Best practices for wind project development

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in collaboration with:

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Abstract

Ethiopia launched an ambitious program for developing renewable energy capacity, namely the Growth and Transformation Plan II (GTPII). The GTPII's overall goal is to add roughly 6 GW of new capacity by 2020 (excluding the Grand Renaissance Dam, which is already being finalized) exploiting the Country's renewable energy resources potential in hydro, solar, geothermal and wind at most. Whilst hydropower constitutes the backbone of the national generation mix, wind energy has entered the Ethiopian energy system only recently. Going through the typical development stages of a wind project, and looking at the different approaches used by governments concerning energy auctions, this paper will examine key concepts of project bankability and the current Ethiopian strategy. The study will also provide tangible case studies and best practices in Governments approach to tenders. Finally, the development of a 320 MW wind farm project, implemented by Italgen in Egypt, will provide an exhaustive analysis of wind farm permitting process and the steps developers need to take to deliver a project.

Wind project - site development

This paragraph will describe two key elements for a wind site development: Micrositing activities and the role of the Environmental Impact Assessment (EIA).

Micrositing

The definition of the wind turbines positioning, which constitutes a wind farm within a project area is usually referred as "Micrositing" or layout design. A proper Micrositing is essential in order to maximize the resource exploitation both in terms of energy yield and project economic efficiency.

In a Greenfield project development, the Windfarm layout definition typically follows two macro phases which may be referred here as *Site Screening & Selection* and *Detailed Resource Assessment, Project Design and Optimization*. The first involves the project site selection and preliminary analysis at large scale, the last includes all the exhaustive *on site* studies and design.

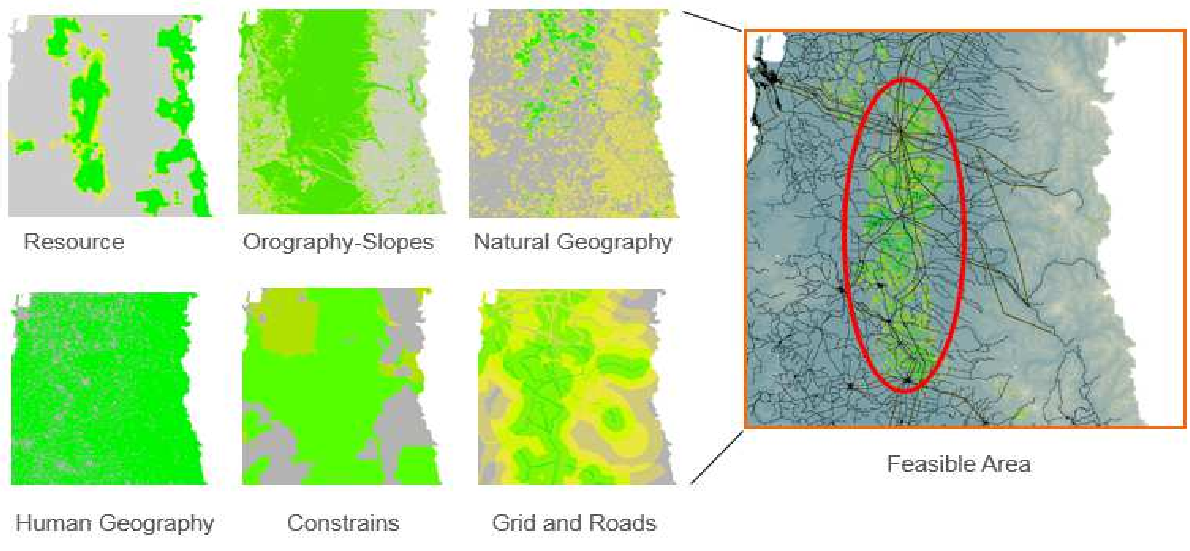
The *Site Screening and Selection* phase is carried out through a multi criteria analysis where information, gathered from different sources, is processed to identify sites or areas, which fulfil a group of predefined project development feasibility criteria. In such way promising areas can be identified and further development effort can be focused.

