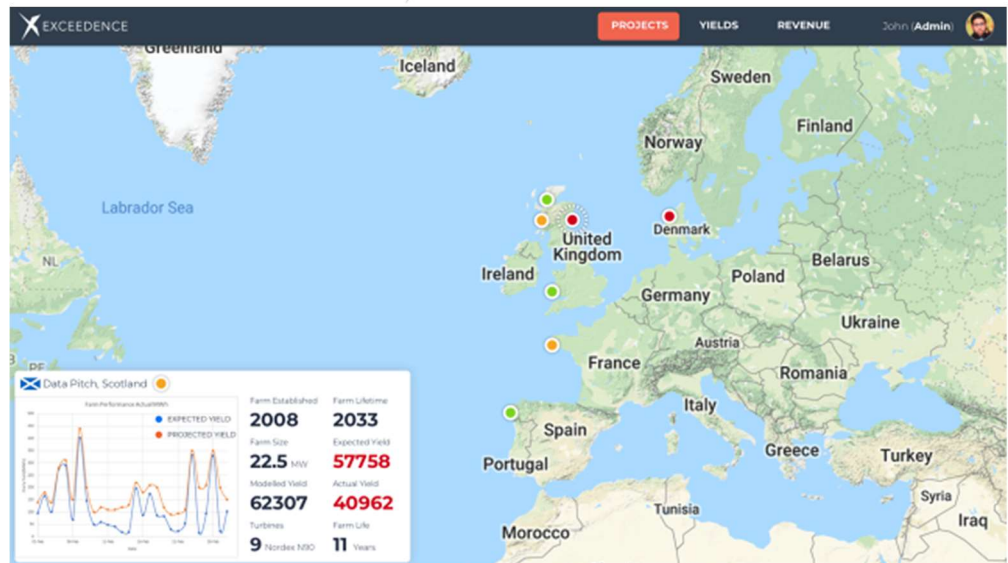**Key Findings:**

By using Exceedence Compare we were able to prove the following:

- Quickly highlight issues form portfolio to farm to individual assets
- Follow a simple workflow trail
- Find systemic issues in single turbines
- **See the full technical and financial picture**

For more information on Exceedence Compare please visit:

Exceedence.com

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For more information on our EU Datapitch project that has funded the development of Exceedence Compare See www.datapitch.eu

Overview screen of portfolio performance in Exceedence Compare

Exceedence COMPARE – Offshore Wind
Case study: Identifying Systematic underperformance of assets

Many wind energy projects underperform after they have been built. The reasons are various however one thing is constant. Unpicking and rectifying the cause is difficult as the drivers behind the performance are complex. Currently there are on the market several operational software packages that will help analyse **technical** under performance

Exceedence go further and are the first to offer a solution to build a digital twin of the project from a technical and financial performance approach and use such key figures such as monthly **yield**, **revenue**, **IRR, NPV, LCOE** to highlight the **performance delta** from the ORGINALLY financed project.

We provide a series of comparison screens **OVER TIME** that show the deltas and allow a deeper dive into the farm performance down to each of the turbines. This case study shows a worked example of a real wind farm and focuses on identifying one particular issue of an asset underperformance. The financial impact of the underperformance is discussed in another case study.

The farm consists of 9 turbines with an installed capacity of 22.5MW that was built in 2008. Data for each turbine was available as well as overall farm performance.

The problem
The portfolio dashboard above highlights in red the underperforming farms and a quick mouse over shows the extent of the problem. A quick click and the past months ACTUAL data is loaded in and is then compared against the expected.

Technical Performance

Factor	Modelled	Expected	Actual	Delta
Yield (ADE)	62307 MWh	57758 MWh	40962 MWh	-34% ↓
Availability	95%	95%	96%	1% ↑
Capacity Factor	31.60%	29.3%	23%	-29% ↓
Average Resource	7.14 m/s	6.82 m/s	6.92 m/s	-3% ↓
LCOE	£83.67	£90.23	£127.90	53% ↓

Financial Performance

	Modelled	Expected	Actual	Delta
IRR	13.73%	12.33%	6.50%	-53% ↓
Revenue Per Month	5192.25	4813.16667	3413.53	-34% ↓
Annual Revenue	£649031.25	£601645.83	£426691.08	-34% ↓
Simple Payback (years)	7	8		-100% ↓
Discounted Payback	10	12		-100% ↓
NPV/MW	£1334694.12	£1040192.60	-£47533	-100% ↓

1. The Modelled output – What was originally forecast in the techno-financial model.
2. Expected output – the original model run with the actual wind data

