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Avoiding surprises at the investment table: Making risk-based wind development decisions

A wind resource assessment program should stand as one of the most crucial undertakings of the pre-construction phase of any new wind energy project, yet far too often it remains an afterthought. The projection of energy generation is one of the most sensitive value drivers in a power plant's *pro forma*, and a confident estimate requires years of careful research, planning, and due diligence. A common complaint levied against late-stage wind development projects, however, is that not enough had been done to reduce the uncertainty in power-production calculations.

Unfortunately, the wind industry has yet to fully appreciate resource assessment risk, mainly because the traditional approach to modeling and predicting wind power has gained market traction as a simple solution. Considering the complexities involved in wind assessment—including measurement error, spatial variation, and climate fluctuations—this *status quo* approach is far too simplistic and has fallen behind the capabilities of modern technology.

Today's wind energy investors deserve increased risk assurance and a modern, more sophisticated risk model can provide it.

Capturing uncertainty

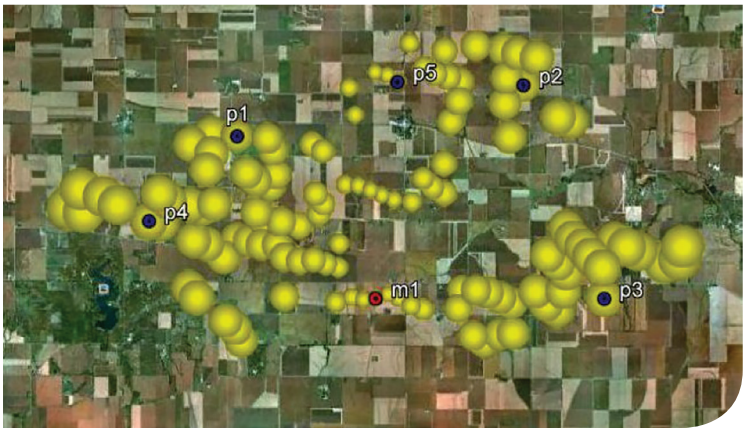
The challenge facing all potential and existing wind power projects can be summed up in one word: uncertainty. Whether it's forecasting the weather or the longevity of a turbine, the risks involved are due to the uncertainty of future conditions.

Progressive wind resource models use uncertainty as a barometer, tailoring a project's investment more sensitively to the risks involved.

Ten-year, suggested energy uncertainty levels

Vaisala Risk Rating	Uncertainty Level (10-year percent of energy)	Typical Stage of Development
A	Uncertainty ≤ 6%	Usually in operating projects only
B	6% < uncertainty ≤ 8%	High-quality investment-grade project
C	8% < uncertainty ≤ 10%	Typical quality investment-grade project
D	10% < uncertainty ≤ 12%	Marginal quality investment-grade project
E	12% < uncertainty ≤ 15%	Early stage development (not investment grade)
F	Uncertainty > 15%	Prospecting stage (not investment grade)

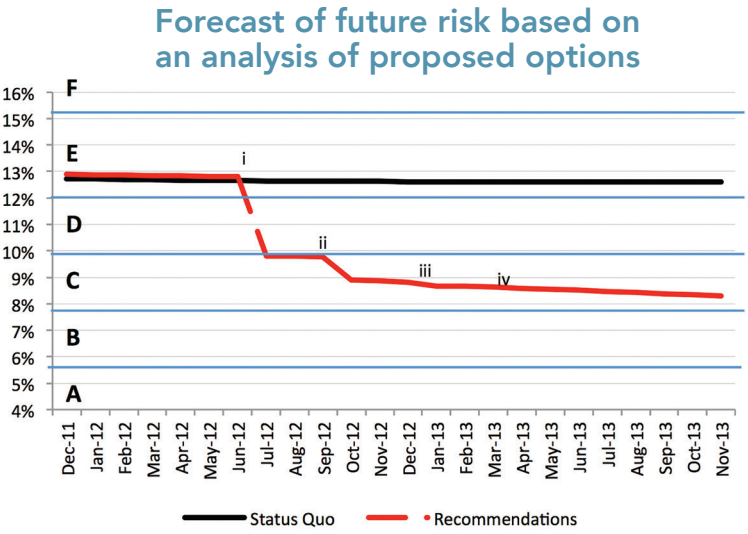
After observing the numerous uncertainties calculated for many projects Vaisala 3TIER Services developed a rating system that may be used as a project guide. Projects are most often financed at a rating of "C" or better, a reasonable target.



