Financing wind farms and the impacts of P90 and P50 yields
Andrew Tindal, EWEA Wind Resource Assessment Workshop, 11 May 2011
A wind farm financier will ask the following questions

How much will my wind farm cost? Capex
How much will my wind farm cost to operate each year? Opex
When will my wind farm start producing power?
How much will I be paid for the energy I produce?
How much energy will I produce each year?

Of relevance to this workshop is:

How much energy will I produce each year?

A vital question for a financier!
Is there enough information to answer the question?

The first question is are the data of sufficient quality, quantity and length for an assessment to be undertaken which is suitable for supporting a financial transaction?

If yes a formal assessment will be undertaken and reported.
How certain are you of your prediction?

The output from an energy assessment will be the predicted long term energy yield. This is also called the Central Estimate or the P50 estimate.

It is called the P50 as there is a 50% chance the result will be lower and a 50% chance the result will be higher than the predicted long term energy yield.

The financier needs to know what the uncertainty in the prediction is in order that they can assess their risk. Statistical methods have been developed to quantify the uncertainty in any given prediction.
The uncertainty risk register

A risk register is developed. Uncertainties typically include:

- Measurement accuracy
- Correlation
- Historical data period wind variability
- Vertical extrapolation
- Future period wind variability
- Flow and wake modelling
- Loss factors

These are quantified, converted to units of energy where needed and combined.

Normal distributions and independence often assumed.
The uncertainty result

Individual uncertainties combined to give results as in example graph below. P50, P90 and P99 energy levels for 1, 10 or 20 year future periods often presented. P50 and P90 (10 year) commonly used by financiers in Europe. P50 and P99 (1 year) commonly used by financiers in North America.
Equity deals

If one party is buying a wind farm asset from another party then this is an equity transaction and the new owner will be fully exposed to the benefits the project will bring (upside) and is fully exposed to the risks of the project (downside).

Conventional wisdom is that a P50 energy prediction is appropriate for such a transaction as the buyer is equally exposed to upside and downside. (Uncertainty is used for sensitivity studies)

There is often significant debate between parties on many aspects of the project (including uncertainty) in coming up with an agreed fair value!
Debt deals

If one party is raising debt from a bank (or another financial institution) then if all goes well the bank will have the loan repaid with interest (limited upside) but if things go badly wrong then the bank will lose the full value of the loan (full downside).

Because the bank has a limited upside but is exposed to a larger downside then the bank puts in a substantial extra layer of protection to control risk.

It does this through using a:

**Debt Service Coverage Ratio (DSCR)**

In simple terms this means that the project must generate more money each year than that which is needed to service the debt by an agreed percentage – typically 40%.
Debt deals – Typical Debt Service Coverage Ratios

Financier’s models often size debt on the P90 10-year energy case, even if the main ‘base case’ uses the P50 over the long term.

So, the lower the P90 relative to the P50, the lower the size of the loan.

The selection of either the P50 or P90 may not be critical, as the Debt Service Coverage Ratio changes with each energy case.

**Europe**
Loan based on P50 with 1.4 DSCR ~ Loan based on P90 (10 year) with 1.2 DSCR

**North America**
Loan based on P99 (1 Year) with 1.0 DSCR
What does this mean to the owner of a project?

A better P90 generally means a bigger loan…

A bigger loan generally means better equity return…

We need a worked example:…
The project – fixed assumptions:

Wind farm of 28 MW costing €39million

Small print below:

Wind farm 14 x 2 MW turbines with total construction cost, project equipment - €1.1 million per MW (ex VAT)
Plus (all as a % of the total equipment cost):
Contingency 3%, Development 5%, Connection 4%, Finance 2%, VAT 10%
Interest during construction to apply for 8 months over the construction period
Capital costs are MW installed based and consistent across the scenarios
Interest rate including margin – 6.5%, Inflation indexation 2%
Loan term target 15 years
Energy rate - €75/MWh
Operating costs are the same between scenarios, except turbine maintenance, which is a variable rate based on production @ €0.01/kWh
The project – variable assumptions:

Wind farm assumed energy 72 GWh/annum

Assumed base case P90/P50 ratio 85%

Alternative Case 1 – P90 @ 87% of P50 (+2% on assumed 85% ratio)
Alternative Case 2 – P90 @ 83% of P50 (-2% on assumed 85% ratio)
Alternative Case 3 – P90 @ 90% of P50 (+5% on assumed 85% ratio)
Alternative Case 4 – P90 @ 80% of P50 (-5% on assumed 85% ratio)

DSCR:
1.4 for P50, 1.2 for P90

Analysis determines loan possible within defined parameters - as a % of the overall project cost
The results:

- **P90/P50 ratio**
- The bigger the P90 the bigger the loan

![Graph showing different cases (Case 1, Case 2, Case 3, Case 4) with lines indicating Total Cost, Total Loan, Energy, and Equity IRR. The graph highlights that the loan amount increases as the P90/P50 ratio increases.]

**Loan amount - €000’s**

**Equity IRR**
What does this mean to the owner of this project?

The P90 energy and loan amount are closely linked.

A 4% difference in P90 leads to a 4% difference in loan size.

The loan increase does not improve equity IRR in the same proportions, but...

Without capex addition, the P90 change Case 1 to 2 caused the following changes:

- **Equity input reduces from ~ €8 million to ~ €6.5 million**
- **Equity IRR increases from ~ 14.3% to 15.7%**

Changing from Case 3 to 4 made the following changes:

- **Equity input reduces from ~ €9.5 million to ~ €5.5 million**
- **Equity IRR increases from ~ 13.6% to 17.1%**
What does this mean to the owner of this project?

If the owner has €9.5 million to invest:

<table>
<thead>
<tr>
<th>P90/P50 Ratio,</th>
<th>Investment required,</th>
<th>IRR(%)</th>
<th>IRR (€),</th>
<th>Money for next project</th>
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<tbody>
<tr>
<td>80%</td>
<td>€9.5m</td>
<td>13.6%</td>
<td>€1.3m</td>
<td>€0</td>
</tr>
<tr>
<td>83%</td>
<td>€8.0m</td>
<td>14.3%</td>
<td>€1.1m</td>
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<td>87%</td>
<td>€6.5m</td>
<td>15.7%</td>
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<td>€3.0m</td>
</tr>
<tr>
<td>90%</td>
<td>€5.5m</td>
<td>17.1%</td>
<td>€0.9m</td>
<td>€4.0m</td>
</tr>
</tbody>
</table>
Summary

Financiers want accurate future energy predictions for wind farms

It is normal to provide a Central Estimate energy prediction and an uncertainty analysis presenting P90, P99 or other probability levels

Reliable uncertainty analysis allows financiers to make better decisions

Reductions in uncertainty make a big difference to investor returns

Most owners are very sensitive to P90 and P99 results