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Electrification of oil and gas with offshore wind

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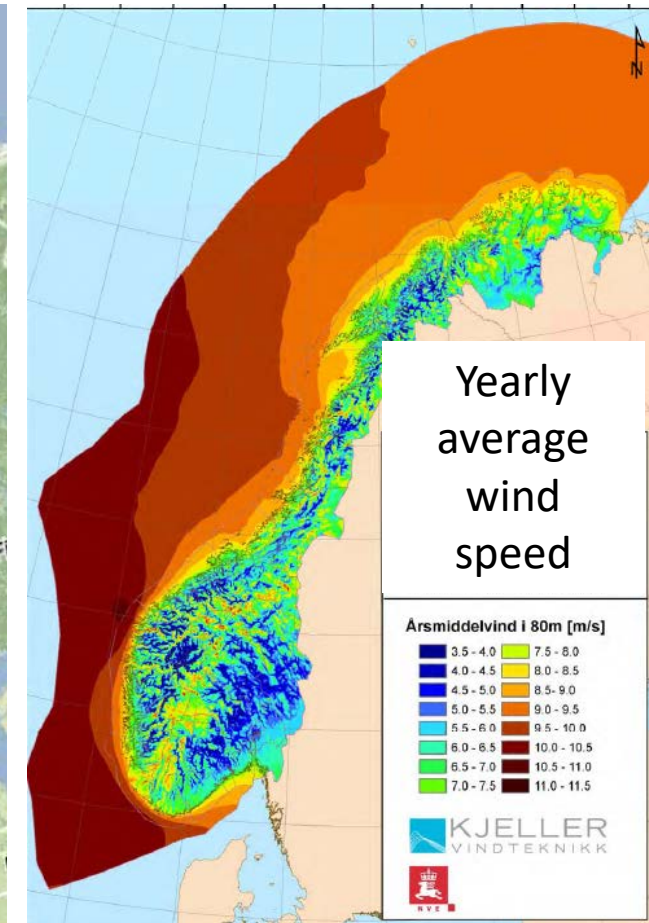
Norwegian Research Centre for Offshore Wind Technology

Motivation for electrification of Oil & Gas

- Reduced NO_x and CO₂ emissions
 - Reduce carbon footprint
 - Reduced tax
- Reduced fuel consumption
- Increased redundancy (if properly designed)
- Reduced need for maintenance
 - Reduced run-time for gas turbines & diesel engines
 - Reduced number of installed power plant units
- Alternative to costly/difficult upgrade of on-site power-plant, to cover increased power demand for tail production

Topic of high relevance for Norway

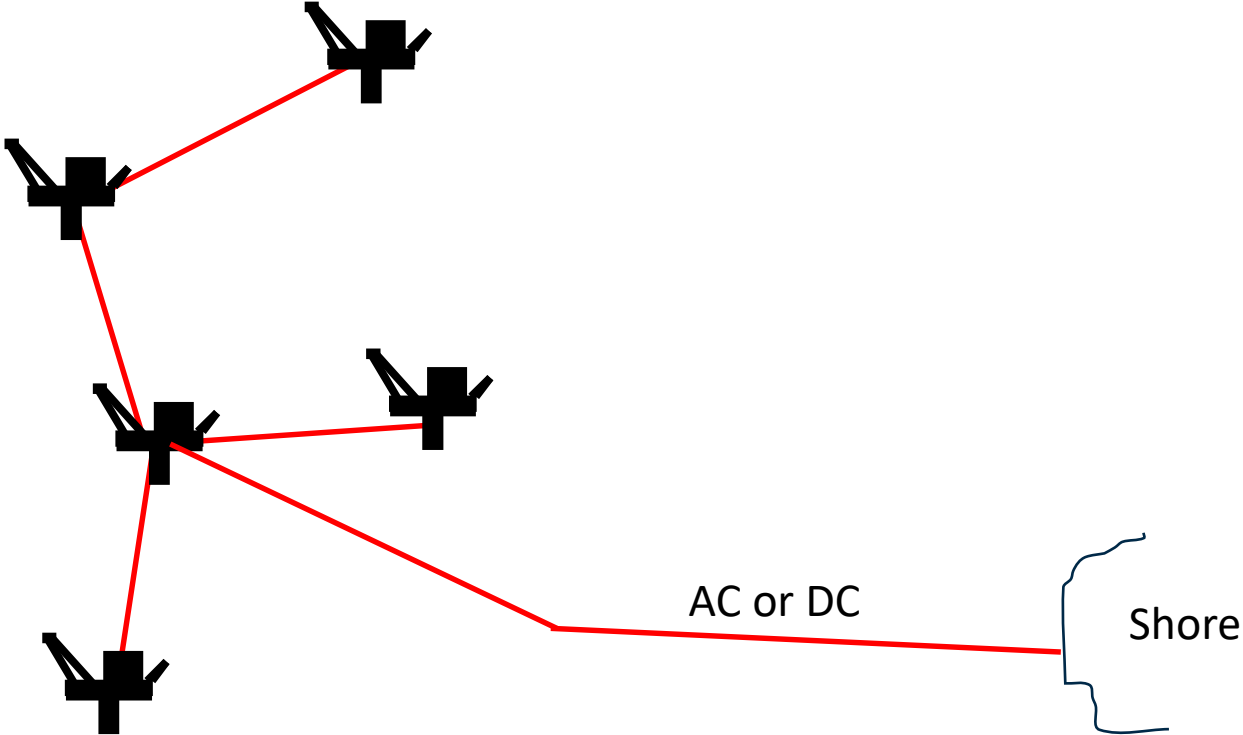
- Norway has ~3 % of the worldwide oil and gas production
- ~25 % of the Norwegian CO₂-emissions origin from power production and gas compression in the petroleum sector
- CO₂ and NO_x – taxes penalize use of fossil fuel in Norwegian sector
- New fields are obliged to consider electrification (regulatory decision)
- O&G-fields in locations with good wind resources