This analysis normally includes the following items:

1. Large area wind resource mapping;
2. Terrain complexity and land cover evaluation;
3. Assessment of constrains due to human life and activities;
4. Assessment of constrains due to land use restrictions;
5. Grid connection and road infrastructure presence.

Figure 1 shows an example of *Site Screening and Selection* phase made through a Geographic Information System (GIS).

Fig. 1 – Site Screening and Selection phase - *Feasibility Criteria Fulfilment is shown for each topic in a Green-Yellow and Grey colours scale.*



The *Detailed Resource Assessment, Project Design and Optimization phase* focuses in *on site* studies. Among these studies the most important in wind project development is, without doubt, the *on site measurement campaign*. Up to the presence, on site measurements constitute the only way to assess the wind resource with the accuracy needed to properly design and estimate the future possible yield and performance of a wind farm in a pre-construction phase. An effective on site measurement campaign is typically made through the installation and management of Meteorological Masts. Their position, number, configuration and height are chosen in order to be representative of the site spatial resource variation and the expected turbine size. At least 12 months of measures are needed to characterize the resource, a shorter time is not enough, but more time could be needed to completely investigate the site's resource spatial and time variability.

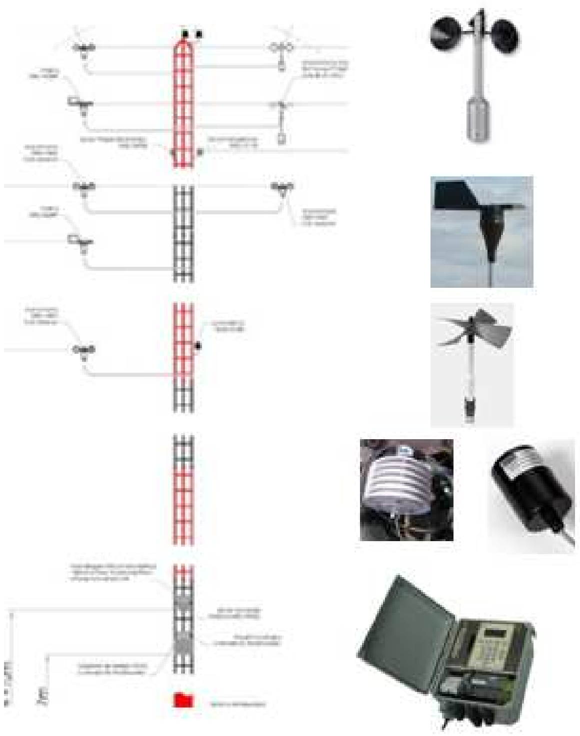


Fig. 2 - Typical Met Mast Sketch and instrumentation types

Once the *on site measurement campaign* is made, a Wind Resource Assessment study (WRA) is performed to obtain a detailed resource spatial distribution of the interested site and the energy yield and a mutual interaction estimation of the wind turbines in the layout under study. The WRA study can be divided in the following activities:

1. Data treatment;
2. Long term climatology definition;
3. Flow modelling;
4. Wake calculation;
5. Loss estimation;
6. Uncertainty estimation.

In the *Detailed Resource Assessment, Project Design and Optimization* phase, the Micrositing or layout design criteria considers the following elements:

- **Project Constraints**
  - Available Land;
  - Maximum power;
  - Permitting / Law requirements;
  - WTG size;
  - Distances from roads, lines, houses;
  - Noise and shadow limits;
  - Restricted areas;
  - Other environmental constrains.
- **Turbine suitability & Energy yield**
  - Construction suitability;
  - Flow and ambient conditions suitability;
  - Wake interactions.
- **Internal procedures**
  - Best practices;
  - Performance;
  - Safety;
  - Cost.

The above elements are generally combined in an optimization process as the one presented in **Figure 3**.

