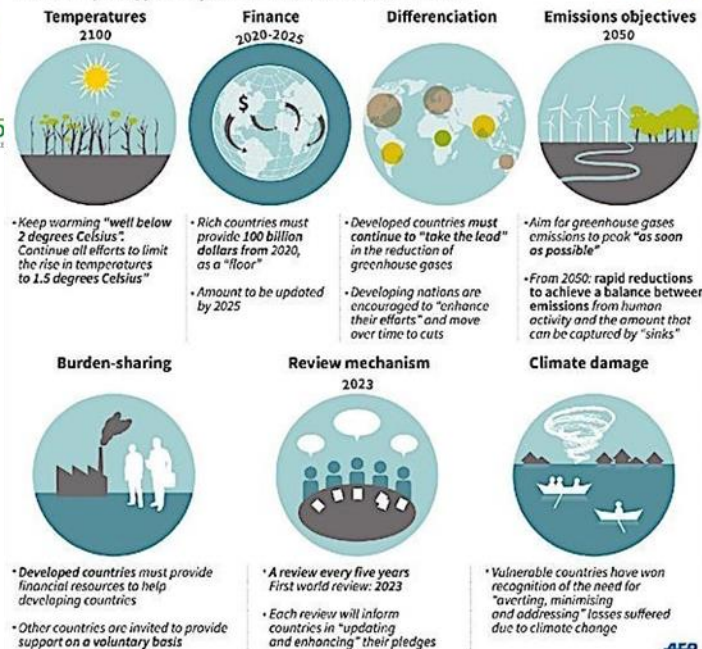


The role of gas in the European energy system.
Decarbonization strategies of energy companies.



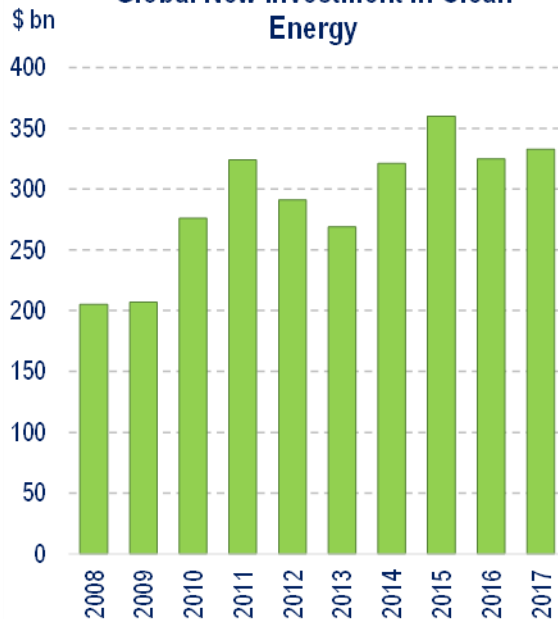
The Paris climate agreement: key points

The historic pact, approved by 195 countries, will take effect from 2020



Global Renewable Energy Development

Global New Investment in Clean Energy



Source: Bloomberg New Energy Finance

Total amount of investments in renewable energy within the last 10 years exceeded

2.9 trillion US dollars

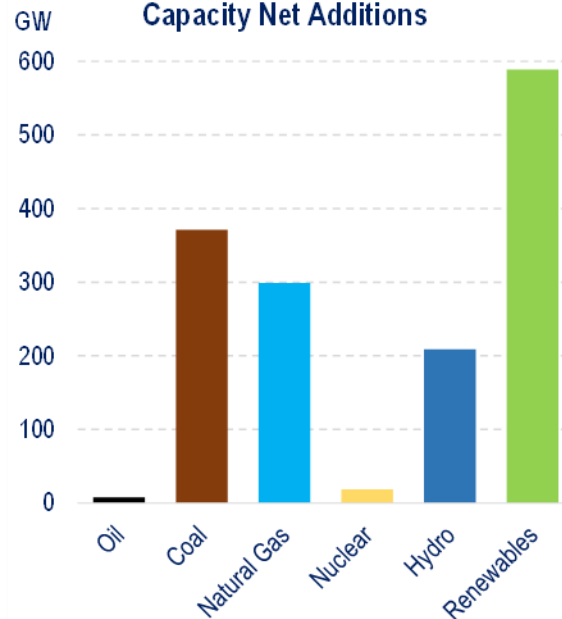
Since 2010, net additions of renewable power generation capacities were the biggest among all energy resources and already reached