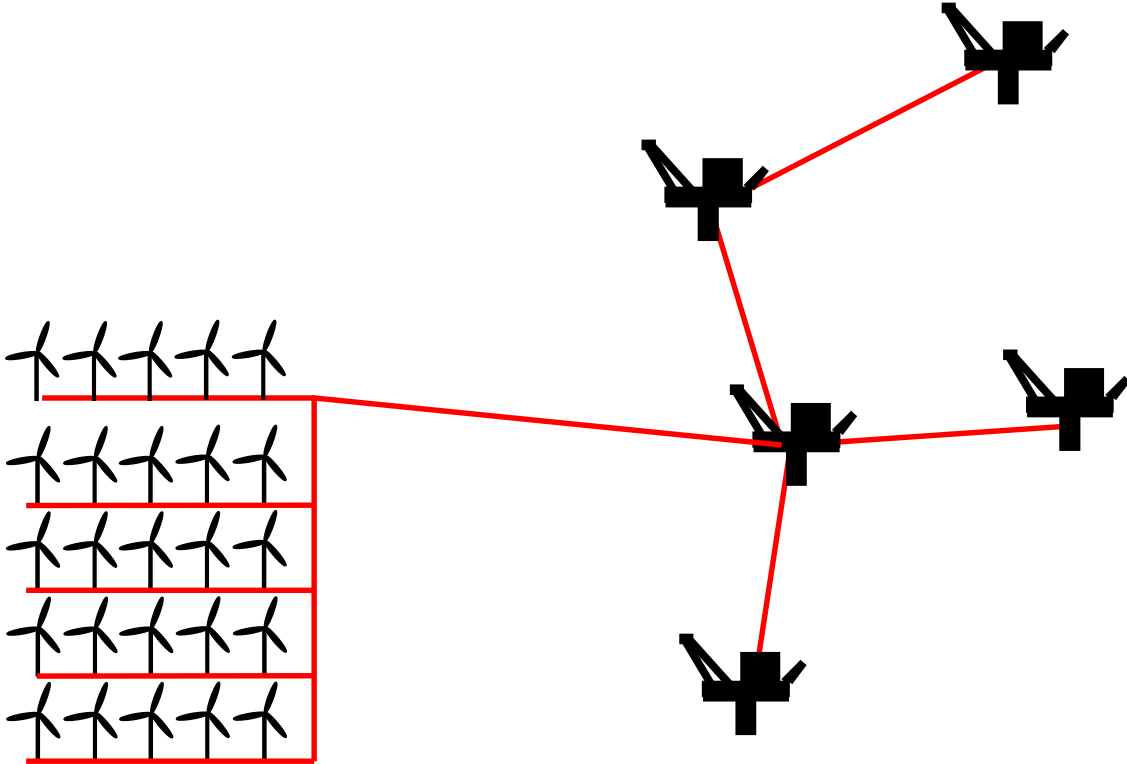
Conclusion of one of the NOWITECH studies:

