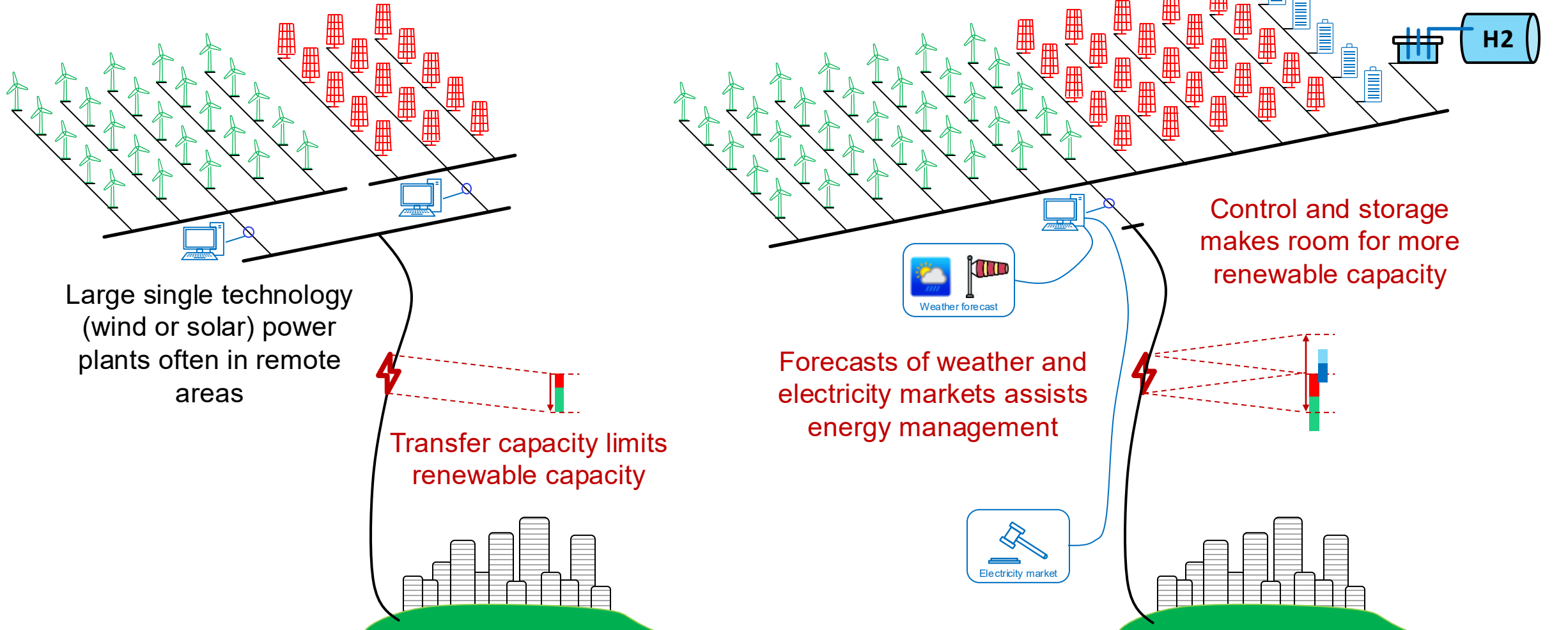


Poul Sørensen

Planned power emulator test equipment for Risø HPP

Why utility scale hybrid power plants?