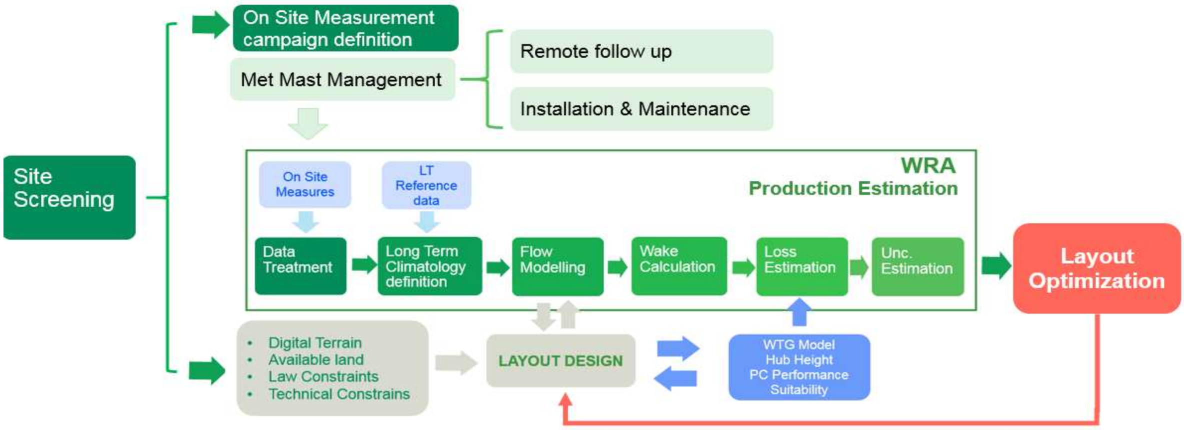


Fig. 3 - WRA study and layout definition & optimization process

The importance of the EIA process within the Permitting procedures

The EIA is typically the first step developers take in demonstrating that they have identified and will be managing environmental and social (E&S) risks.

The EIA process in Ethiopia is determined by the *EIA Proclamation (299/2002)* which is the tool for harmonizing and integrating environmental, economic, cultural and social considerations into the decision-making process in a manner that promotes sustainable development. The Proclamation clearly defines:

1. Why there is a need to prepare an EIA;
2. What procedure is associated with undertaking an EIA;
3. The depth of environmental impact studies required in an EIA;
4. Which projects require the undertaking of a full EIA study;
5. Which projects need partial or no EIA study;
6. To whom the report has to be submitted.

The Ethiopian EIA process is shown in **Figure 4.**

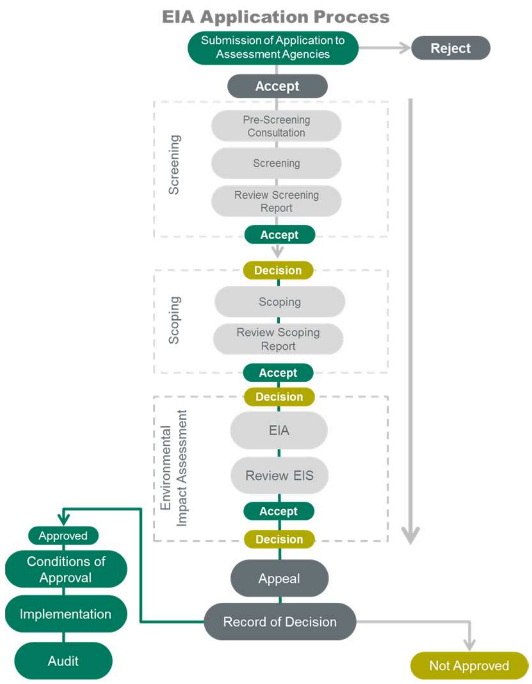


Fig. 4 - Ethiopian EIA Process

Environmental and Social Risks Associated with Greenfield Wind Development

Potential E&S impacts when fostering Greenfield wind developments in Ethiopia are included in **Figure 5** and key risks explained further below.

