NOWITECH

The NOWITECH Reference Wind farm

A base case model to be used in offshore wind farm research

Further work for the NRW

To define among others: HVDC-system, turbine controller, park controller and turbine spacing including wake modelling

Current situation in wind farms

66 kV collector grid technology is available and enables higher power flow and lower losses.

Both the converter station platform and the offshore substation transforms the voltage.

The substation and converter platforms make up ~7 % of the total investment cost for a wind farm.

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CENTRE FOR ENVIRONMENT-FRIENDLY ENERGY RESEARCH

Established by the Research Council of Norway

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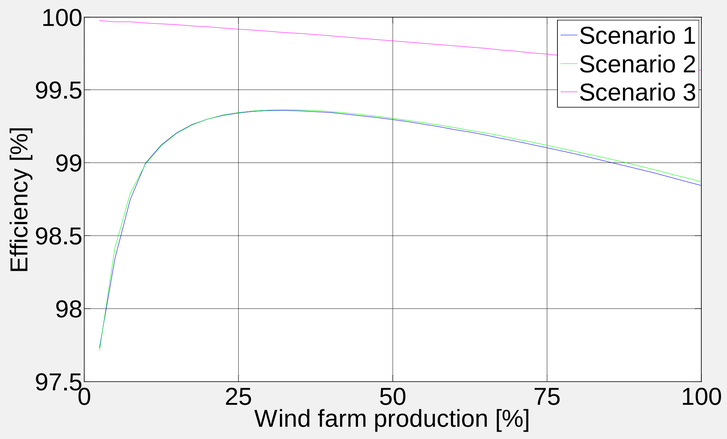
The NOWITECH Reference Wind Farm

Cost reductions due to electrical design in wind farms

The NOWITECH reference wind farm (NRW) is created to have a base case research model that enables focus on specific research topics. The initial focus of the NRW has been to design an electrical system that minimizes the lifetime cost of the internal grid.

Project focus

- Can untraditional design of the internal grid in an offshore wind farm lower lifetime costs?
- Is 66 kV collector grid a better option for large wind farms such as UK Round 3 projects?
- Can offshore transformer substations be eliminated in HVDC connected wind farms?
- Between these two possibilities and the more traditional solution with 33 kV collector grid and substations: Which is the most cost effective over the lifetime of the wind farm?



Simulation results for power losses in the internal grid

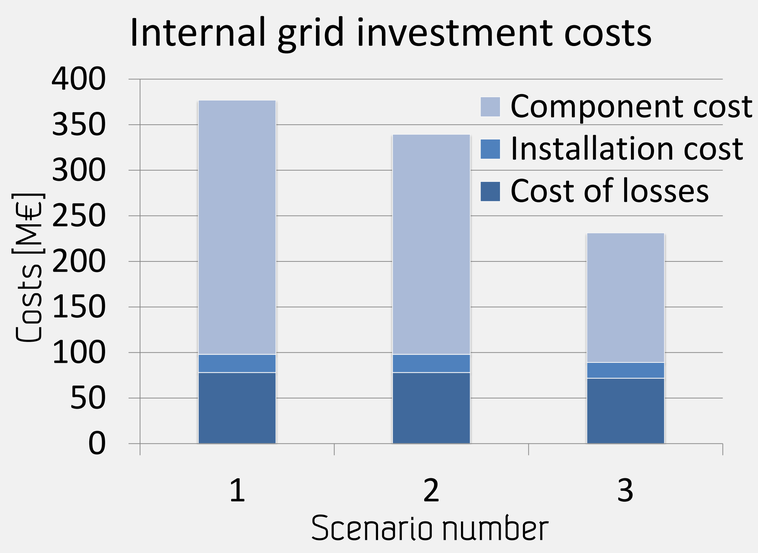
Results and findings

Upgrading the collector grid voltage level to 66 kV and eliminating the offshore transformer substation **save 137 M€** when compared to the standard configuration.