Risø-HPP

Meteorology
mast

225kW retrofitted
hybrid storage
wind turbine

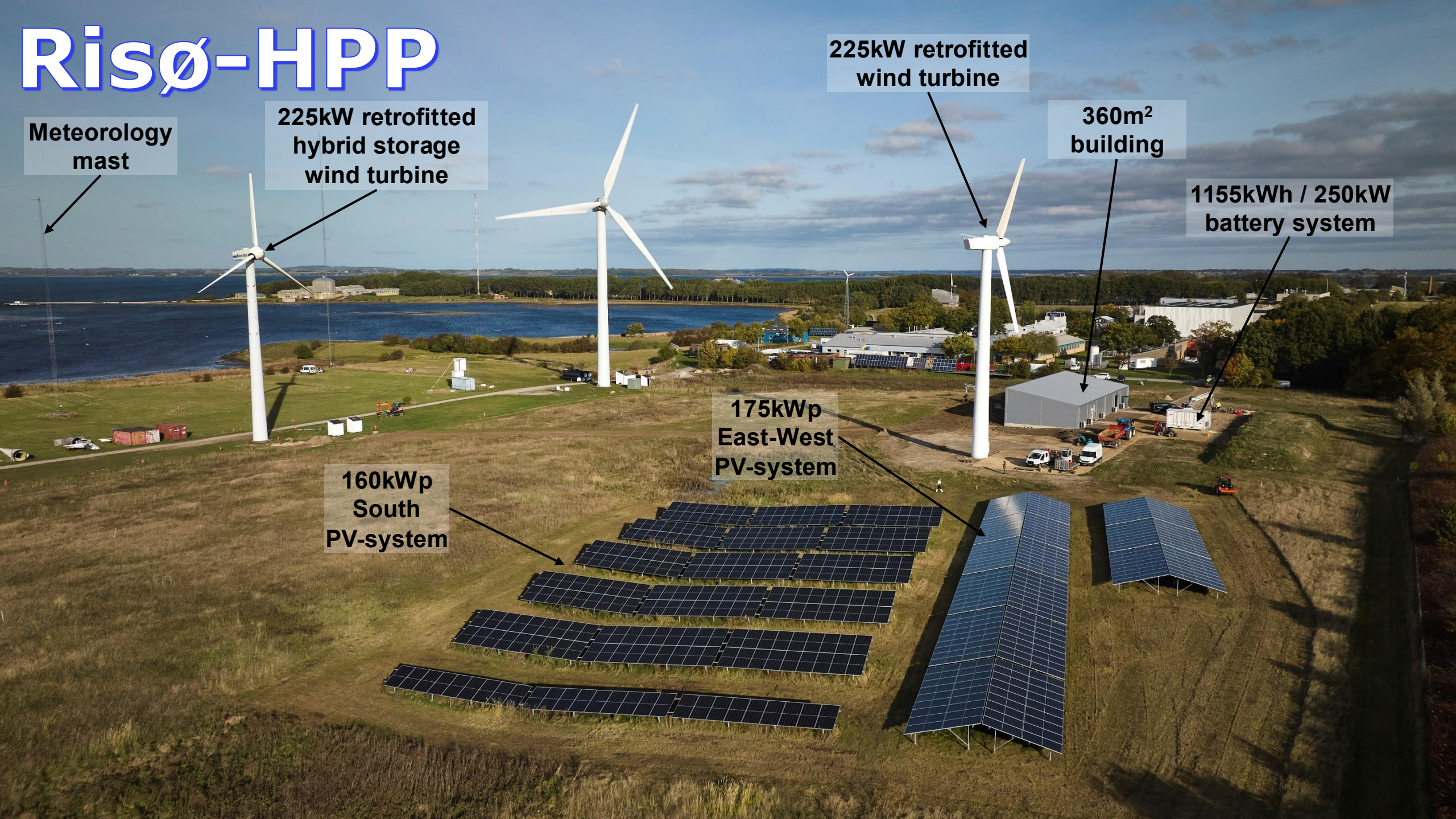
225kW retrofitted