Fig. 5 - Potential E&S Impacts

1. *Site selection* – a poorly selected site can result in E&S risks causing unnecessary permitting delays, costs and community conflicts.
2. *Stakeholder engagement and resettlement* – one of the main considerations for wind power projects in Ethiopia is access to suitable land for development and consequently, the potential impacts on livelihoods of people using that land through economic and physical displacement.
3. *Risk of impact on bird and bat populations* – bird and bat mortalities due to collisions with wind turbine blades are typically one of the key potential impacts on the environment. Impacts from wind power projects on bird and bat populations can lead to significant development delays, increased costs and challenges in securing permit approval and financing. Impacts from wind farms on bird and bat populations are well documented and include habitat loss, displacement and collision with turbines, all of which can adversely affect species populations.
4. *Noise and Visual impacts* – the presence of the wind turbines can create a visual impact on the landscape. Operating wind turbines also generate noise emissions, which can be disturbing to nearby sensitive receivers.

Best Practice

There are a number of actions that developers should undertake from an E&S perspective to make permitting in Ethiopia as streamlined and efficient as possible; where acting early is key to success:

1. *Perform early screening of potential high risk E&S issues* – this can either be in the form of an early stage due diligence/fatal flaw analysis or red flags assessment. By integrating consideration of potential E&S impacts into early site selection and design decisions, impacts can be minimised or avoided where feasible.
2. *Engage with your lender group early on E&S issues and their requirements* – they usually have good experience on similar projects and are able to share this with the developer.
3. *Robust baseline data collection* – particularly for birds and bats, collection of reliable, robust and representative baseline data is vital to understanding the potential impact of the wind development. Coupled with collision risk assessments and designing mitigation and monitoring measures, bird and bat populations need not be a show-stopper.
4. *Early engagement with government stakeholders* – by discussing the project early with the decision-makers such as the Ministry of Water, Irrigation and Electricity (MoWIE), and Ministry of Environment, Forestry and Climate Change (MEFCC) to agree upon approaches, you can avoid unwanted surprises and reassure government departments that the E&S risks are being robustly managed.

5. *Understanding the importance of social issues* – working to build trust with local communities at the outset, understanding potential impacts on livelihoods, determining if a project will have the potential to affect indigenous people and appointing a community liaison officer, will all help to manage local project risks effectively.
6. *Identify opportunities that can create additional value to affected communities* - by considering E&S issues early in the project life cycle, a risk-based approach can be taken to prioritise the management of key E&S impacts and provide a clear framework of tasks to address potential impacts in stages. The costs associated with addressing these impacts can also be internalised at this early stage, representing the real costs of the project.

Governments approach to project tenders

Renewable energy auctions have proved to be successful mechanisms to support renewable energies development. Several countries around the globe have adopted auction mechanisms aiming to attract a large number of players, to increase competition and ensuring new generation capacity at lower prices.

When designing auctions, policy makers can therefore learn from a vast pool of experiences from other countries and tailor the mechanism to the Country's economic condition, structure of the energy sector, maturity of the power market and to the specific goals they would like to achieve (i.e. reducing entry barrier for new players or maximizing the likelihood of efficient and timely project delivery).

From this point of view, a key element in the hands of the policy makers is the **selection of the project sites**. Two possible approaches exist:

- Sites may be selected by off-takers or Governments. This implies that the off-taker/Government takes the responsibility to perform early development activities, including wind measurement campaigns, geotechnical, hydrological and topographical investigations, obtainment of land rights, initial permits and definition of interconnection solutions. Such approach reduces developer costs and liabilities, lowers the risk of plant construction delays and allows to centrally coordinating sites selection according to grid proximity and demand centres development.
- The alternative approach is that developers select their own project sites bearing all costs for the site scouting and development. Therefore, the developers not only compete on industrial and financial basis, but they are also encouraged to compete in the selection of the best sites in a more efficient way than a centralized off-taker/Government may do.