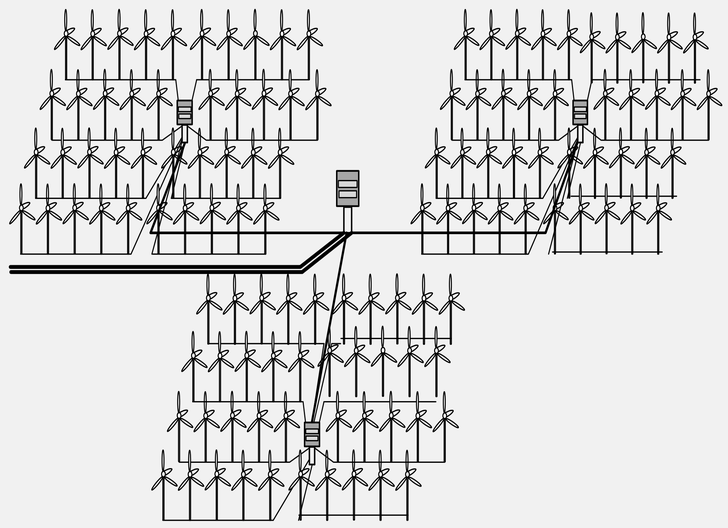
That is approximately **50 % of the investment** on the internal grid from the circuit breakers in the WTG to the circuit breakers on the converter platform.

Upgrading the voltage saves a small amount due to lower losses, but mostly due to the lower diameter required in the subsea cables. It is therefore a better solution in large farms.

Power losses go down when eliminating the substation transformer because the distance to the converter platform is small, so the substation is not necessary in the internal grid.



Methods



The NOWITECH Reference Wind farm, scenario 2

The NRW quick facts:

- A MATLAB Simulink model
- 120 10 MW NOWITECH reference turbines
- 200 km long VSC-HVDC cable at ±420 kV
- Similar to the Dogger Bank Creyke Beck A wind farm

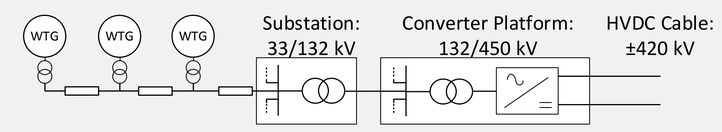
Three scenarios for the electrical system has been evaluated:

- Scenario 1 is the base case using the traditional solution with 33 kV collector grid and substations.
- Scenario 2 with substations and a 66 kV collector grid.
- Scenario 3 is without substations and with a 66 KV collector grid.

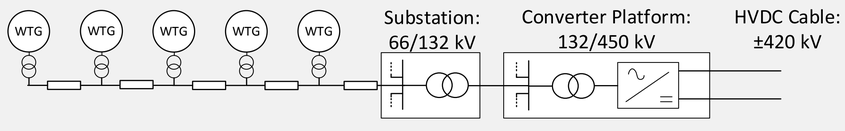
Methods cont.

To find the most cost effective solution, approximate numbers for installation and component costs were required from earlier projects and cost overview reports.

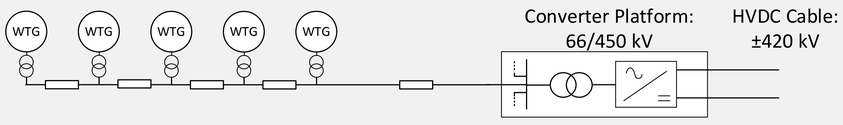
To find the cost for energy losses, minimum energy losses for different production levels are found through simulations. Empirical production data gave the duration for each production level, and the total energy loss was found. Energy price per year is given by the CfD incentive scheme in the UK and expected power prices.



Scenario 1: 33 kV collector grid voltage and three substations



Scenario 2: 66 kV collector grid voltage and three substations



Scenario 3: 66 kV collector grid voltage and eliminated substations