wind turbine

360m²
building

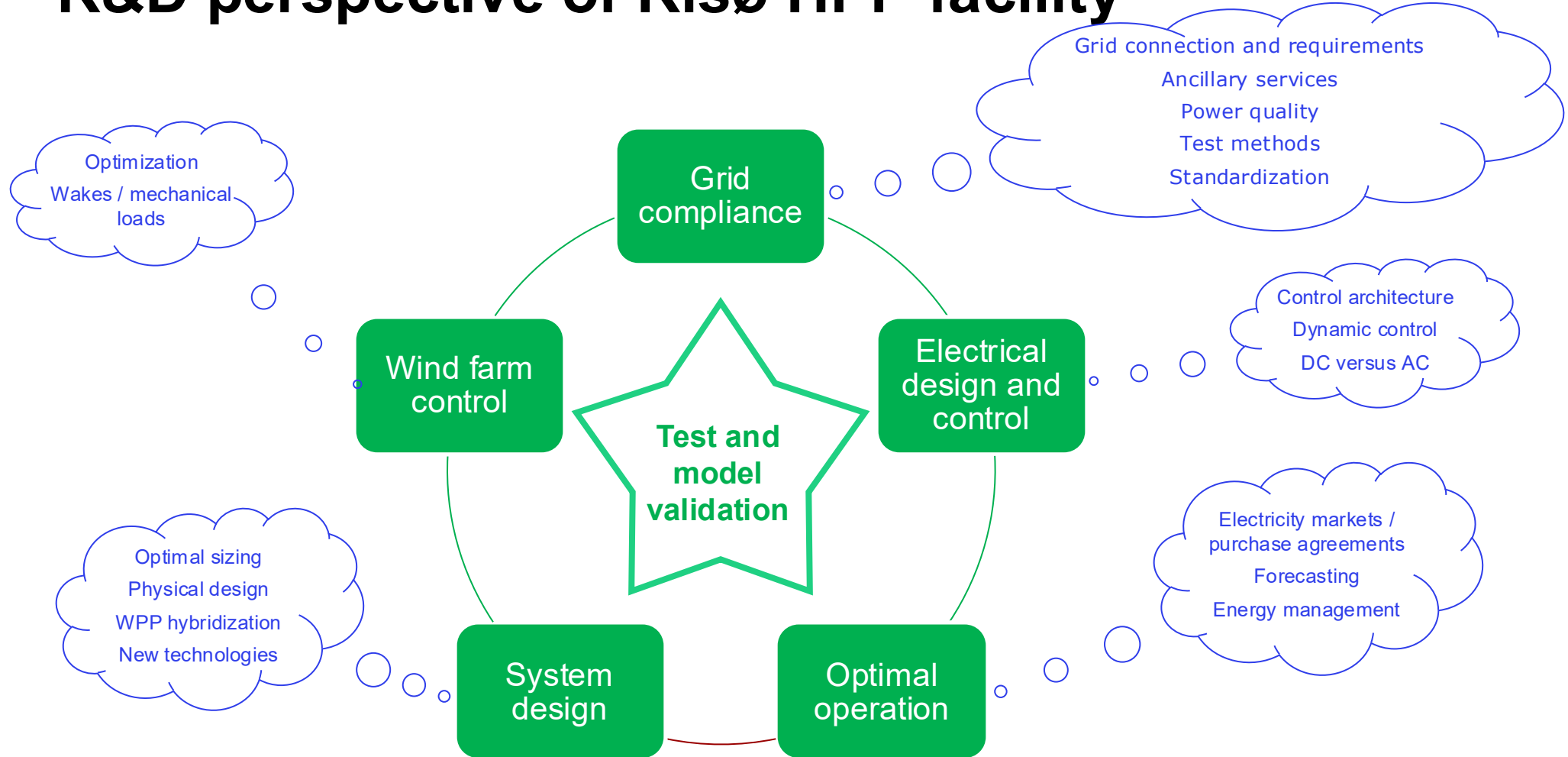
1155kWh / 250kW
battery system

175kWp
East-West
PV-system