Potential for achieving 40% reduction of
CO₂/NO_x emissions from
OG installation by utilizing offshore wind

Electrification alternative: Connect to shore

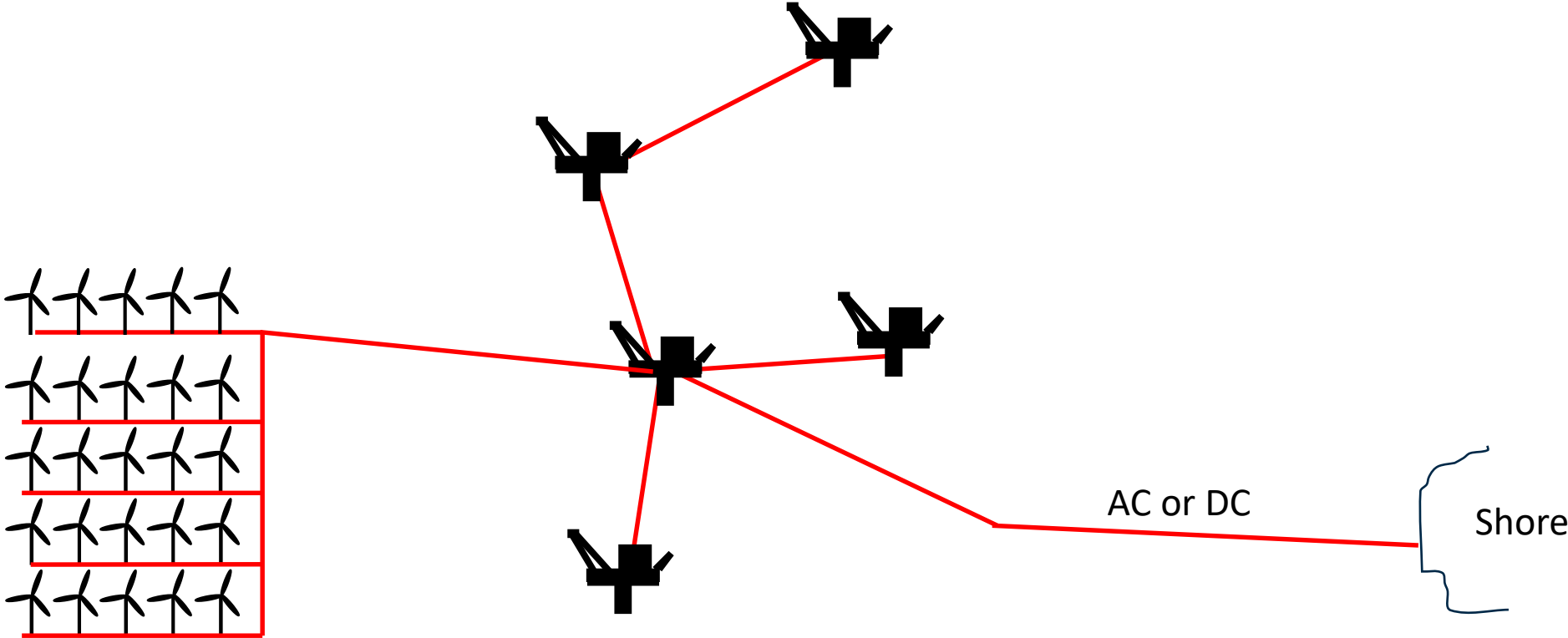


Electrification alternative: Local wind power



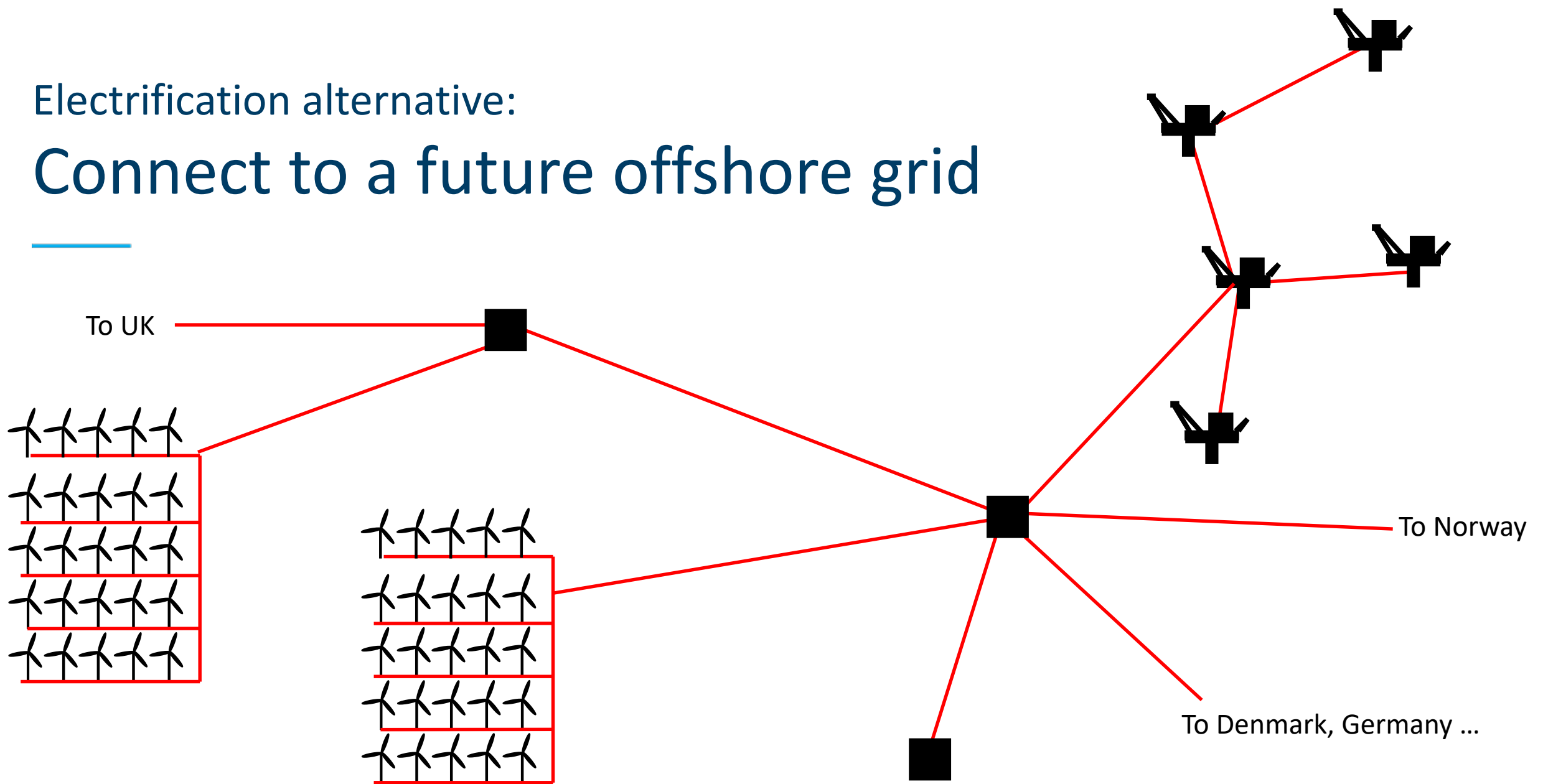
Electrification alternative:

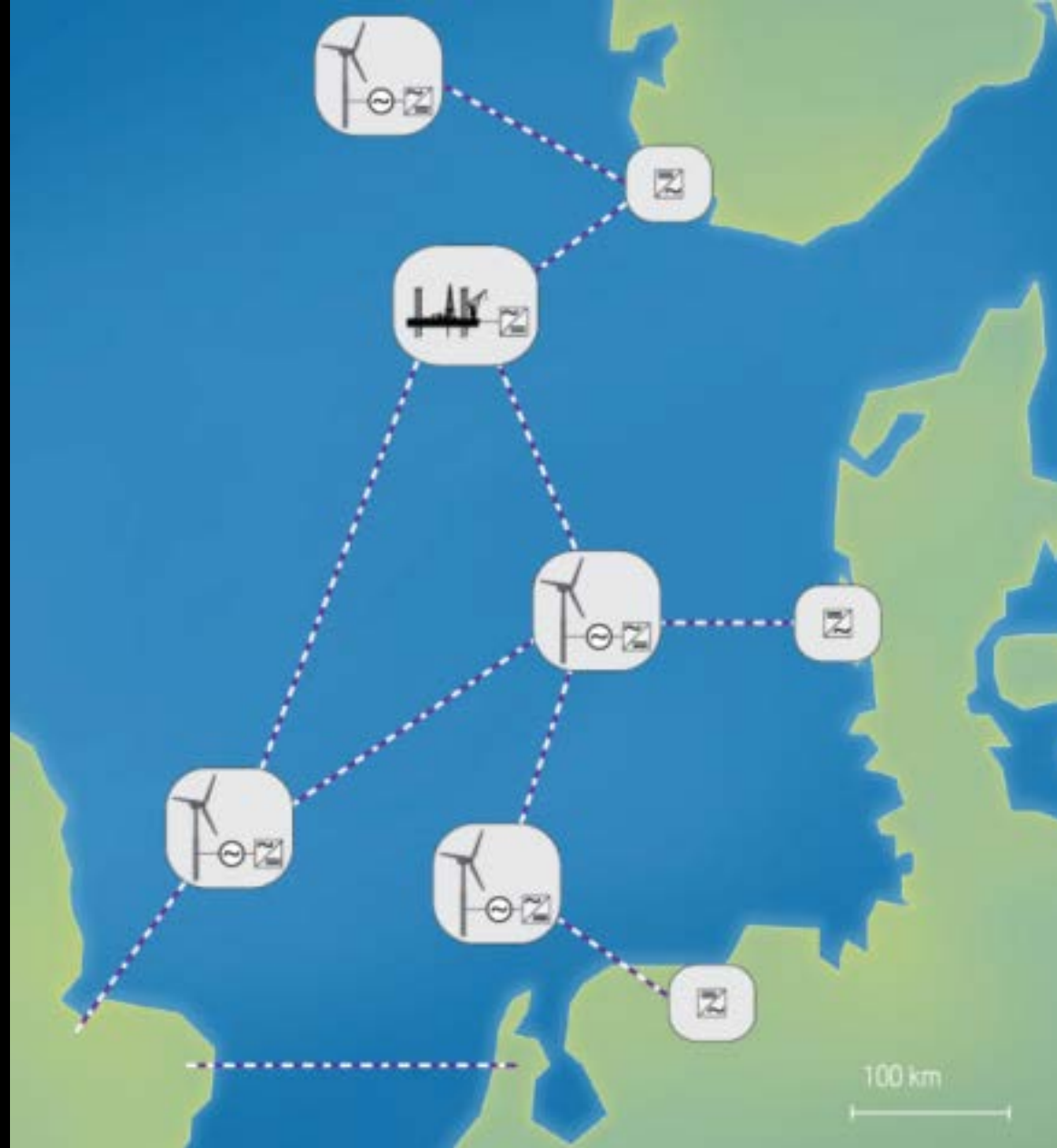
Wind power with shore connection



Electrification alternative:

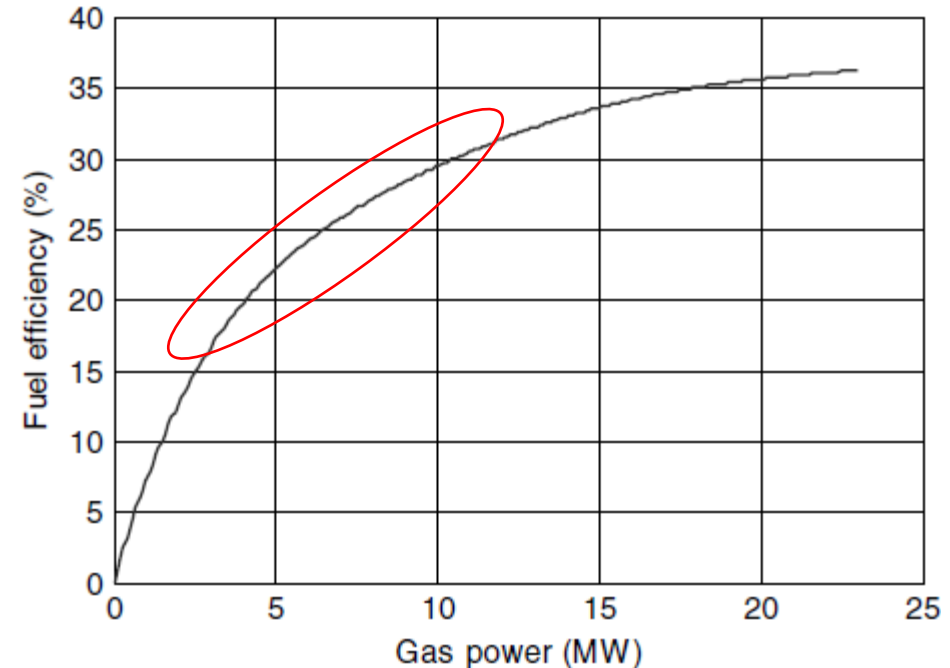
Connect to a future offshore grid





Important characteristics of O&G power systems

- Extreme requirements to availability of power
- Redundancy requirement implies running with more units than actually needed
=> Lower efficiency of gas turbines
- Wind turbines as well as single loads will have power rating comparable to gas turbine generators
=> Frequency and voltage transients may be a challenge
- Cost of blackout is extreme
=> Difficult to introduce new, non-proven, solutions