600 GW

However, the key challenges of increasing the share of renewables in the power mix has not yet been met:

- Intermittent power generation
- Lack of efficient energy storage

2010-2016 Global Generation Capacity Net Additions



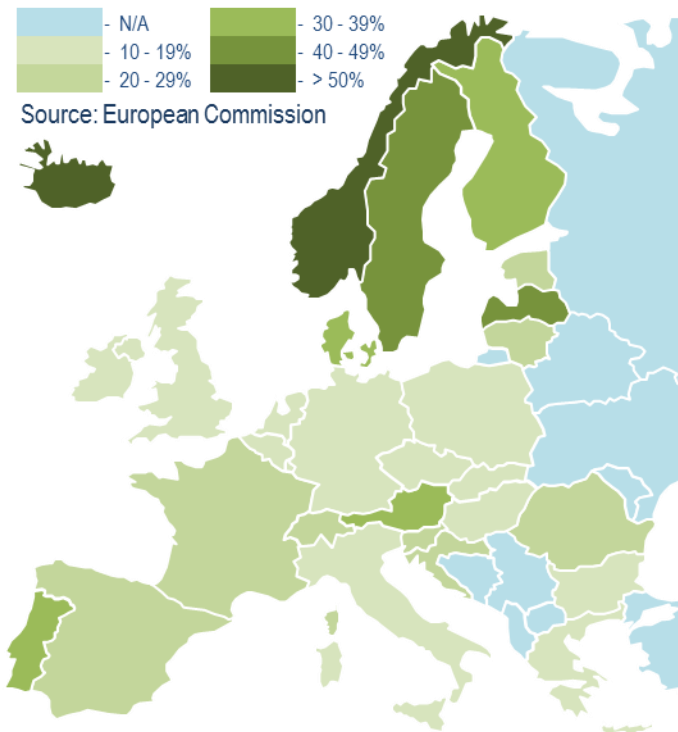
Source: IEA

EU Targets for Share of Renewable Energy in Gross Final Energy Consumption by 2020

The EU's Renewable Energy Directive sets a mandatory target of 20% of renewable energy sources in the final energy consumption by 2020.

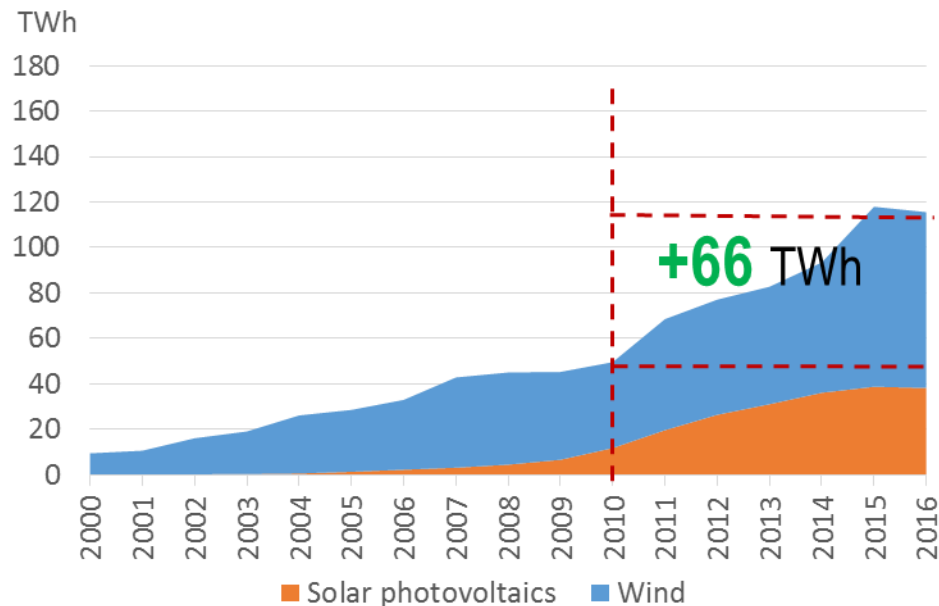
To achieve this target, the EU countries have to achieve their individual targets of RES share in the final energy consumption.

