

A GL company



Optimising Performance – A Selection of Case Studies

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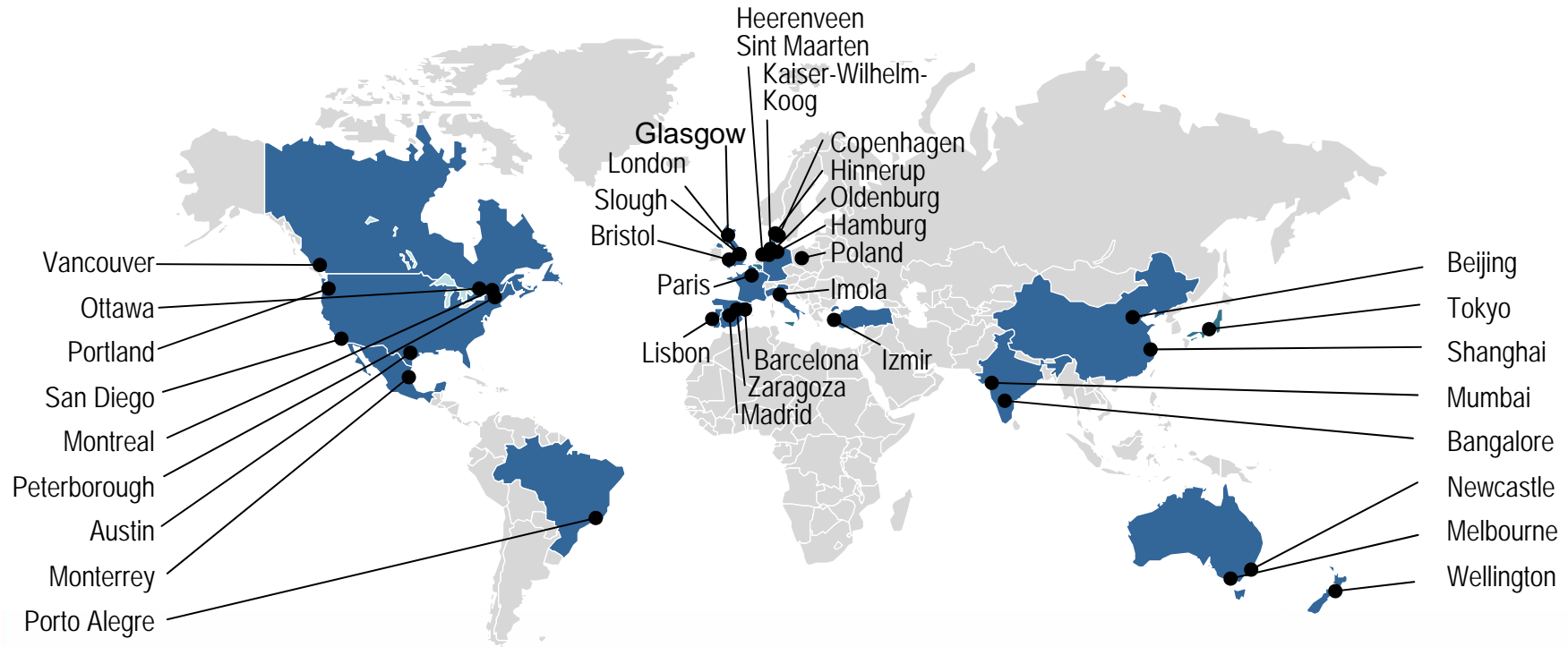


Renewable Energy Experts
worldwide



Our geographic reach

- 650 renewable energy staff, in 35 locations, across 18 countries
- Wind, Wave, Tidal and Solar





