Risk Quantification and Risk Management in Renewable Energy Projects

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Authors:

Altran Italy
- Jean Michelez
- Nicola Rossi

Altran Spain
- Rosario Blazquez
- Juan Manuel Martin
- Emilio Mera

Altran Netherlands
- Dana Christensen
- Christian Peineke

Altran Germany
- Konstantin Graf

Arthur D. Little
- David Lyon
- Geoff Stevens

Contact:

Under the following **link** you can download an abstract of the study free of charge. If you are interested in the complete report, please contact us by email **(marcom@altran.com).**

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David de Jager IEA-RETD Operating Agent, Louis Fananas Deutsche Bank, Eduardo Foz BP Solar,Carlos Montoya IDEA, David Jack Lux Energia Solar, Rafael Luna Naturener Solar, Jorge Castano Sunpower, Juan Carlos Sirviente Naturener Solar, Antonio de la Torre Abengoa Solar, Florian Klein Abengoa Solar, Van Gansewinkel Henk Eneco, Bos Tiemen Jan Eneco, Horst Max EWT, Buddenbaum Ed EZ (regulator), Jongkind Anne Nuon/Weom, Jongste Niels Green Giraffe, Stefan Hochbruck Bard Offshore

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Name: see above	Name: Jean Michelez, David Lyon, Emilio Mera	Name: David de Jager	Name: IEA-RETD

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Executive summary: Risk Quantification and Risk Management in Renewable Energy Projects

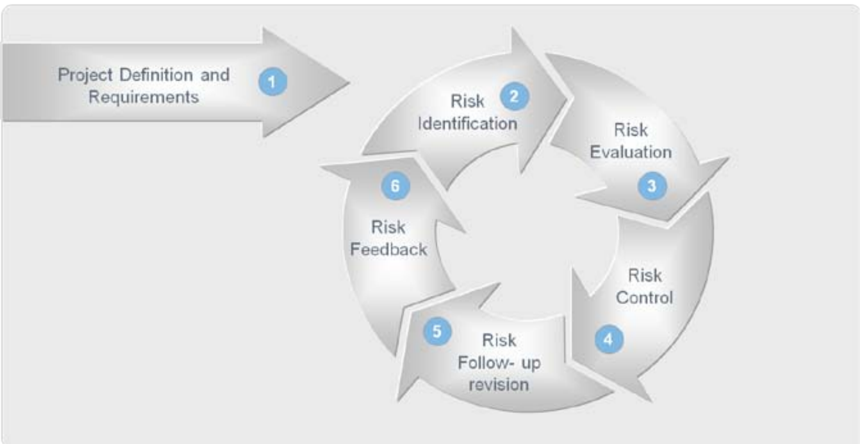
Renewable energy plays an important role in the transition towards a low carbon economy and the provision of a secure supply of energy. Many years of research and development have brought a number of renewable energy technologies to a stage where they are technologically mature and ready for a more widespread market introduction. However, perceptions of the associated risks have constrained the progress of renewable energy; as a consequence there is still a gap between Renewable Energy Systems (RES)[1] promoters and financing organizations:

- **Venture capital and project finance gap**. The further development of renewable energy projects is restricted by the challenge of bridging the technology development and scale-up gap. This reflects the very different requirements of Venture Capital (VC) investing in emerging technology, and project finance supporting established technologies (often supported by a stable regulatory regime).
- **Availability of venture capital to sustain emerging technologies**. Emerging technologies (e.g. wave and tidal) need to raise working capital for both sustaining the operations of technology companies as well as the demonstration projects. Markets now recognize the high capital, high risk, long lead time involved with these technologies; unless venture capital firms are following their own previous investments, they are now pulling away altogether.

A key challenge in obtaining financing at a reasonable cost is the ability to quantify and manage the different elements of risk (i.e. organizational, political, technical, commercial) associated with RES projects. This project commissioned by the International Energy Agency and conducted by Altran and Arthur D. Little provides reproducible and transparent techniques to assess the risk/return profiles of RES investments. In doing so, the project provides RES-specific guidelines in classification, assessment and management of different risk elements associated to support project valuation.