The most ambitious targets set in Iceland and Norway – **72%** and **68%**, respectively.

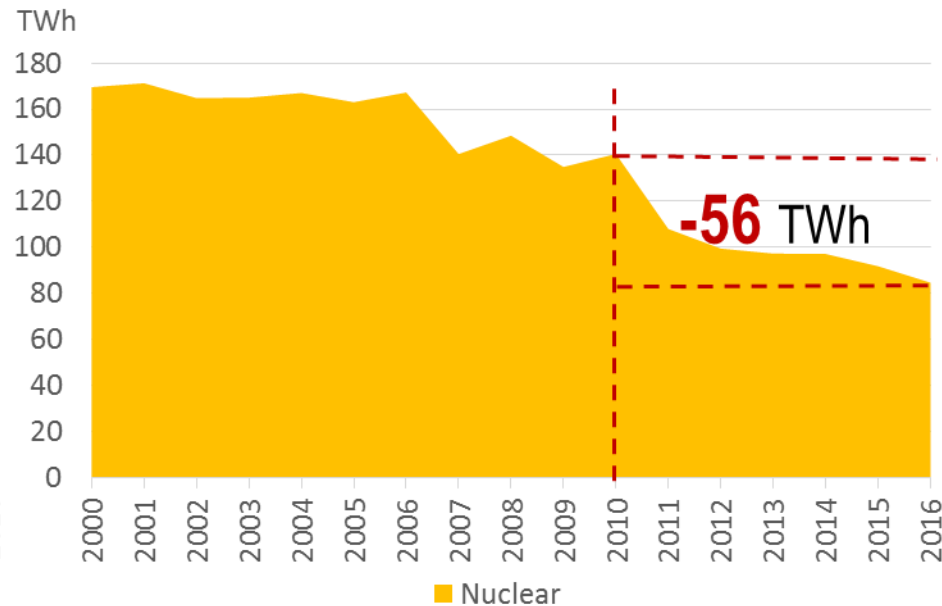


Energy Transition in Germany

Electricity output



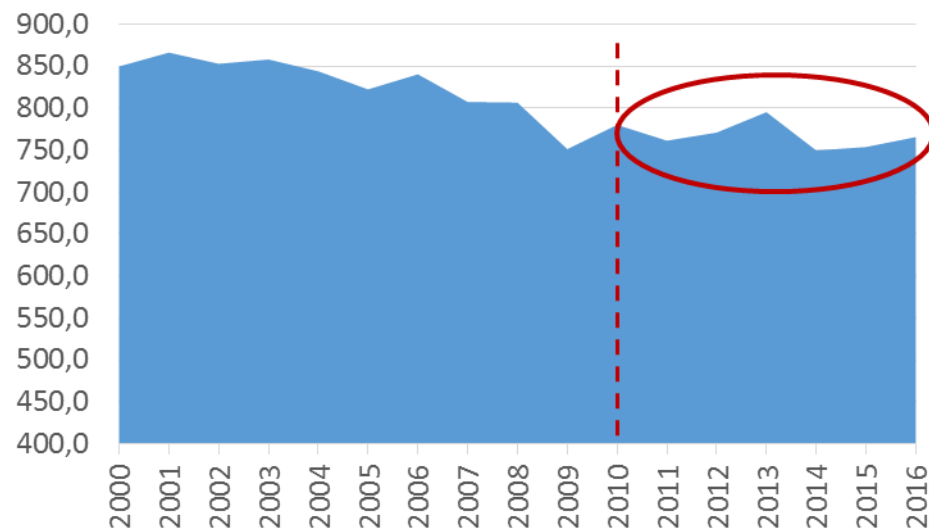
Source: IEA