The graphic is an Uncertainty Map from a sample report. The yellow circles identify turbines and are scaled as a function of uncertainty. Red dots are existing met towers and dark blue dots are proposed met towers. Although wind resource and energy assessment models have come along way, not all programs offer the same capabilities. For example, Vaisala 3TIER Services' Energy Risk Framework offers a collection of models that, together, let developers make justifiable, strategic investments to minimize risk and optimize wind energy capital.

This approach allows stakeholders to differentiate between the riskiness of various projects. It provides the capability to balance multiple current conditions and constraints against a future risk profile, which can be pre-set to the comfort level of the project's developer and financiers.

A key highlight of this modern framework is an ability to model the uncertainty in future energy production by comparing various scenarios and their outcomes. Such work would compile a collection of physical realities in a software platform. Each uncertainty model relates to specific validation studies or statistical theories, providing a precise rationale for its inclusion. Moreover, the uncertainties continually interact with one another throughout the global covariance models, until the final measures of wind power performance risk are compiled.



A hypothetical budget analysis with specific recommendations for future actions is aimed at reducing uncertainty from a non-investment grade rating of "E" to an investment grade of "C." Project recommendations are scheduled at dates identified as i to iv in the chart.

Minimizing risk

Consider a typical choice made in a wind resource assessment program, such as determining how much meteorological equipment to install at a site. The traditional way a developer would assess this choice is through industry rules-of-thumb or best practices. These rules might include a specific hub-height measurement or a certain number of met towers per 100 megawatts (MW) in simple versus complex terrain. This type of guidance is helpful, but not necessarily ideal, because too much uncertainty remains in play.

For example, imagine a 150-MW project in rolling farmland, with a single met tower that has collected data for one year. The project faces significant investment decisions in the second quarter of the following year. The developer's investment risk appetite requires that the 10-year energy uncertainty of any project be less than 8.0% (i.e. actual energy produced is likely to fall within 8.0% above or below the initial estimate). With just the one met tower, current uncertainty is 11.5%.

With limited time and budget, it's difficult to determine the best way to invest and reduce uncertainty to an acceptable level for financing. If no additional met tower is added, it's likely the uncertainty will drop to just 11.3% by the time the Q2 investment decision arises.

A modern risk model allows users to conduct an uncertainty optimization program. The developer can then examine the impact of adding met towers to a site to collect more data for the final investment evaluations. Hundreds of scenarios can be modeled and configurations tested to optimize the exact number and location of met towers.

In this case, analysis shows that installing two additional met towers over the next two months to improve spatial coverage drops uncertainty to below 8.0%, satisfying internal criteria by Q2 when the investment decision is scheduled. However, after installing a total of three additional met towers, uncertainty reduction reaches a point of diminishing returns. In other words, additional met towers yield slight gains, but not enough to justify their upfront capital costs.

This same risk model can also be used to evaluate the advantages of various remote sensing technologies at a site, or met towers of different heights. An advanced understanding of how these choices impact future uncertainty can help justify current investments and optimize where capital is best spent.

Forecasting investments

Merely relying on traditional rules-of-thumb or past experiences can also prove risky when it comes to project investments. This is particularly true when investors are forced to balance future uncertainties against ever-tightening budget constraints. In wind power, this often involves decisions with big repercussions, such as the signing of a power-purchase agreement or a turbine-supply agreement.

With a sensitive modeling tool, it's possible to track a desired risk level before a required final investment commitment. For example, if faced with a project that has forecasted a high level of uncertainty at its expected commitment date, a developer can choose from three options:

1. Invest appropriately to meet the risk profile and commitment date,
2. Invest less than recommended, pushing the commitment date further out, or
3. Lower investment standards while keeping the commitment date firm.

With an investment-risk profile and the right modeling software in place, analysis and evaluation of each scenario can lead to the most productive choice.

Uncertainty is a given in any industry. However, wind production uncertainty poses unique challenges to the market that must be properly assessed and managed for ongoing success. A modern energy risk framework goes beyond current approaches by incorporating uncertainty measures throughout its analysis to make better projections. When implemented properly, modern risk-modeling tools let stakeholders develop better strategies for portfolio management, reducing the chances of unpleasant surprises at the investment table.