The dashboard highlights both technical and financial **deltas** in performance with negatives highlighted in red. This dashboard belies the complexity below as the software is using the ExceedenceFinance engine in the background to build parts of the Modelled, Expected and Actual data. KPIs available are

- Instantaneous Power
- Availability
- Yield
- Capacity factor
- Resource
- LCOE (levelised cost of Energy)
- IRR
- Revenue per month
- Annualised Revenue
- Simple payback
- Discounted payback
- NPV/MW

Turbine Summary

Name	Actual Energy (MWh)	Availability	Capacity Factor		Mean Wind
Turbine1	425.77	98%	25%		6.57839438864087
Turbine2	425.55	97%	25%		6.53817524131946
Turbine3	385.31	92%	23%		6.72825305481149
Turbine4	389.25	97%	23%		6.31141021155754
Turbine5	441.67	96%	26%		6.90413780233133
Turbine6	303.06	96%	18%		5.68239927380954
Turbine7	329.72	94%	20%		6.19818000744046
Turbine8	400.81	97%	24%		6.38685964260914
Turbine9	312.39	96%	19%		5.56763176091271
Total	**3413.53**	**96%**	**23%**		
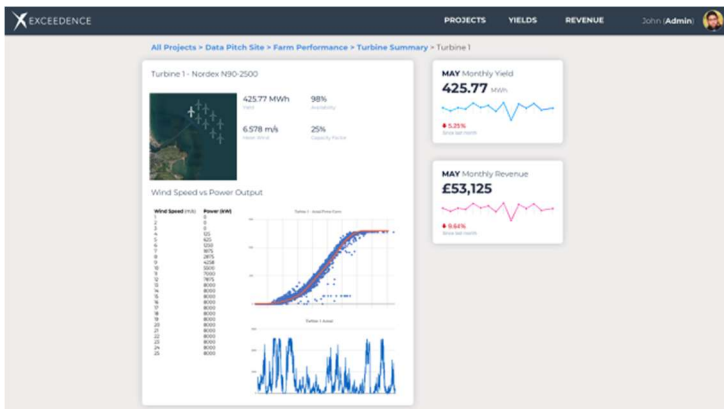
A further click into the technical performance dashboard shows the performance per turbine and again the problems are highlighted in red. Clicking on the turbine pulls up all the performance data on an individual turbine and it is this that will show individual assets that underperform. The software has easily allowed us to follow the trail from the portfolio level right down to a single asset in a farm. Shown below are 3 distinctly different reasons for a single asset underperforming that we were able to highlight from only 1 month of operational data.

1. **Availability** – The KPI shows a lack of availability but the detail power curve show that there was plenty instances of wind where zero power was produced. This could be a fault condition or a maintenance issue
2. **Rating** – The turbine never reaches its peak output and flatlines well below it. This appears to be a systemic issue.
3. **Underperformance** – The turbine is consistently under-delivering at the upper end of the power curve. This is another systemic issue but one that correct maintenance may fix like blade cleaning.
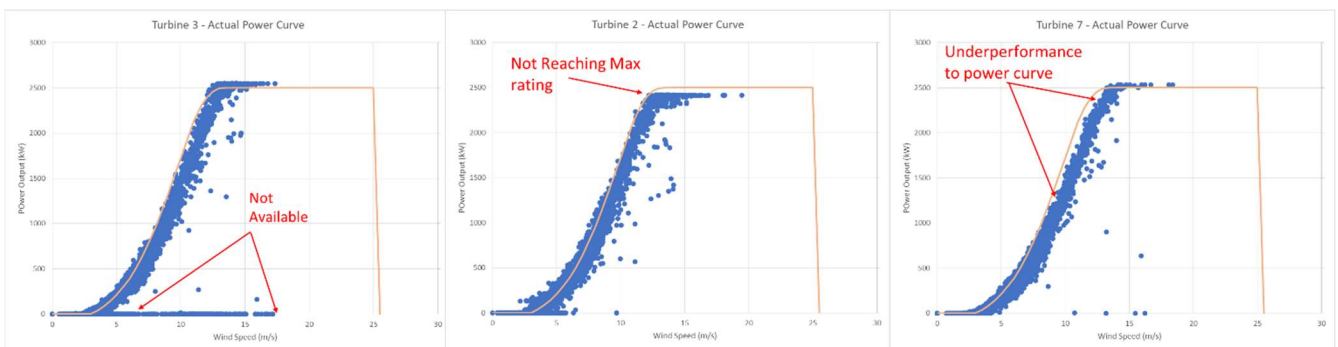
"Exceedence Compare quickly allows the user to go from high level portfolio analysis right down to individual turbine performance to identify and rectify systemic asset underperformance"