  An additional benefit of this approach is the creation of a value chain also in the development phase.

The selection of one approach or the other significantly changes the allocation of risks between the off-taker/Government and the developer and by consequence it impacts the level of participation of bidders and, ultimately, the contracted price. The first approach (site selection by the off-taker/government) largely reduces the risks faced by the developers and it may be preferable for Countries at an early stage of renewable energy deployment programs that aim to be more attractive for potential players. On the opposite, the second approach seems preferable for Countries with a stable regulatory framework and mature renewable energy programs.

Governments could also look at hybrid solutions, like the Brazilian approach for hydro projects, where participants bid on the same site, previously submitted by one private developer (the proponent is allowed to participate in the tender and is refunded the development costs, if not winning). The following **Tables 1, 2 and 3** show respectively: Moroccan, South African and Egyptian governmental approach towards tendering procedures.

Case #1	Morocco – 850 MW wind tender
RFP issue date	February 2014
Awarding date	October 2014
Tender Authority	Kingdom of Morocco
Off-taker	ONEE
Awarded capacity	850 MW
Tender mechanism	Sealed bid competitive tender to award multiple projects based on a specific technology and capacity size to a single bidder.
Site selection	Specific sites are evaluated and selected by the tender authority through ONEE (the Transmission System Operator). Tender documentation includes geotechnical, topographic, seismic and wind studies and preliminary EIA.
Grid	Grid access and tariffs are guaranteed by ONEE
Asset ownership	Developer for the 25-year contract period, then reverts to the Kingdom of Morocco.
Evaluation criteria	1) Prequalification — pass/fail outcome mainly based on project experience, financial background and material disputes. Exclusive agreement with WTG manufacturer as mandatory requirement. 2) Projects evaluated on: (i) Compliance with technical specification and other tender requirements; (ii)Local content; (iii)Price.

Table 1 – Morocco 850 MW wind tender case study

Case #2	South Africa – REIPP Round 3
RFP issue date	May 2013

Awarding date	October 2013
Tender Authority	Ministry of Energy - Department of Energy - IPP Office
Off-taker	Eskom Holding Ltd
Awarded capacity	1457 MW
Tender mechanism	Sealed bid reverse auction to allocate a fixed total capacity to multiple bidders across multiple projects of varying scales. Typically multiple technologies, although each represents a separate auction with capacity caps set per technology (carrying over to next round if not reached).
Site selection	Site selection, access and full permitting are the responsibility of the bidder.
Grid	Grid connection (access and cost) is negotiated by bidders with Eskom and is at developer risk.
Asset ownership	Private sector project developer.
Evaluation criteria	1) Prequalification / Bid Response Compliancy — pass/fail outcome based on various legal, financial, technical and environment requirements. 2) Projects evaluated on: (i) Price (70%); (ii) Local economic development (30%) – Minimum local content requirement of 40% with a portion of black ownership.

Table 2 – South Africa REPP Round 3 case study

Case #3	Egypt – Gulf of Suez
RFP issue date	April 2013
Awarding date	May 2015
Tender Authority	Egyptian Ministry of Electricity and Energy (EMEE)
Off-taker	Egyptian Electricity Transmission Company (EETC)
Awarded capacity	250 MW
Tender mechanism	Sealed bid competitive tender to award one project based on a specific technology with a minimum capacity of 250 MW to a single bidder

Site selection	Specific site evaluated and selected by the tender authority. Land lease signed with New & Renewable Energy Authority (NREA). Tender documentation includes geotechnical, topographic, seismic and wind studies and preliminary EIA.
Grid	Grid access and tariff are guaranteed by Egyptian Electricity Transmission Company (EETC).
Asset ownership	Awarded bidder for 20 years from Plant COD. On expiry of the term, the facility to be decommissioned and dismantled.
Evaluation criteria	1) Prequalification process based on financial and technical capabilities 2) Tender process: the lowest Levelised Electricity Cost identifies the winner

Table 3 – Egypt Gulf of Suez tender case study

An overview of RE market in Egypt

Egypt is one of the hotspots for renewable energy development in the MENA (Middle East North Africa) Region.