Conventional energy projects have been developing and refining methodologies for risk assessment for many years. The project considers the lessons learnt in detail in order to understand what is transferable to RES projects. Using specific RES project case studies and involving conventional energy, RES and risk management experts, the project has resulted in a methodology applicable for RES projects. The methodology is broken down into a number of key (and established) elements:

Figure 1 Generic Project Risk Management Process



[1] In this document renewable energy sources and technologies will be referred to as RES.

Risk management methodologies can (and should) be the same between RES and conventional energy projects. In particular, any RES project risk management approach should structure and apply a conscious approach to risk identification, risk appraisal, risk handling and risk review.

The key is to be able to tailor the complexity of the risk analysis and associated management processes to the size and nature of the projects. An important requirement is to avoid “oversizing” risk assessment and to avoid introducing low value complexity.

1. Project definition and requirements: The first step requires a detailed description of the context in which the analysis is carried out. Project descriptions of RES projects are likely to differ from conventional projects in a number of key areas:

- Technologies such as wind, PV are much more **“modular”** than other types of projects. Where grid connection and other enabling construction costs are lower (e.g. PV), the investment critical mass is lower and capability for plant growth is higher.
- RES projects can include **less mature technologies** where technical standards have not been developed. These projects follow a very different logic to purely commercial projects (e.g. for a demonstrator project the performance is more important than build time, hence delay might be acceptable).
- Compared to other infrastructure projects, RES technologies (with the exception of biomass and biofuels) have relatively **low O&M costs** compared to up-front investment.
- There are **complex permitting processes** which need to be described. This includes administrations at different levels and for different matters (e.g. planning, environmental permits, subsidy permits, and grid connections).
- Specific issues associated with **dispatchability** have to be documented carefully. This applies to technologies such as wave, wind or PV, but not to tidal or biomass/biofuels. Given the incapacity to store and/or forecast energy generated with the same accuracy as other conventional generation technologies, renewable energies are often much more sensitive to the supply-demand balance in the grid.
- All RES projects are based on a **distributed generation model**. Therefore the project description should describe the operational model of utilities (which can be much more complex than with conventional generation).
- Given the limited **sources for finance** of smaller RES projects (compared to conventional energy projects) and the limited commercial background of sponsors, these need to be documented carefully. Project finance and its associated fee structure requires projects sufficiently large to support the fees with sufficient cash flow to justify modest interest rates. Venture capital could absorb the higher risk but requires higher returns which are not compatible with taxpayer subsidised schemes.

2. Risk identification involves ensuring all key topics are considered, and lessons learnt from past projects are incorporated. In practice this process is improved by the use of a Risk Breakdown Structure (using a structured approach to list risks that could be encountered), the use of a facilitated workshop and the drawing from “risk libraries” based on past experiences.

There are a number of issues that are often particularly critical for RES projects which often inform the identification of risks such as:

- **Technology maturity:** Many RES technologies are immature and may not deliver the design output and / or the design service factor. Therefore in many cases risk identification covers management of risk in the R&D phase as well as project realization. At the same time, the evolution of RES product lines and technologies is much quicker compared to traditional energy projects. It is therefore much more vital to appraise new product options.

- **Integration of the RES project into the existing conventional energy grid:** Renewable energy sources tend to be distributed with variable power output, whereas grids need to supply any (to include low demand and high wind conditions...) demand with high reliability irrespective of the weather or light conditions.
- **Dependency on weather:** RES Technologies such as PV, wind, and wave technologies are dependent on weather patterns which creates uncertainty in projected revenues.
- **Long term taxpayer support for the financial position of the RES project:** Compared to conventional energy projects, RES projects rely on long-term subsidy scheme frameworks put in place by governments. As a result they need to consider risks associated with public policy and its implementation.
- **Large land take typically required:** Risk assessment needs an adequate treatment of the social objections to RES projects. These can include the land-used for PV or onshore wind projects or the land required to grow feedstocks. The land required can often be in rural or remote locations, where industrial activity has not occurred in the past.
- **Permitting:** RES projects often involve a multiplicity of interfaces in permitting which can become critical risks in project delivery.
- **Market factors in the procurement of main items of equipment:** Many technologies are subject to pinch points in supply-demand. The sector as a whole is growing very rapidly; at the same time there are “tactical” demand restrictions at the time of policy review periods. This results in cyclical oversupply followed by supply shortage periods affecting product availability and price. For some technologies the supply chains are still in early stage of development with renewable energies competing against established industries.