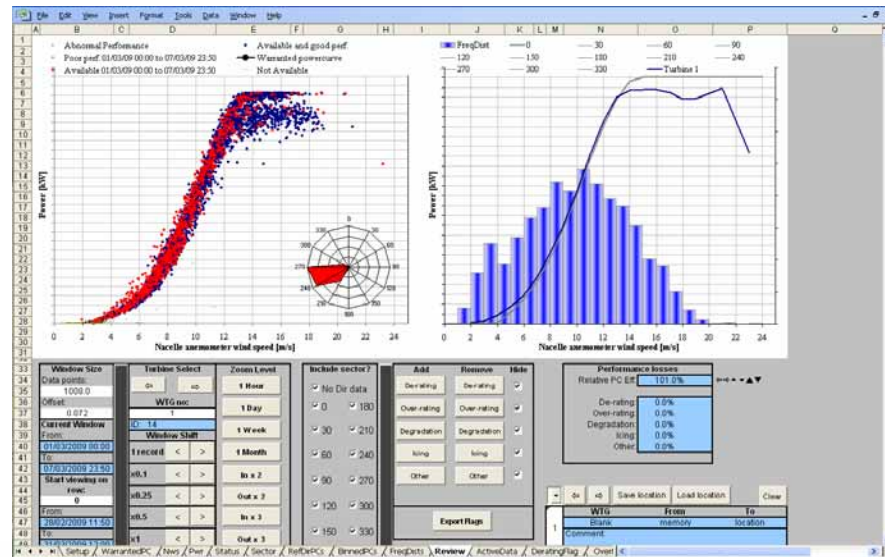
Asset Management and Optimisation Services (AMOS)

25 Professionals worldwide (7 UK based)



A GL company

- ✓ Performance Monitoring
- ✓ Fault diagnostics and forensic analysis of SCADA data
- ✓ Post-construction energy forecasts
- ✓ Warranty calculations
- ✓ End of warranty inspections
- ✓ O&M advice
- ✓ Performance profiling and benchmarking

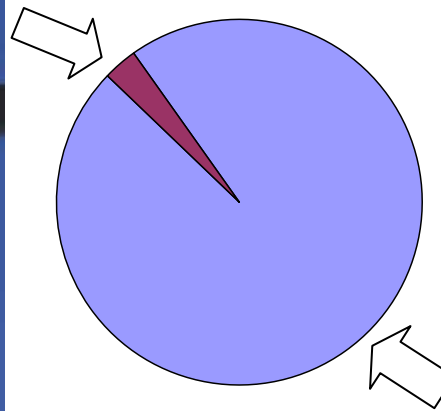


Over 15 GW of operating plant assessed worldwide



Performance Optimisation

- Not just a question of availability but efficiency!



Turbine stopped for 3% of the time
- Main focus of contractors

Turbine running for 97% of the time*
- But how efficiently?

* Observed Availability Trends, Harman, Walker, EWEC 08

Case study 1

Availability: Liquidated damages claim (UK)