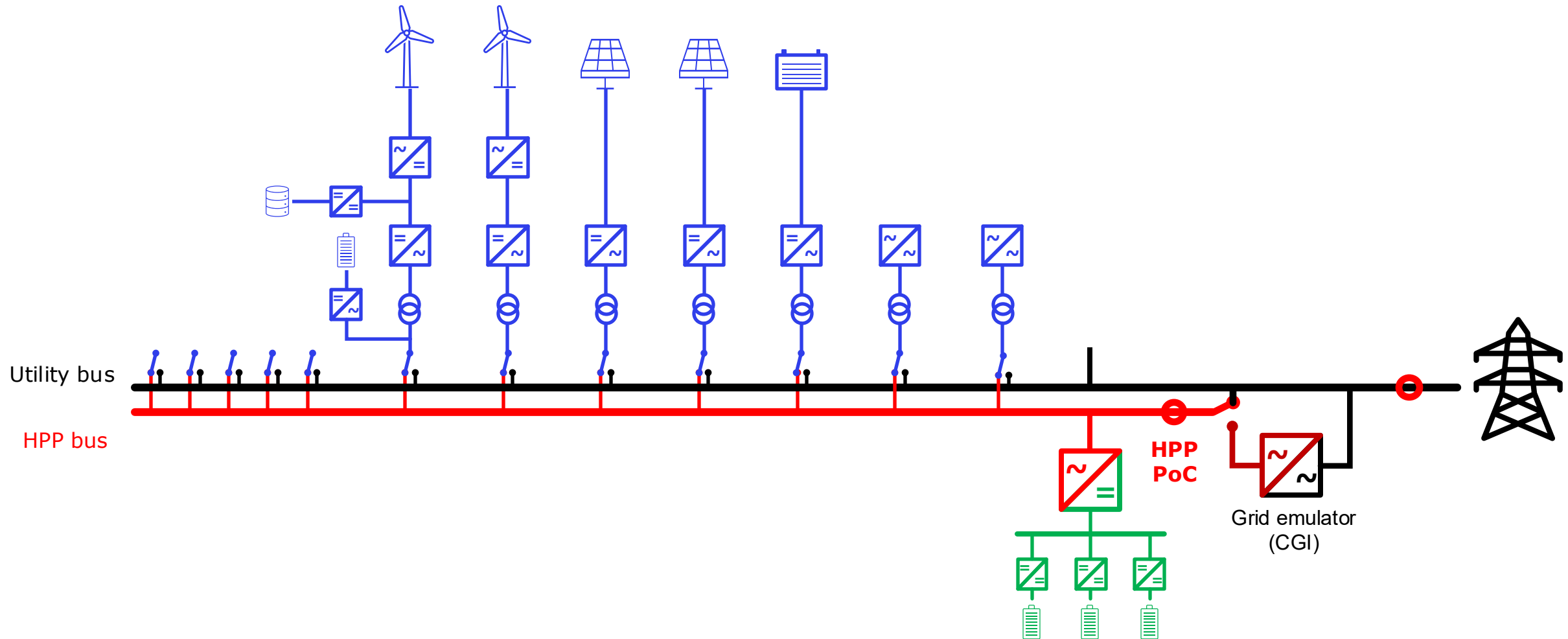
160kWp
South
PV-system



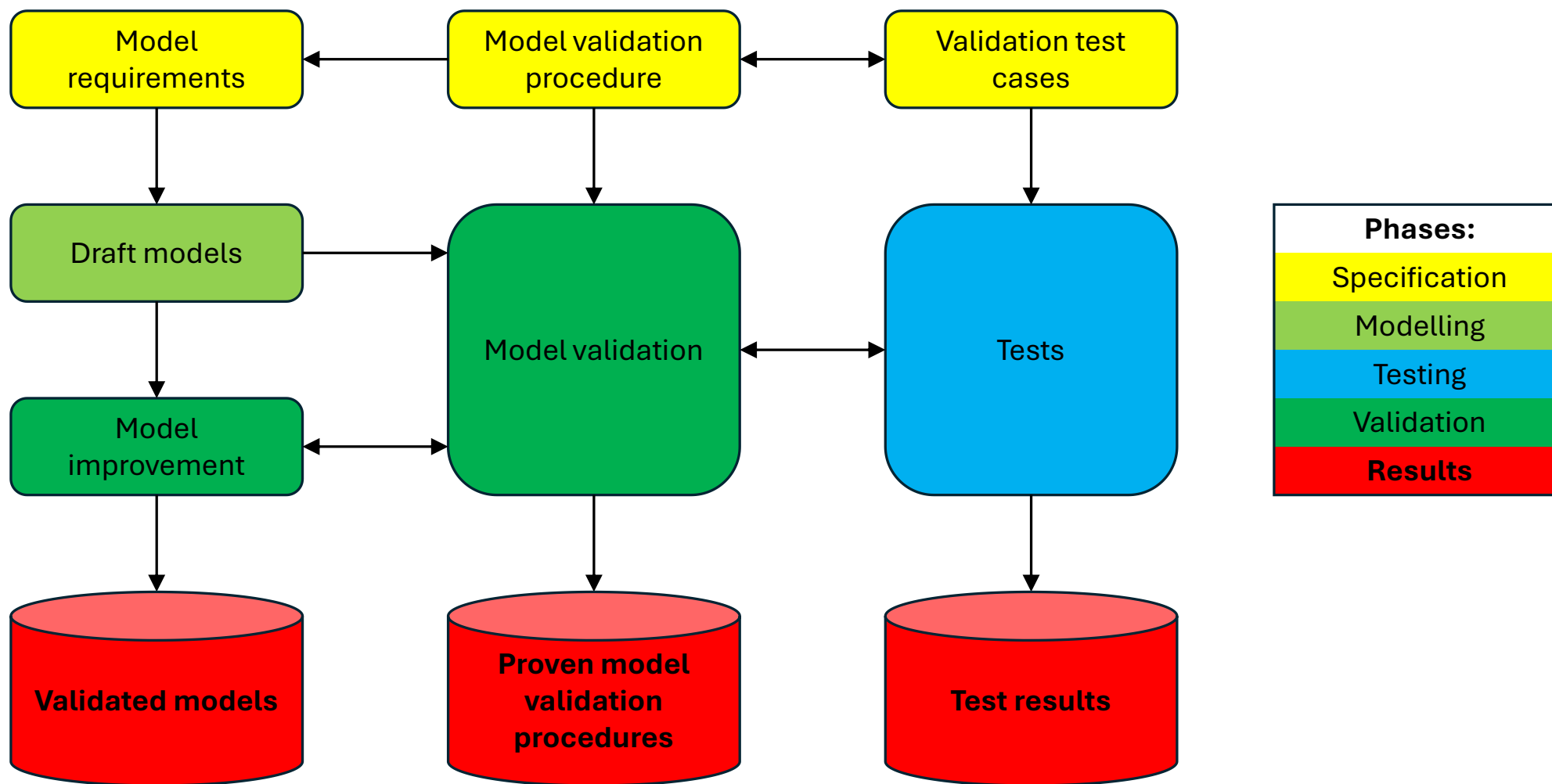