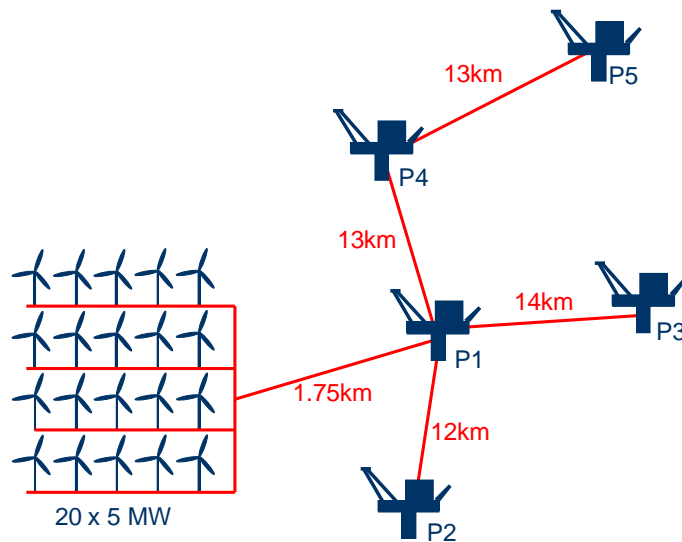


The electrification alternatives have been studied within NOWITECH

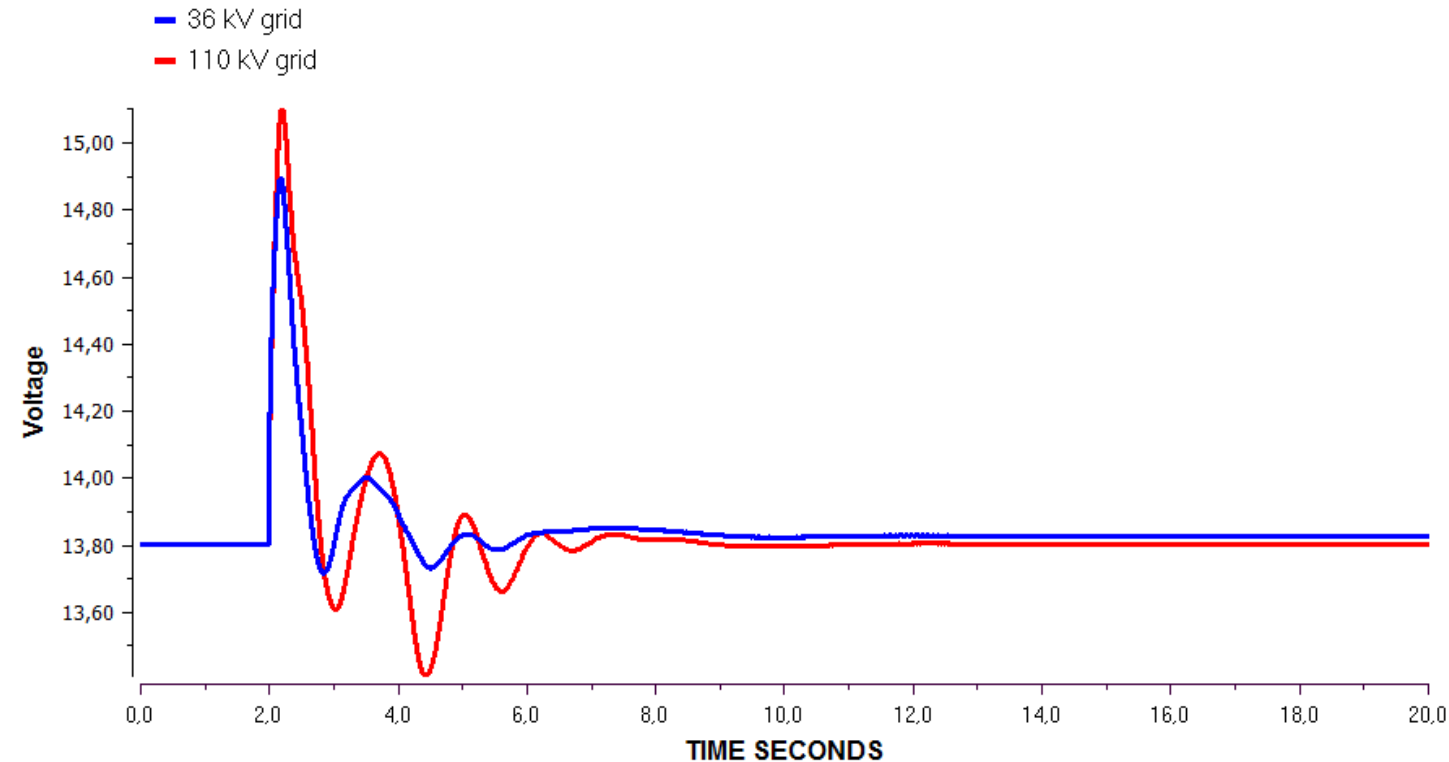
- Simulation and laboratory studies:
 - Voltage and frequency stability
 - Contingency handling
 - Identification and solutions to technical challenges
 - Technical feasibility evaluation
- Control strategies for stable and safe operation
- Case studies
 - Fuel and emission reductions
 - Economic feasibility evaluation

