANSITION

If you google the words "Denmark", "Green", and "Energy", you will come up with results such as:

Denmark is a laboratory for green solutions (denmark.dk)

Clean and renewable energy – Denmark leads the way (denmark.dk)

Green Danish energy production at record high in first half of 2022 (State of Green)

Denmark expands renewable energy production and CO2 tax (Invest in Denmark)

Leading the transition to renewable energy (Ørsted)

And the list goes on...

... But why?

From black to green energy

In 1972, oil accounted for **92 percent** of gross energy consumption in Denmark. Thus, when the OPEC oil crisis quadrupled the price of oil in 1973, Denmark's economy and energy supplies were severely affected.

This led to a total restructuring of Danish energy planning. We began exploring other possibilities and diving into the world of renewable energy.



From black to green energy

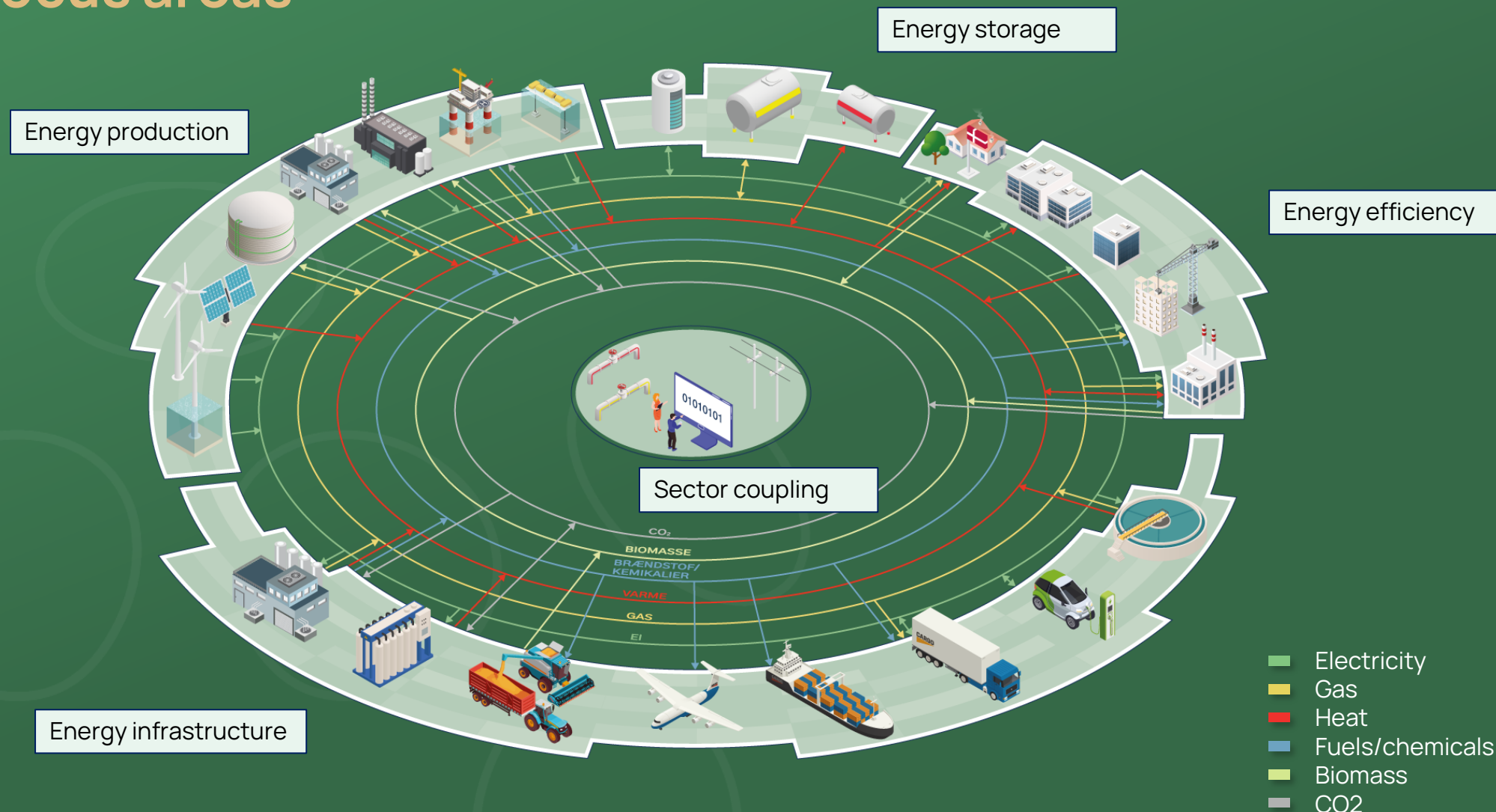
Today, wind and solar power alone supplies **50 percent** of the electricity in Denmark and the goal is to be **completely independent of fossil fuels by 2030**.