R&D perspective of Risø HPP facility



Risø HPP – Double bus system

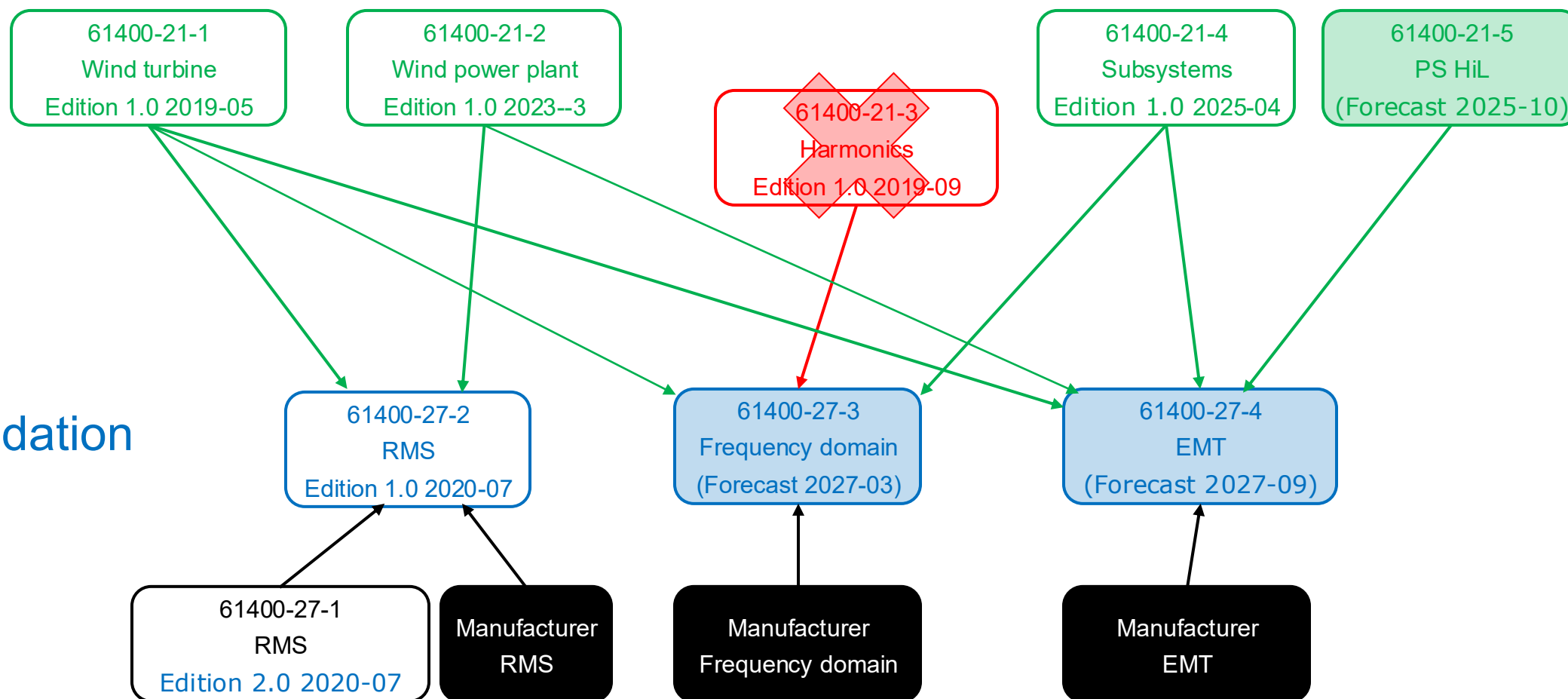


GREAT project with TotalEnergies



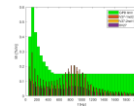
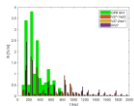
IEC 61400 standards – wind energy generation