Sample result from simulation study

- Voltage transients following loss of 100 MW wind power
 - 36kV grid: +7.9%
 - 110kV grid: +9.4%



NOWITECH WP4 Task 4.2 - Wind farm and five oil platforms



STRI Software

DATE 8 NOV 2010 TIME 14:53:03 JOB basis Simprow 11.0.008

Diagram:9

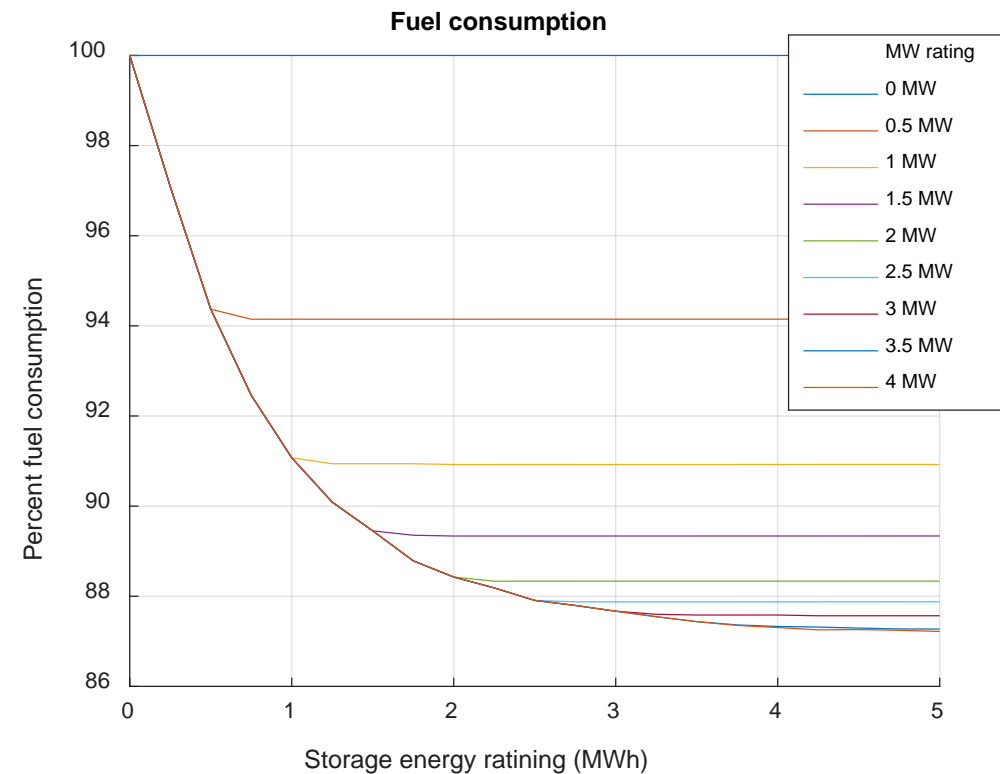
Conclusions from NOWITECH studies

- No technical show stoppers
- Economic feasibility are within range

Energy storage: Enabler for wind to O&G ?