The country is facing a rapidly growing energy demand due to population growth, economic expansion and increased industrial output. It additionally suffers from power shortcuts due to ageing infrastructure, lack of adequate generation and transmission capacity, which may lead to a serious energy crisis. A continuous and reliable supply of electricity is required for Egypt's socio-economic development. With a demand growth expected to remain at around 7% per year over the next decades, an exceeding generation capacity of 1,500 MW per year is required and, to this purpose, the development of renewable energy resources has become a priority. Egypt has committed to increase its share of renewables in the country's power mix to 20% by 2022 (Wind 12%, Hydropower 5.8% and Solar 2.2%) and 37% by 2035.

The country currently sources just 3% of its electricity generation from renewables. To achieve its ambitious targets, the Government plans to invest in the renewable energy sector and to develop wind and solar energy plants across the country.

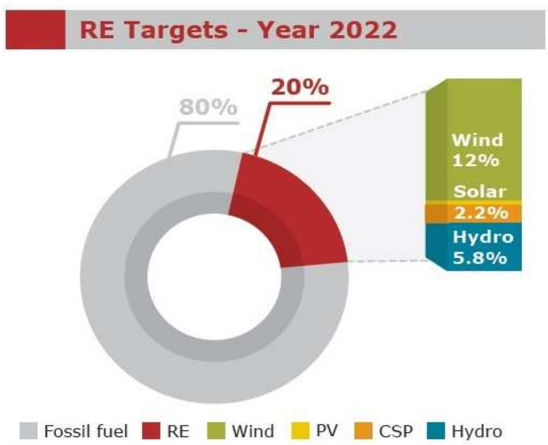


Fig. 6 – Egypts RE target RCREEE

Case Study – Italgen's wind farm in Egypt

Italgen's 320 MW wind farm project is part of the National Energy Strategy targeting to reach 20% of energy coming from renewables by 2022. Located in one of the windiest regions of the world, about 100 kilometers north of Hurghada, the plant, with a capacity factor of 55%, can reach almost 5,000 hours per year running at full load.

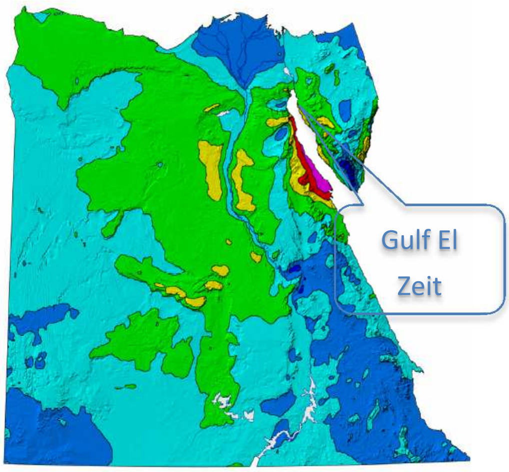


Fig. 7 – Egypt's Wind Atlas

Gulf El Zeit wind farm project is the first and most relevant foreign direct investment in the country under BOO (Build-Own-Operate) scheme to get the Generation License and to be fully permitted by the Egyptian Government.

The Memorandum of Understanding established the first formal step and institutional agreement between Italgen and the Government of Egypt, represented by the Ministry of Electricity and, specifically, by NREA, the New and Renewable Energy Authority acting as the national focal point to develop and introduce renewable energy technologies in the country.