Tests



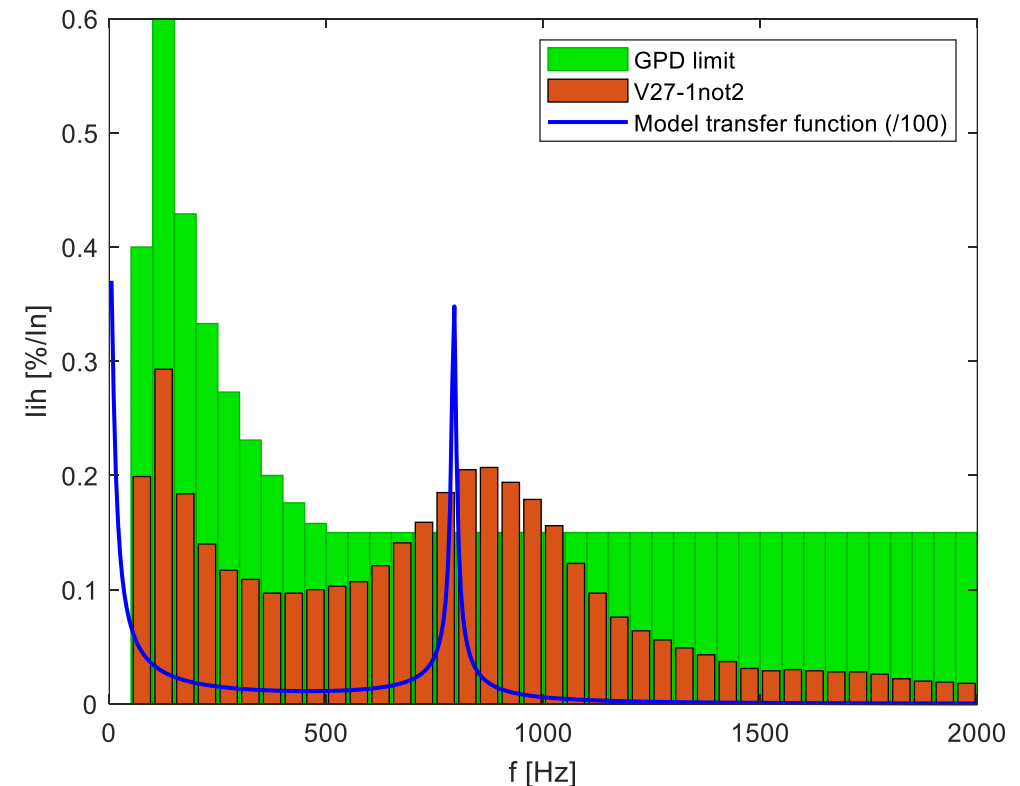
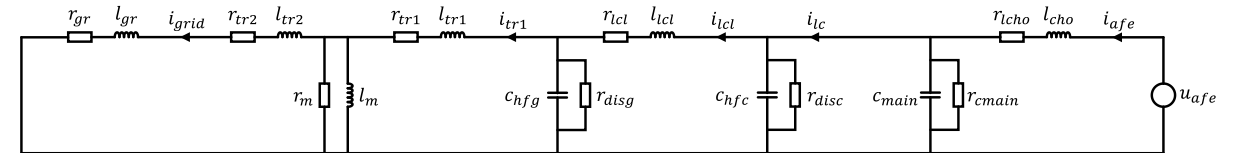
Harmonic and interharmonic currents – and limits

- Harmonic and interharmonic current emissions from Risø HPP 2025
 - Harmonic currents within Green Power Denmark limits
 - Interharmonic currents exceed Green Power Denmark limits