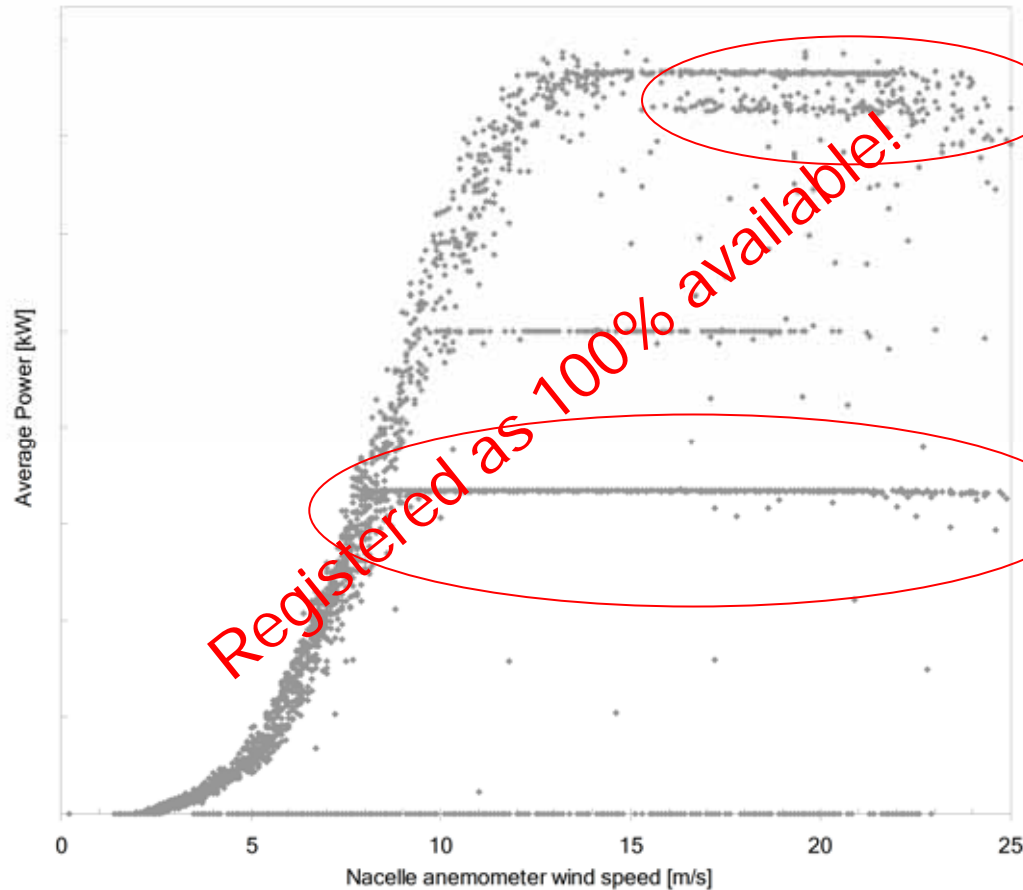


Status description	A01	A02	A03	A04	A05	A06	A07
LINE FAULT VOLTAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOTOR PROTECTION TOP CABINET	0.0	2.6	0.7	0.0	0.0	0.0	0.0
PROGRAM START PLC	0.9	0.5	0.3	3.5	0.3	0.0	2.2
NO ACTIVITY CAN-BUS CCU	0.0	0.0	0.1	0.1	0.1	0.8	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROTOR CCU COLLECTIVE FAULTS	0.0	0.0	0.0	4.8	3.2	0.0	0.0
TIMEOUT PITCH CONTROLLER	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GEARBOX OIL LEVEL TOO LOW	0.0	0.0	0.0	0.2	0.1	0.1	0.1
BATTERY VOLTAGE LOW AXLE 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REPAIR	1.4	0.0	0.0	0.2	1.6	0.3	0.2
LIMIT SWITCH ROTOR BLADE 90° DEFECTIVE	5.3	0.0	0.0	0.0	0.0	0.0	0.0
BRAKING PAD OF SECONDARY BRAKE WORN OUT	0.0	0.0	2.1	1.3	0.0	0.0	0.0
BLADE ANGLE ASYMMETRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BATTERY VOLTAGE LOW AXLE 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDERVOLTAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVERTEMPERATURE PITCH MOTOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GENERATOR BRUSHES WORN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NO SPEED REDUCTION WITH SECONDARY BRAKING	1.0	0.0	0.0	0.0	0.0	0.4	0.3
YAW LIMIT SWITCH ACTIVATED	0.0	0.0	0.0	4.2	0.0	0.0	0.0
MOTOR PROTECTION PITCH MOTOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All other statuses	0.1	0.1	2.0	1.3	0.9	0.7	0.1
	8.8	7.5	5.8	15.7	6.2	2.3	2.9

- Availability warranty liquidated damages claim calculated by manufacturer at £35k (~5M¥)
- GH review of SCADA data and service records reveals incorrect downtime allocation
- Eventually claim paid at £300k (~45M¥)

Case study 2

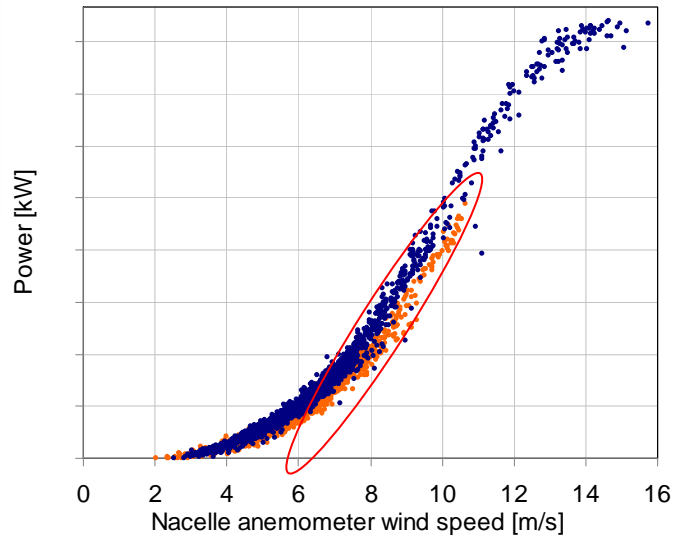
Efficiency: De-rating losses (UK)