Over the past four decades, Denmark's economy has grown almost 80%, while the energy consumption remains largely unchanged. Additionally, in 2022, **Denmark ranked the world's most sustainable** out of 180 countries in the Environmental Performance Index (EPI).



Danish focus areas within the energy sector

Five focus areas



Focus area #1

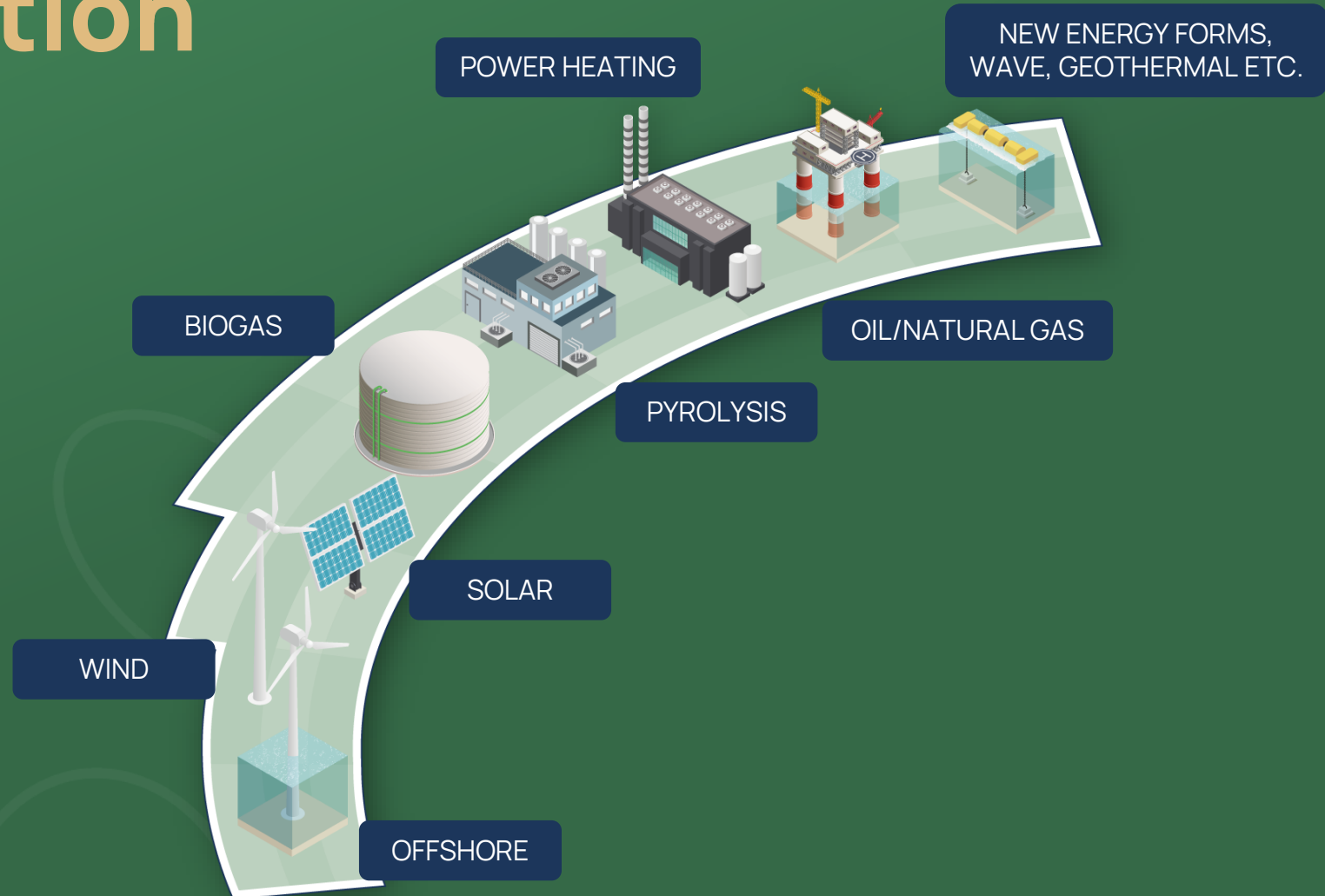
Energy production

Trends

- Esbjerg Declaration: 65 GW in 2030 and 150 GW in 2050 offshore wind in the North Sea
- Solar and wind must quadruple in just 8 years.
- Today, Denmark has more than 4,000 wind turbines on land and 500 at sea, corresponding to approx. 7 GW.
- Increase of biogas in the gas system from 21% in 2021 to 25% in 2022.