Source: IEA

Carbon Dioxide Emissions

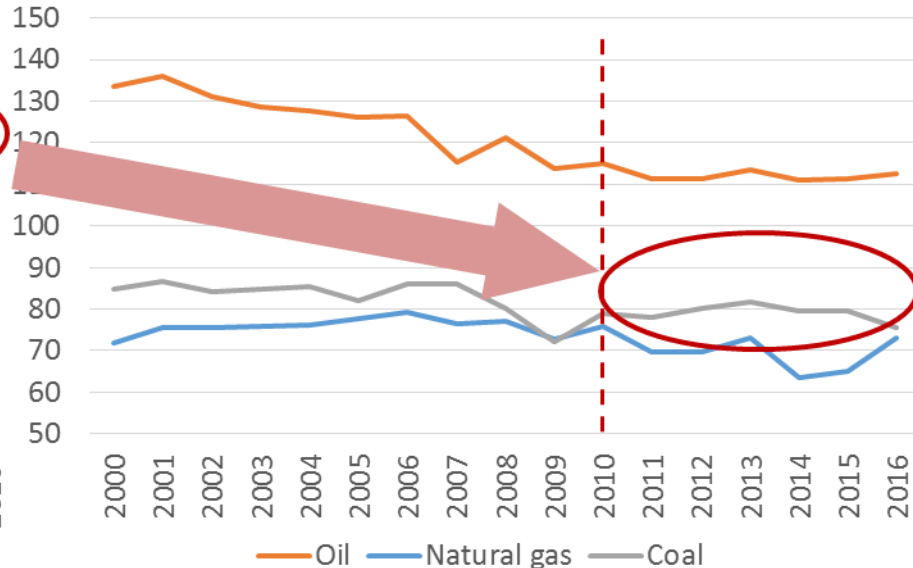
mln t CO₂ eq.



Source: BP Statistics

Fossil fuel consumption

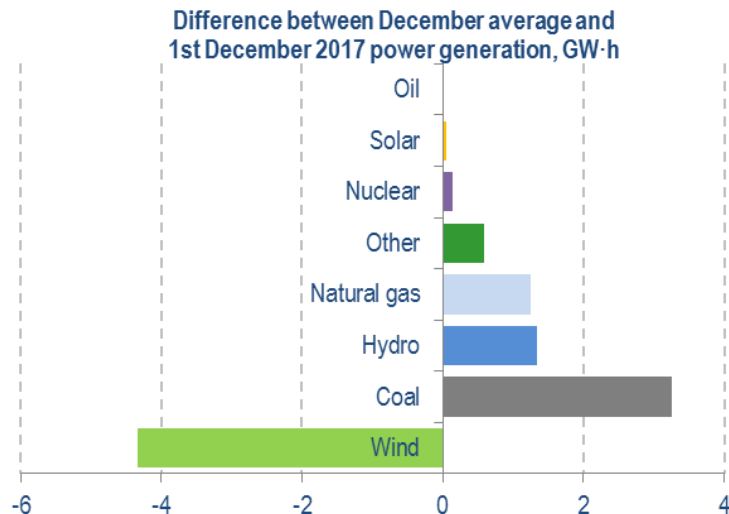
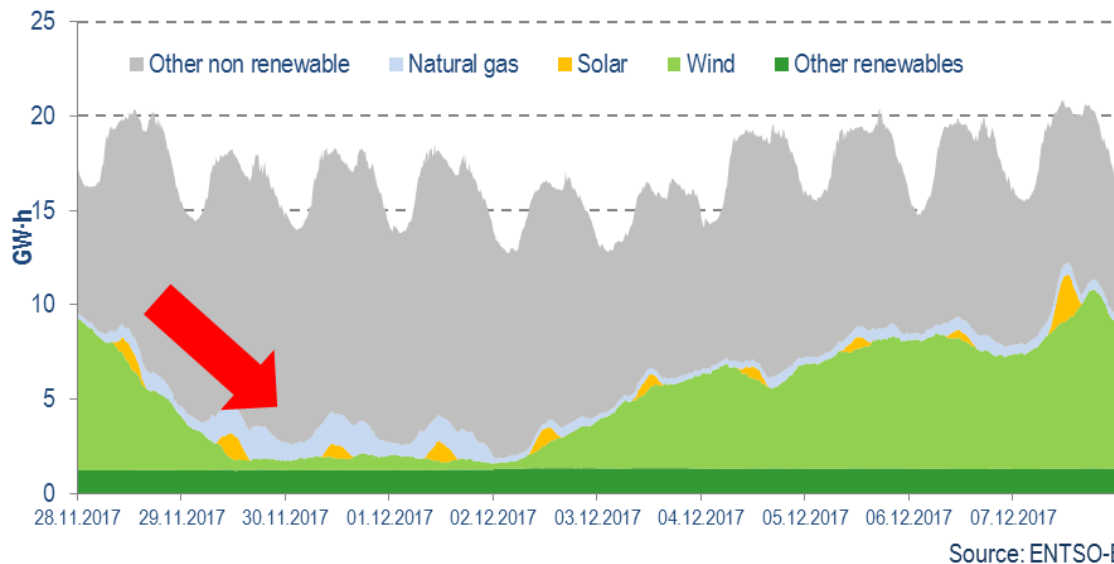
mtoe