3. Risk evaluation draws from an understanding of outcomes from previous related projects and the future context in which the project in question will be carried forward. This context includes market aspects, the political and social context and financial factors affecting potential investors' views.

Given the modularity of RES technologies, they often involve smaller projects compared to standard infrastructure projects. In these cases, the balance of analysis vs. judgement has to be adjusted slightly towards judgement with more emphasis on workshop approaches. These workshops appraise the probability of occurrence, potential impact on the project and manageability of each of the risks.

In the simplest RES projects, risk assessment can be conducted through a management team discussion on each topic. As projects become more complex, the structuring of facilitated workshops using independent experts with additional sophistication in analysis tools is important. Different experts/stakeholders will differ in their assessment of risks. These uncertainties can be combined in Monte Carlo-based simulations resulting in the production of a probability function of budget, timeline and profitability of the project.

It is important that the technique chosen for comparative assessment of the impact of the various risks must be clearly explained and understood by those undertaking the assessment.

4. Risk Control and follow-up: The risk analysis is then followed by a formal corporate control procedure which places a requirement for the analysis on the project promoter and allocates responsibility for action. In practice this can be conducted through the sequential project stages (e.g. Appraise- Select- Define-Execute-Operate) with an incremental amount of investment/risk in each subsequent phase. The management strategy for each risk normally includes: a risk management plan (e.g. specific objectives, resources, timeline, accountability and reporting indicators and frequency), and allocation of contingency budget to the project execution through the measurement P50-P80 values in probability functions.

5. Risk Feedback At the end of a given project, the project risk plan is compared against the actual project journey and results. From this review, lessons learned are extracted and incorporated into the risk library to enrich future risk management exercises.

The report discusses innovative support measures to address key sources of risk for RES projects:

- For political risks (often characterised by discrete events and therefore hard to control), country credit default swaps, risk sharing schemes, and insurance are important
- Economic risks can be managed through mechanisms such as JVs and other arrangements, including insurance, guarantees, derivatives, and risk transfer approaches.
- Social risks can be captured as part of health safety, social and environmental impact assessments and stakeholder engagement plans. Specific mitigation measures are then developed by subject matter experts into a Health, Safety, Social and Environment (HSSE) management plan.
  For technical risks these can be managed through guarantees, warranties, insurance, as well as agreements or other organisational arrangements between key parties. Therefore, there is significant overlap with measures to address economic risks.

The report finally makes a number of recommendations which are organised by the stakeholder group:

- The public sector should encourage the further development of the methodologies to support its important role in promoting / developing key support measures.
- Developers can benefit from this systematic approach to risk management; they can also benefit from linking this approach to measures to manage project risk.
- Investors can promote this methodology to developers and participate in risk assessment workshops for significant investments. They can also use this methodology to promote and develop support measures.

The project also identifies a number of general opportunities to develop and refine the methodology further, to engage key players on the methodology and to capture information on key risks associated with renewable energy (ensuring critical lessons are learnt).

While many of the techniques and approaches will not be new to banks and others, there is a real need for key players to speak the same language. Once this has been achieved, it is possible to have a meaningful debate on what risks to accept, avoid or transfer. Finally, the approach will allow key players to have a realistic understanding of risks involved in renewable energy technologies and develop appropriate support measures (or avoid counterproductive measures).

At the same time the development of a structured and rigorous approach to risk assessment and management will allow parties, such as smaller project promoters to engage effectively with potential investors; the use of the Risk Breakdown Structure (RBS) will ensure that critical risks are less likely to be overlooked; the use of probabilistic modelling allows a discussion of uncertainty - without creating a "black box" where the workings of the underlying model are not visible.

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