Need for innovation

- Industrialization with focus on LCOE improvements for RE and "value of wind".
- Balancing the electricity grid and new system solutions that support stable and safe integration and electricity supply from renewable energy sources.
- Reduction of GHG emissions from oil and gas facilities, decommissioning and recycling of infrastructure (CCS).



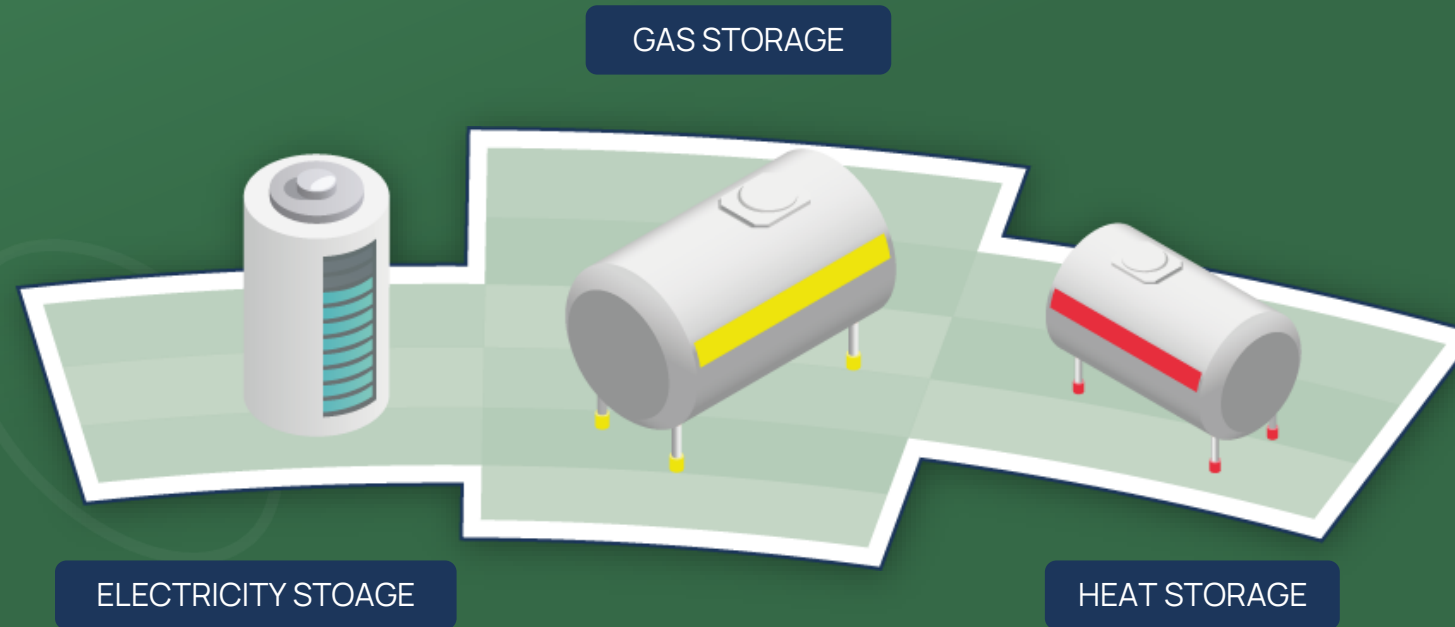
Energy storage

Trends

- Energy storage technologies provide a flexible solution to the imbalances in the electricity grid.
- The Commission has estimated that to meet its 2050 climate targets, the EU needs to sixfold energy storage capacity.