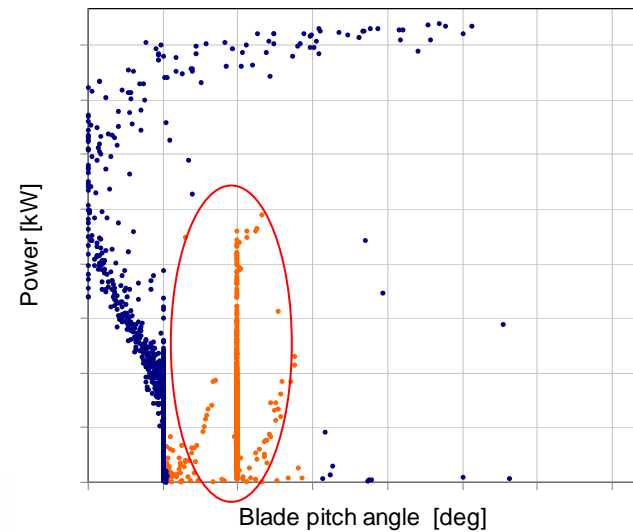
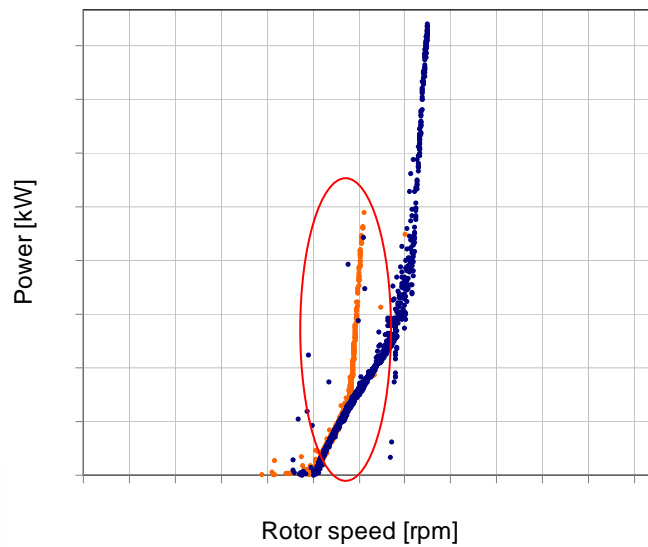
- Wind farm not producing budgeted energy despite good wind speeds
- Analysis identified periods of de-rating and quantified energy losses
- £200k (~30M¥) lost revenue due to manual de-rating of the turbines
- De-rating now kept to a minimum through regular monitoring

Case study 3

Efficiency: Controller malfunction (France)

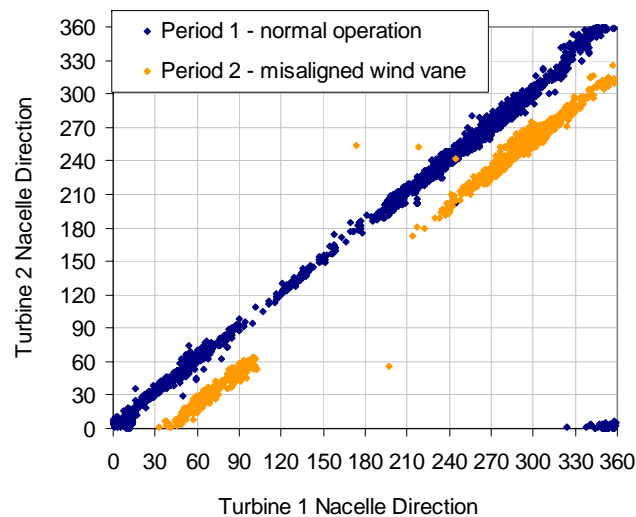
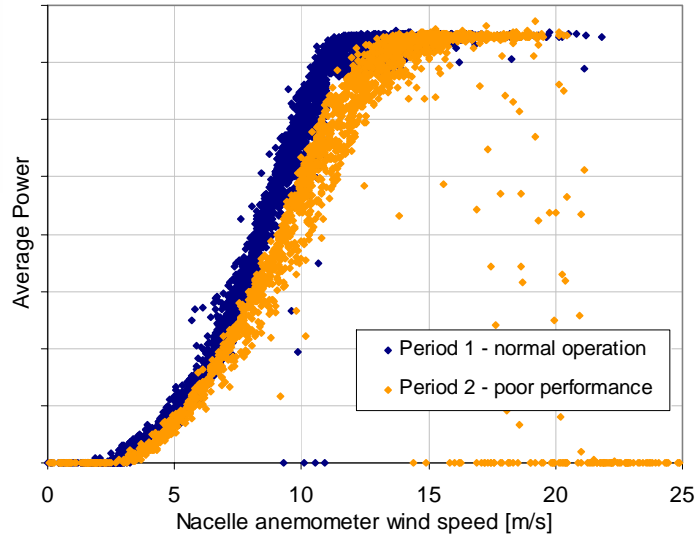