Source: IEA

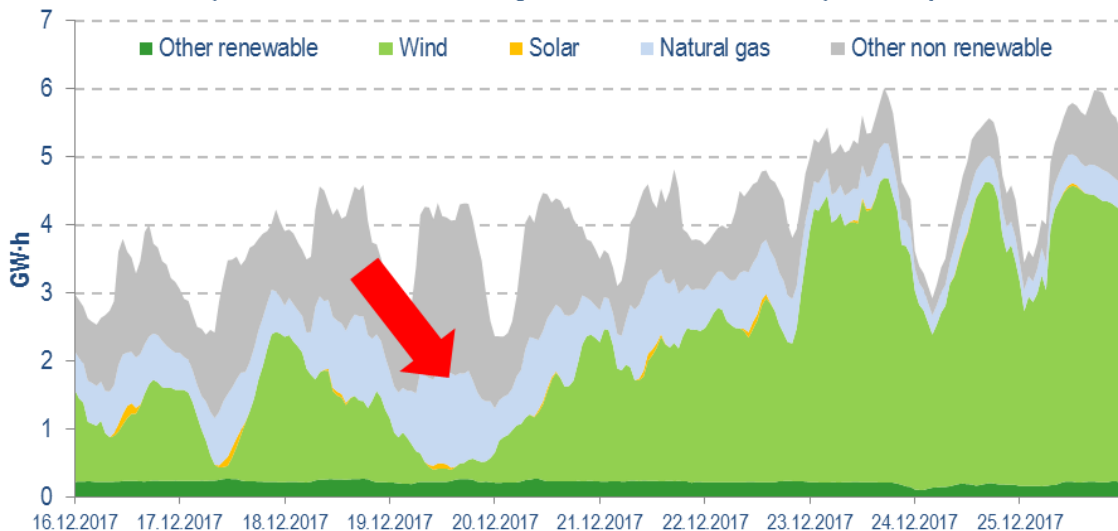
Power Generation in Germany

- 'Dunkelflaute' periods in 2017 and 2018 appear regularly.
- In December 2017 the share of wind and solar energy in the power mix fluctuated between **4,5%** and **32%**.
- On December, 1st 2017 the share of wind and solar energy in the power mix dropped to **4,5 %**, occasionally – **2,2%**.