This fundamental, preliminary step has been followed by many concrete actions to attain the completion of the authorization process, among which:

- Land Allocation (through the definition of a Usufruct Agreement with NREA)
- Exhaustive Wind Measurement campaigns
- Generation License (issued by Egypt ERA, the Egyptian Electric Utility and Consumer Protection Agency, entitled to determine rules and conditions related to electricity business activities in Egypt as well as sale and distribution and to grant the relevant licenses.
- Grid Connection Agreement and Network Access Contract (signed with the local TSO: EETC - Egyptian Electricity Transmission Company)
- Detailed Environmental and Social Impact Assessments, focused on the possible implications on the environment, biodiversity and birds' migration. The studies obtained the approval of the Ministry of the Environment.

The permitting process has been the result of a continuous dialogues with Ministries, local Authorities and Communities involved.

Once in operation, the plant will produce 1,500 GWh avoiding the emission of about 750,000 tons of CO_2 and will allow the saving of 2,000,000 oil barrels per year, resulting among the largest power plants from renewable sources in the MENA region (Middle East North Africa).

Lessons learned

The Renewable Energy sector is a key driver for a sustainable economic growth in developing countries. To encourage investments by the private sector (either local or international) Governments should ensure a well defined and reliable policy framework both in regulatory and economic terms, ensuring investors with an economic viability and profitability. Well targeted government investment incentive and support mechanism are additionally welcomed to promote private investments.

Reference to incentive mechanisms, it is essential to optimize their use to avoid pure results or, in the worst case, relevant extra costs which, at the end, would have negative impacts on the "project bankability".

Profit@Risk analysis supporting projects bankability

A bankable project is a project whose underlying contracts allocate risks in such a way that is satisfactory to the financing institutions. Generally, financing institutions pose their attention on the presence of specific provisions within the contracts dealing with mitigation of technological, construction, operational, financial and regulatory risks. Macroeconomic and political/policy conditions of destination Countries, significantly affect project success, as well. Therefore, within the investment decision making process the typical Discounted Cash Flow analysis, evaluating investments profitability, shall be enriched by a risk analysis, screening the impact of all the listed factors on the proposed investment.

An effective risk assessment approach can be based on three main analytical dimensions, each of them involving specific sub-dimensions, as follows (sub-dimensions can change depending on specific cases):

- Country Attractiveness (Regulatory environment, Market size, expected growth, Market entry barriers, Competition (number and size of competitors), Technological issues, etc.)
- Profitability (Expected revenues and costs -> Profits, Time-to-market, etc.)
- Risks (Operational risks, Financial risks, Regulatory changes as main categories).

In this approach, market attractiveness and expected profitability help to identify basic feasibility conditions, to be challenged by including risks components in every sub-dimension previously considered.

Such a model can be built reaching different level of complexity, depending on the investment decision maker requirements, which shall incorporate financiers' ones. Consequently, a risk assessment process can be delivered identifying:

- specific sub-dimensions for each risk dimension;
- quantitative indicators (e.g. from 1 to 4, from High to Low) to describe risk levels for each sub-dimension.

A first separate assessment of Attractiveness, Profitability and Risk conditions can be made, using (weighted) averages of the quantitative indicators previously chosen. Then:

- a first Attractiveness-Profitability matrix can be derived;
- both Attractiveness and Profitability conditions can be assessed against Risk considerations;
- a final matrix resuming the overall process can be drafted, providing the required assessment.