Need for innovation

- Strengthening of solutions for both short- and long-term storage of RE as well as large-scale storage of hydrogen.
- Use of "X" in industry and transport, as well as PtGas solutions
- Industrialisation, safety and standardization by e.g. documentation and product approval of new storage technologies



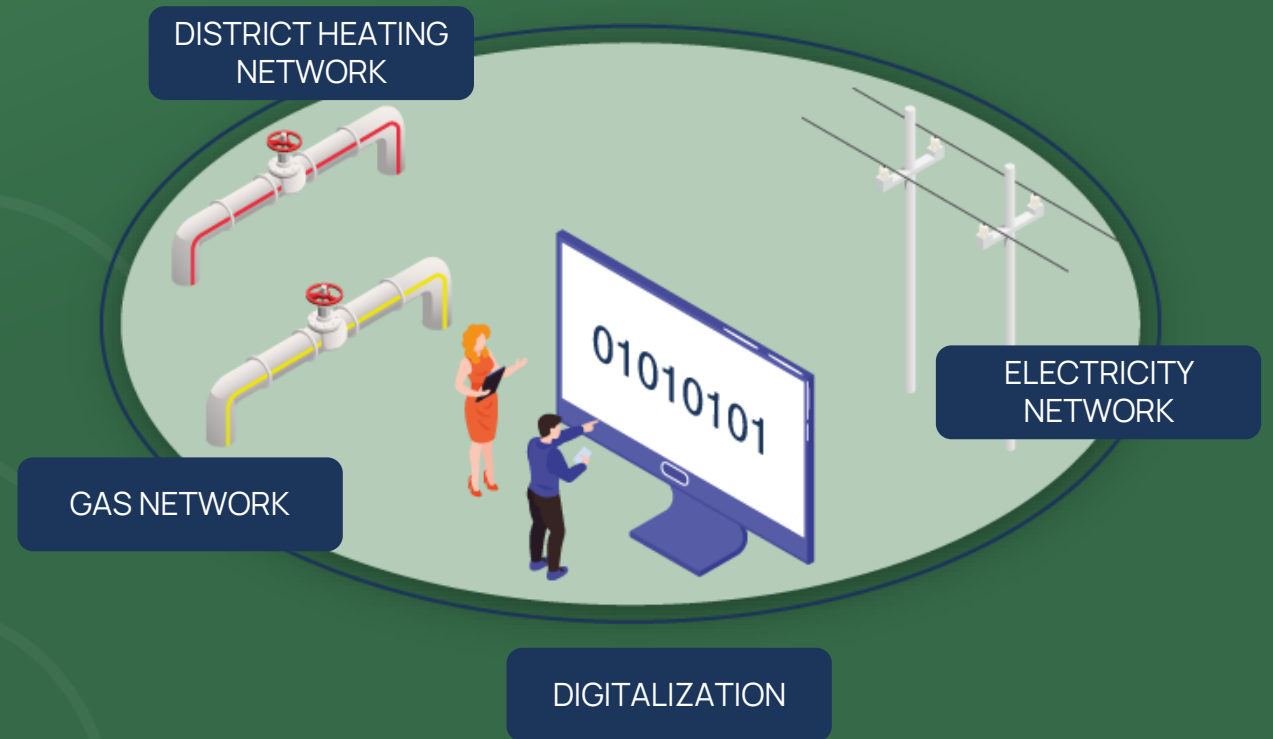
Energy infrastructure

Trends

- Increased electrification and green fuels make demands on infrastructure.
- Energinet is investing 30 billion NOK in the expansion of the electricity and gas transmission networks over the next five years (DKK 25 billion in the electricity network and DKK 5 billion in the gas network).
- District heating will be covered by several different energy sources today, e.g. surplus heat

Need for innovation

- Development within optimization and integration of new large energy plants on land and offshore (production and consumption), e.g. market design, operation, control methods etc
- .Development of existing storage infrastructure (gas) and establishment of new energy infrastructures for energy storage through compressed air, thermal storage and hydrogen, as well as development of technologies and systems for CO2 storage, capture and transport.
- Vehicle to grid (V2G) technologies and new charging solutions as well as development of new IT and OT management architecture across energy forms, e.g. microgrids, energy communities.