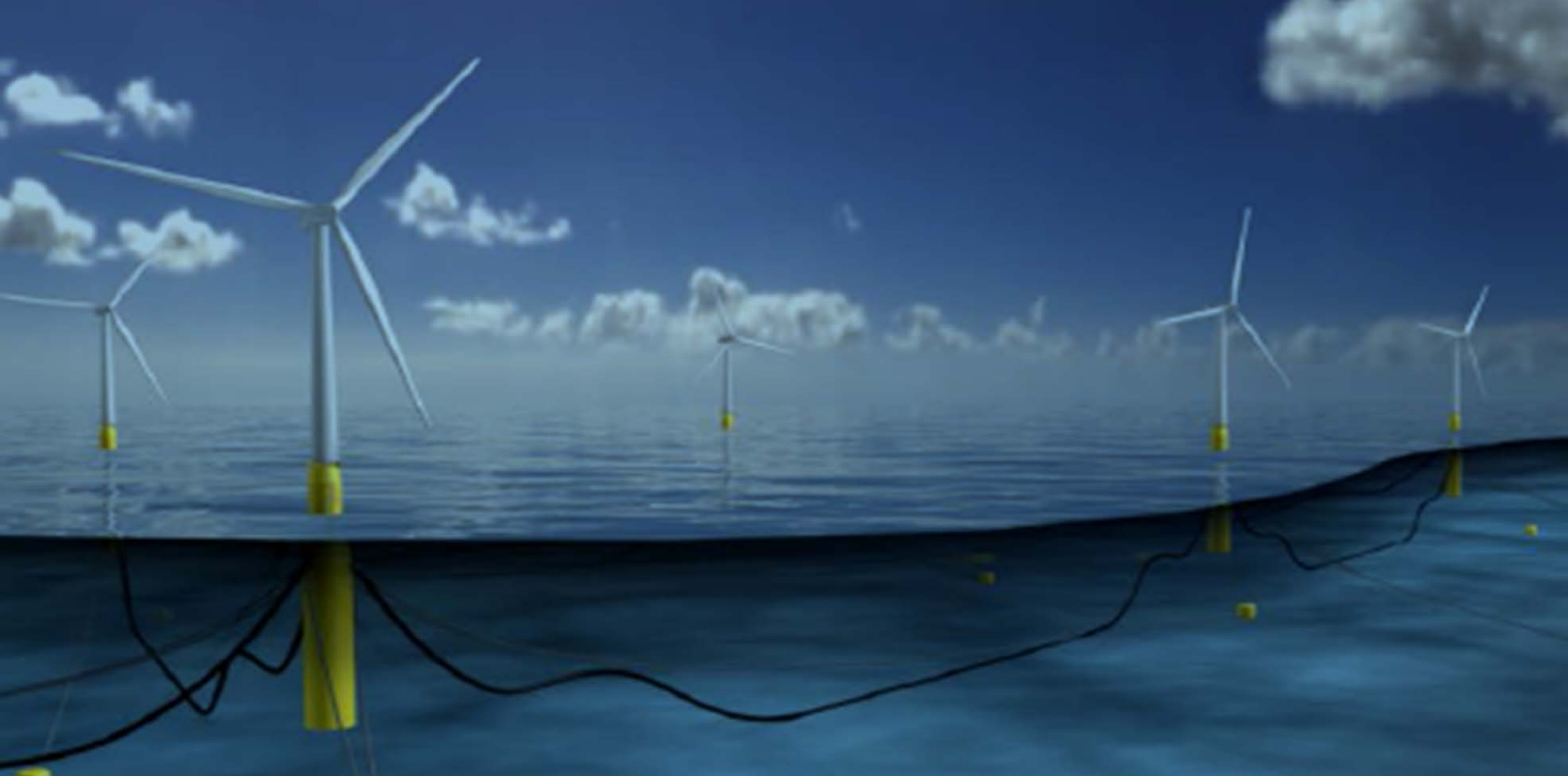
- Storage can supply power while standby gas turbine starts in case of sudden loss or reduction in wind power production
=> Reduced risk for blackout
- A running backup is not needed
=> Increased fuel saving
=> Less wear and tear



Beyond NOWITECH

- SINTEF continues work on electrification by wind power in ongoing project with industry (IPN)
- Statoil is building pilot, shore connected, floating wind farm in Scotland with small onshore energy storage.
- DNV GL has presented concept study of water injection platform with wind power as main source of power

Time for next step: Full scale demonstration !!



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