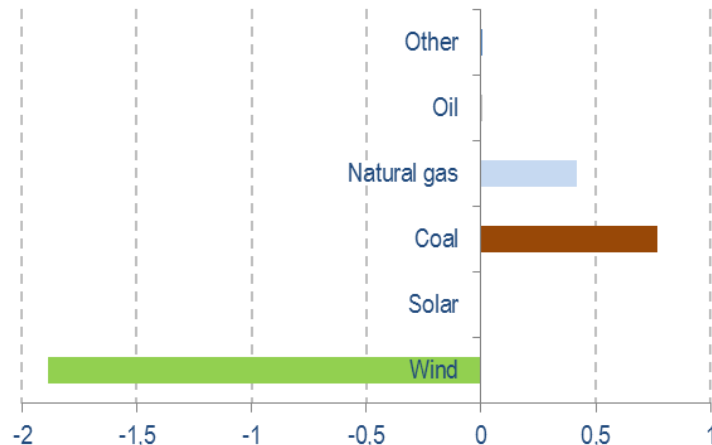


Power Generation in Denmark

- In December 2017 the share of wind and solar energy in the power mix fluctuated between **11%** and **77%**.
- On December, 19th 2017 the share of wind and solar energy in the power mix dropped to **11%**, occasionally – **5,3%**.
- All these periods occurred during winter months, when power system is working in harsh conditions.








Difference between December average and 19th December 2017 power generation, GW-h



Source: ENTSO-E

Gas Advantages in Power Generation

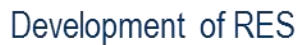
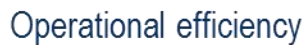
	Gas	Coal	Nuclear	Hydro	Renewable
					
Low capital costs for power plant construction	✓		✗	✗	
Low operational costs for power generation			✓	✓	✓
Short period for power plant construction	✓		✗		
Low pollutions		✗		✓	✓
Availability of construction sites	✓		✗	✗	✗
Possibility of power system balancing	✓			✓	
Independency of energy production from weather conditions	✓	✓	✓		✗

Long-term Strategies for Energy Companies

The Paris Agreement recognizes that countries need to conduct assessments of their vulnerabilities to climate change and undertake adaptation planning processes. Similarly, there is a current need for energy companies to develop a comprehensive understanding of the implications of climate change on their businesses.

Companies consider their current resources, infrastructure investments, future fossil fuel demand, research and development, and technology in order to identify the reliable development strategy.