- Malfunction of controller identified through analysis of SCADA data
- Manufacturer informed and remedial action taken
- If undetected losses would have continued in excess of €30k (~4M¥) per year for a single turbine



Case study 4

Efficiency: Wind vane alignment (UK)



- Wind vane misalignment identified through analysis of SCADA data and confirmed by inspection
- New more accurate method for alignment provided and implemented in collaboration with manufacturer
- Estimated £150k (~20M¥) annual losses avoided with remedy a small fraction of the remediation costs

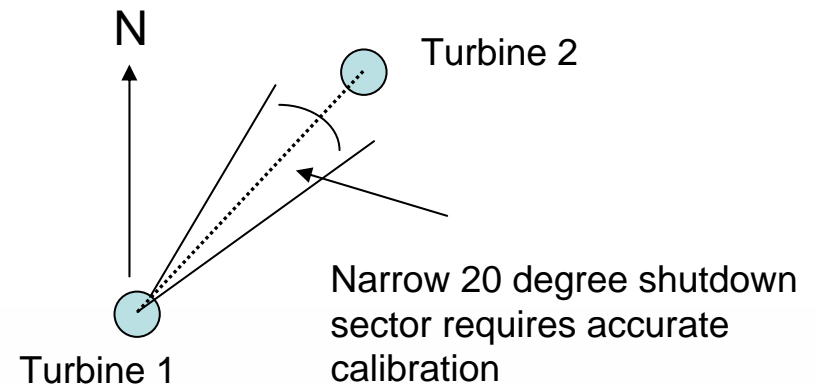
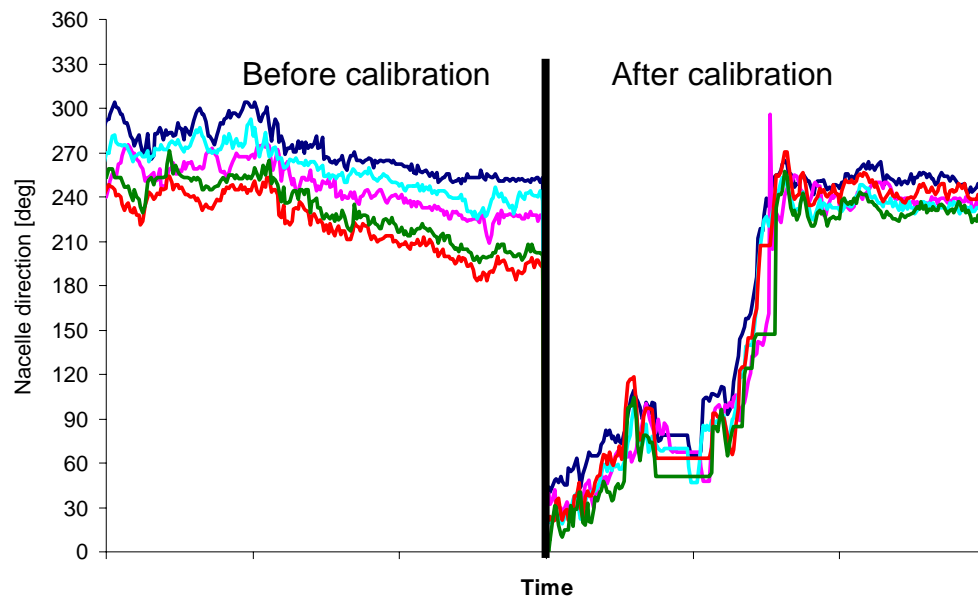


Case study 5

Direction calibration for wind sector management (UK)



- Wind sector management required for certification
- Existing calibration had low accuracy
- Some turbines running in restricted sector and switched off in un-restricted sector
- New calibration method established and implemented in collaboration with manufacturer





Concluding remarks



- Make the best use of the SCADA data to optimise performance
- Don't just focus on availability - the turbines are running for 97% of the time, but how efficiently?
- Think of minimizing turbine loading as well as maximising energy and profits
- Don't rely on contractual arrangements to claim back losses

Regularly monitor your wind farm efficiency to ensure that the turbines are operating as they were designed to!



Thank you

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