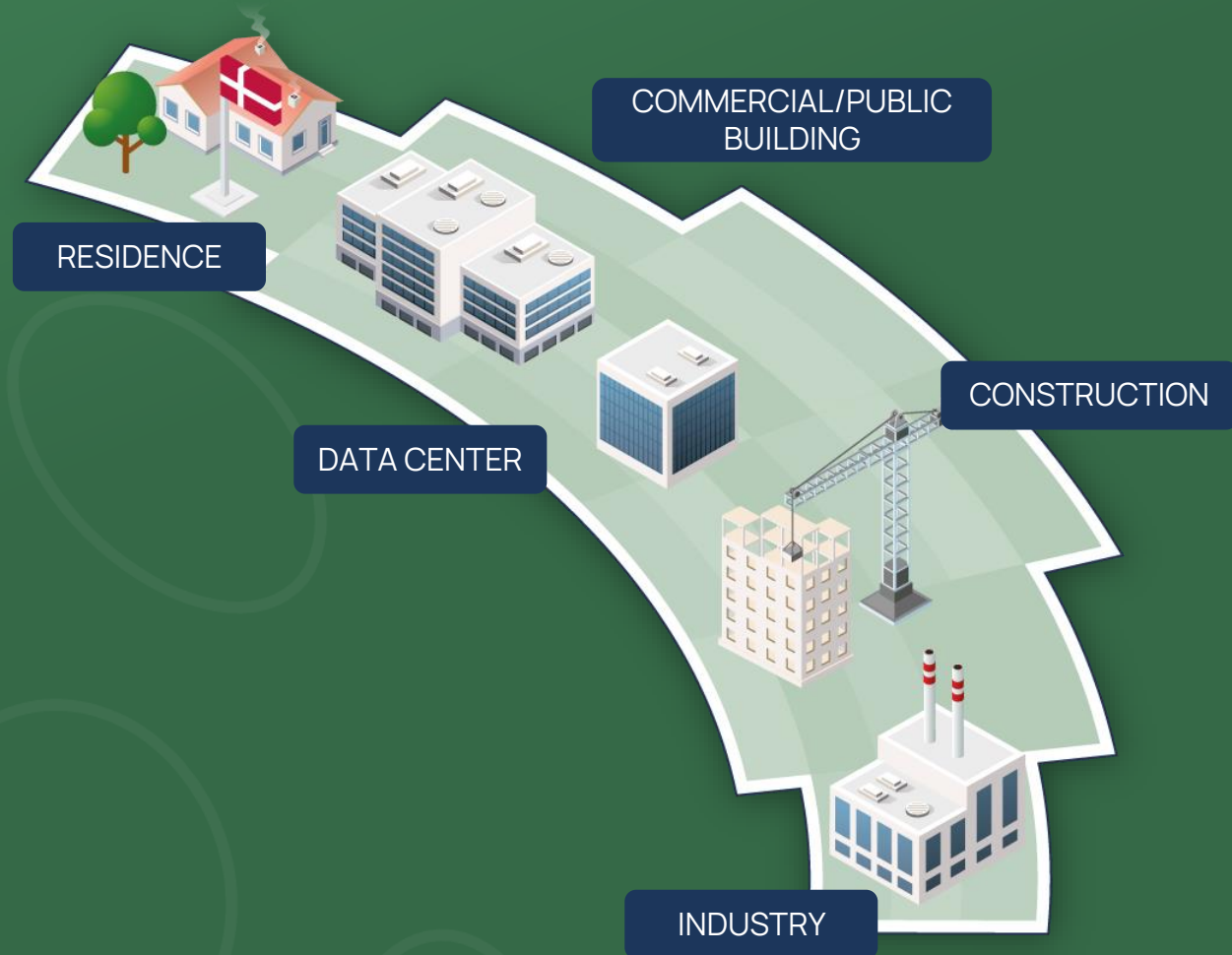
Energy efficiency

Trends

- Target to increase energy efficiency from the current 32% to 36% in 2030 in the EU.
- Total approx. 30% increase in energy consumption without energy efficiency improvement.
- The greenest energy is that which is not consumed.

Need for innovation

- Efficient and intelligent management of energy consumption in industry and utilization of excess energy in the district heating network
- Clever forecast-based management for improving energy consumption and indoor climate, as well as energy monitoring in buildings
- Streamlining and electrification of industrial processes via, for example, efficient high-temperature heat pumps