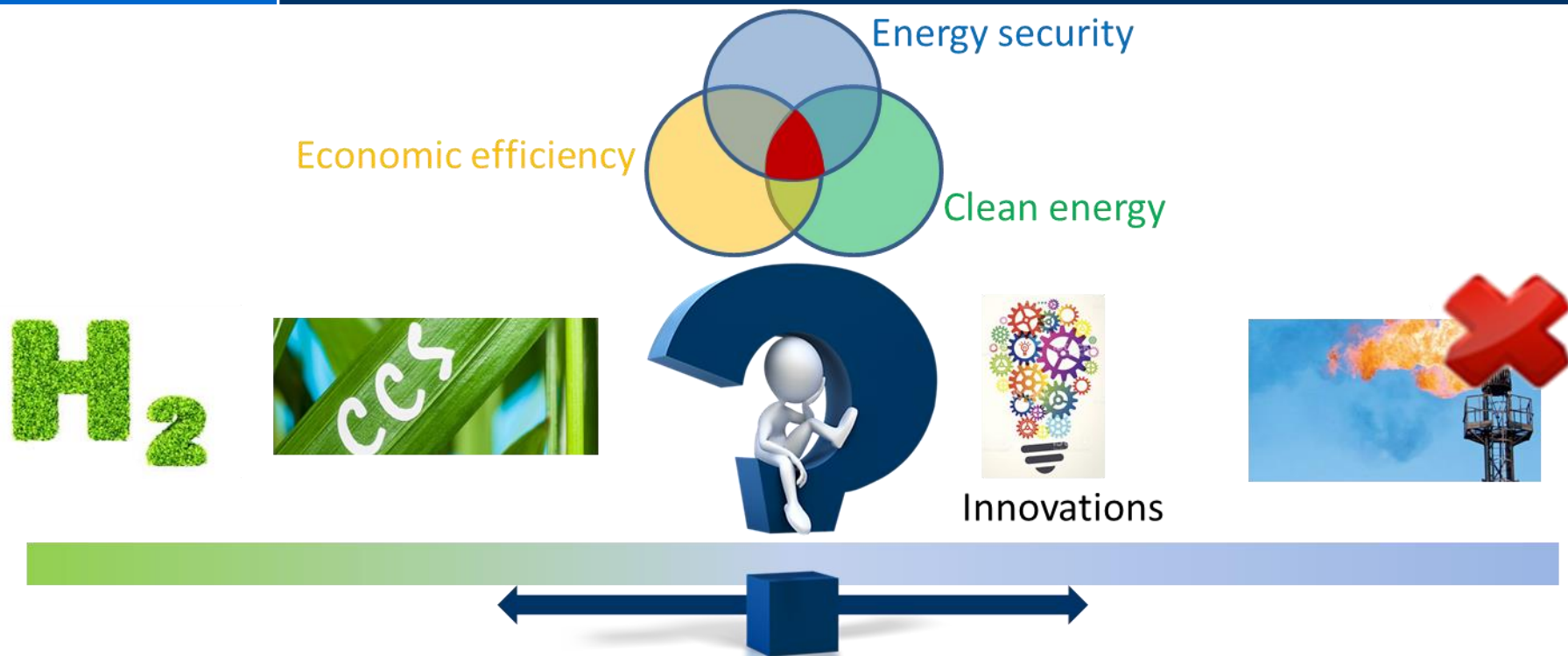


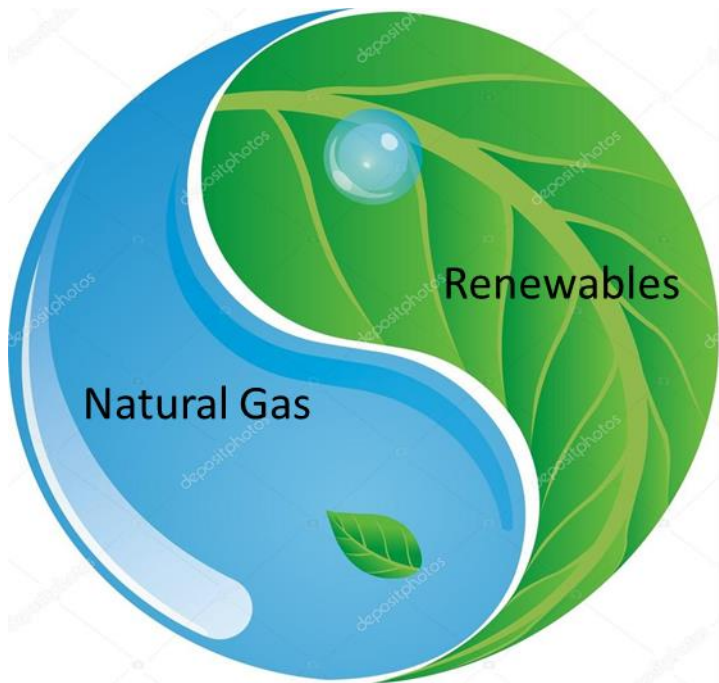


Pathways to Decarbonization

	Shell	Equinor	Total	BP
Operational efficiency	SmartFields, CCS, Flying Nodes, Shell MMLS Liquefaction technology	Sub-sea compression station, WS Seabed Rig, TAIL, Drill Plan, Cloud Data Storage, CCS	Pazflor, CCS, Subsea-to-shore technology	WATS, Plant Operations Advisor Intelligent system
Development of RES	Airborne Wind energy (AWE) - Kite Power Systems, Bioethanol production	20% of CAPEX in RES by 2030, Hywind, Photovoltaic technology solutions, Biofuel technology	25% of investments in RES by 2022	Hydrogen plant, Solar's Mono2 silicon, Biofuel production
Ventures	Shell Technology Ventures, Engineering companies	Equinor Energy Ventures	Total Energy Ventures	BP Ventures

Optimal Solution





«Gas can undoubtedly play a very prominent role when it comes to the decarbonisation process of the energy system».

Prof. Dr. Klaus-Dieter Borchardt



Thank You for Attention