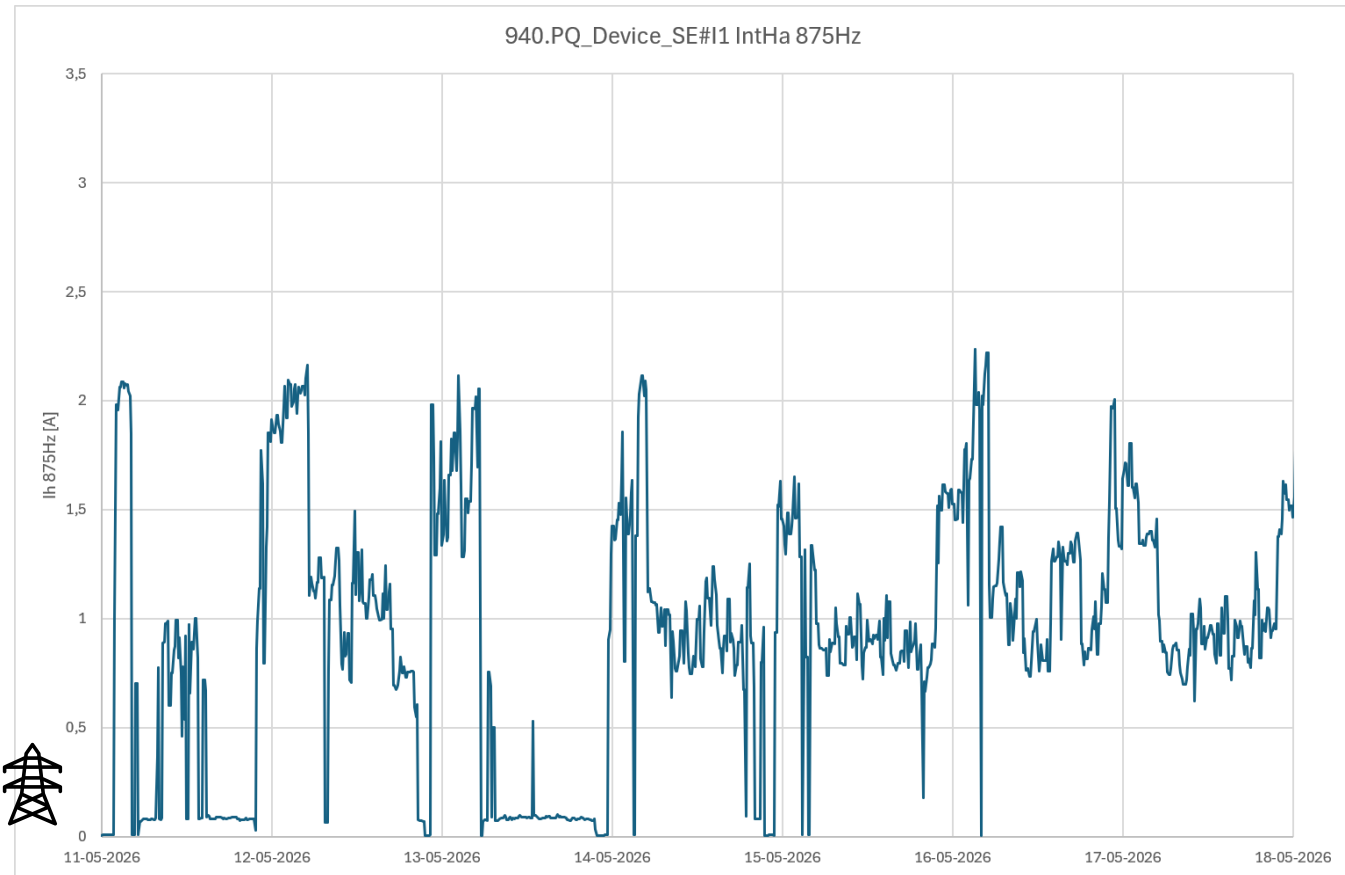
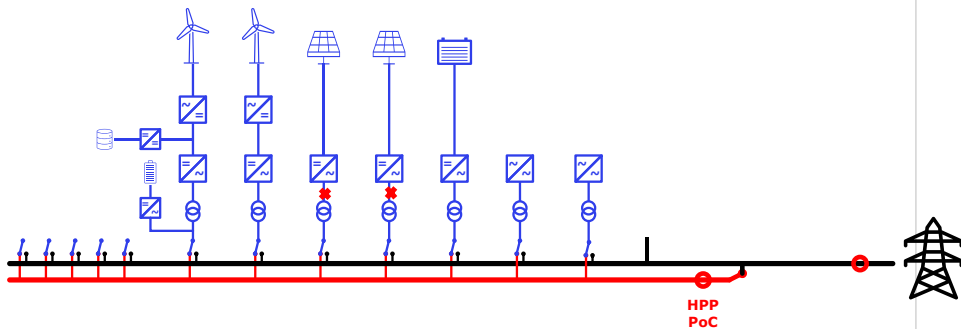
Circuit model – frequency domain

- Electrical circuit model for
 - Converter filter (LC or LCL)
 - Unit transformer
 - Grid equivalence
- Model resonance frequency (790Hz) close to local maximum emission (875Hz)
 - could be accounted for by the tolerance in the filter capacitors ($\pm 15\%$)
 - could also be caused by the influence of the converter control system including the modulation



PV inverter filter impact on WT interharmonics

- It seems interharmonics are highest in nights when WTs produce and PV inverters are off



DTU