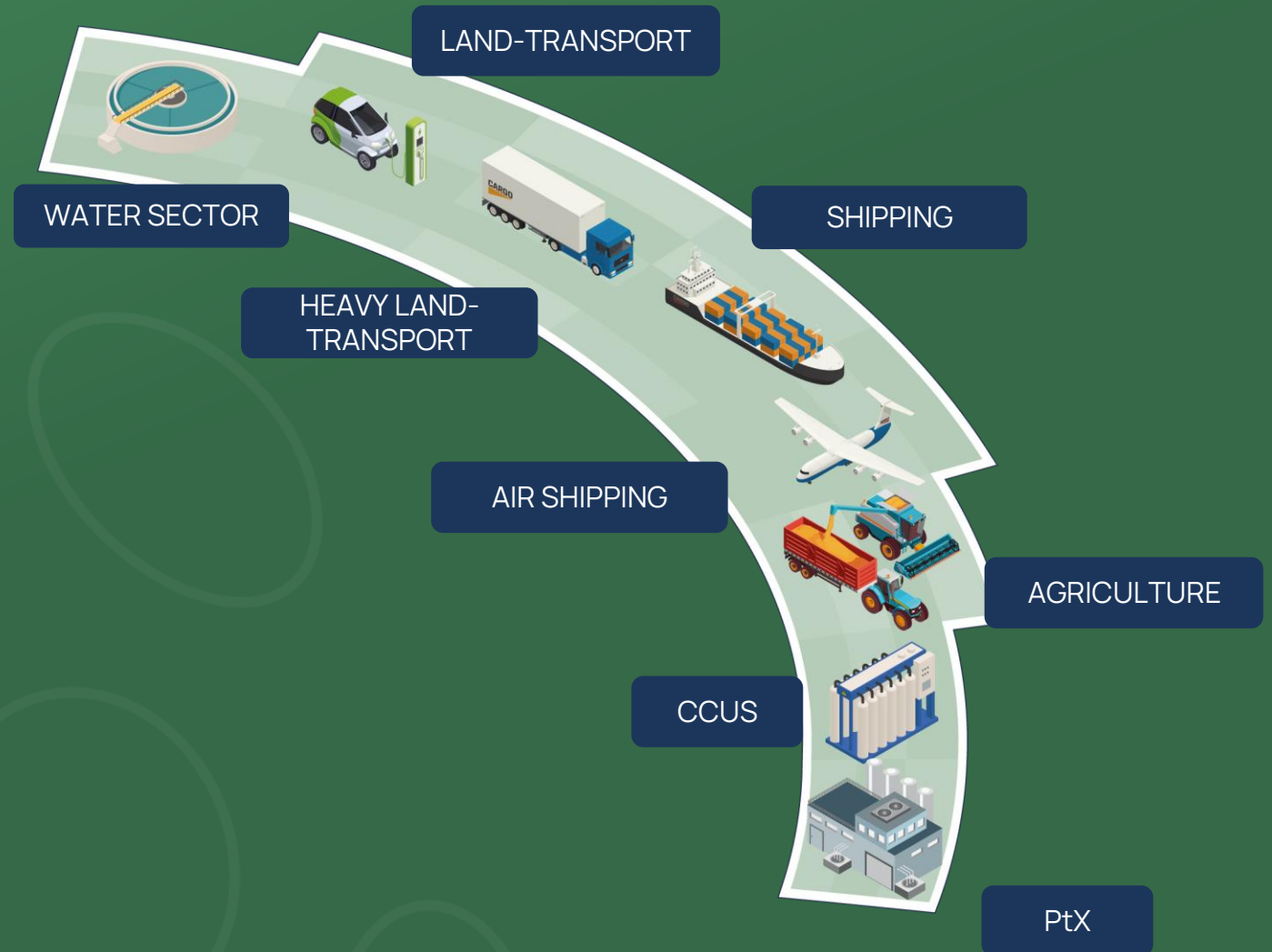
Sector coupling

Trends

- Maersk aims to be climate neutral in 2040 and aims for 1/4 of the fleet in 2030 to sail on green fuel.
- New major partnership for green methanol that can supply 12 new Maersk ships in 2025
- National PtX agreement entails, among other things, an aim to build 4 - 6 GW of electrolysis capacity by 2030

Need for innovation

- Innovation within sector coupling of infrastructure, including electricity, district heating and water to promote flexibility in the energy system.
- Electrification of processes in industry e.g. heat pumps and electric incinerators. Promote integration of large heat pumps, individual heat pumps and other heat pump driven solutions.
- Digitization of the energy system and increased use of data in the energy sector, e.g. AI, forecasting and the flexibility potential of buildings, etc.



We are moving

Biggest energy trends going forward (DK)

- Develop/Expand renewable energy
- Strengthen energy storage, PtX, CCS and CCU
- Strengthen and recycle energy infrastructure
- Increase energy efficiency
- Increase electrification and sector coupling



CO2 reduction in
2030

Thank you for your attention!

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