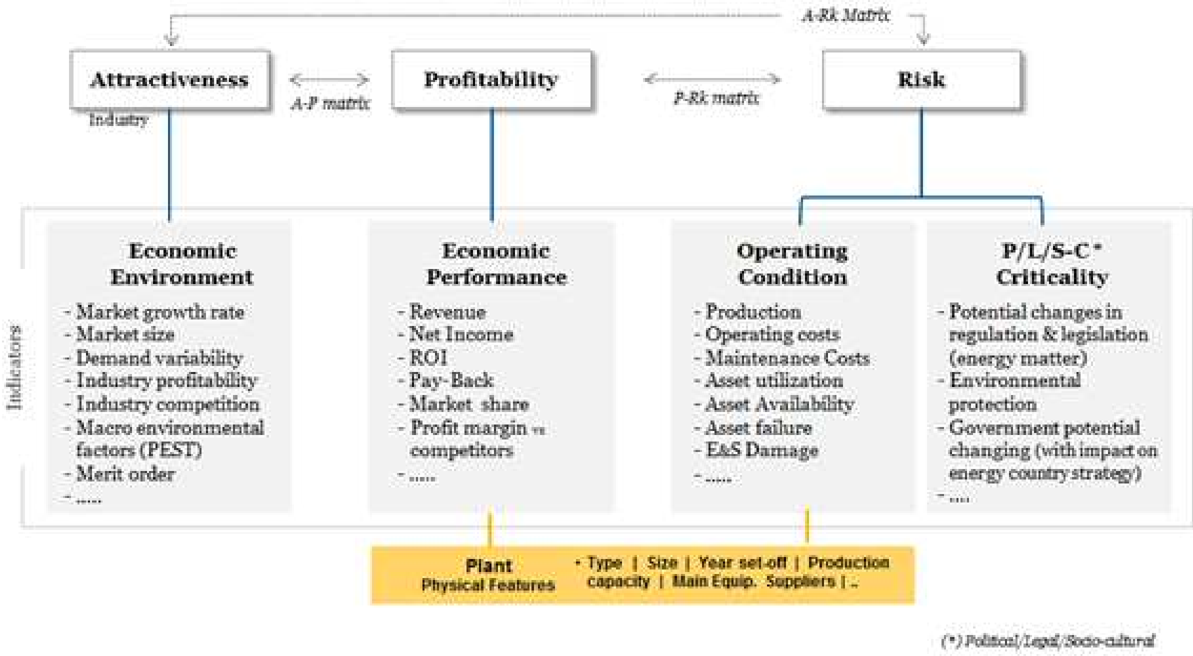


Fig. 8 – Risk assessment matrix (illustrative)

Such a process is expected to be iterative, as many conditions shall be evaluated, until a final fine tuning of the model.

The final objective is to estimate a "strength index" which summarises the investments profitability including risk conditions and, when positively assessed, its bankability.

A Profit@Risk analysis-like view can be applied when making renewable energy policies by Governments. In fact, in order to attract investors, destination Countries' authorities shall aim at creating the most favourable environment which is the one where all the mentioned risks are mitigated by adequate measures. As far as Governments/National authorities are concerned, the following conditions shall be provided, among others, to favour projects bankability:

- Transparency and clarity of procedures;
- Reliability on administrative processes timing and results;
- Clarity of revenue-making conditions (grid access and off take agreements, stable sale prices, compensation of curtailments, etc.);
- Sovereign guarantees on energy payments;
- Comfort on foreign exchange rate fluctuations and currency convertibility.
- Liquidated damages for both delay and performance;
- Reputable and neutral arbitration courts.

As reported in the first part of this paper, technical risks can be managed carrying out proper resource assessment campaigns while the choice of tested assets will ensure minimisation of O&M costs and production failure. Risk management in both cases is under the project promoter responsibility as well as the adoption of wind plant construction solutions reducing time-to-market.

Ethiopia's strategy to speed up wind penetration

Ethiopia is endowed with abundant wind energy resources, which at the moment remain largely unexploited. Over the last 5 years, however, Ethiopia started moving in the right direction: it inaugurated one of the continent's largest wind farms in 2013, 120-megawatt (MW) Ashedoga plant, which was followed by the even larger 153 MW Adama II facility in 2015.

As mentioned above, wind still accounts for roughly 300 MW of Ethiopia's total output of around 4,300 MW, with the vast majority coming from hydropower. This picture is set to change with the government's second "Growth and Transformation Plan", where the Government of Ethiopia (GoE) has planned for an expansion of its wind power capacity up to 5,200 MW by 2020. The Government of Ethiopia has determined that private sector investment is critical to achieve these aggressive power generation targets. Originally involved in the construction phase only, the private sector will be invited to participate in competitive tenders for Independent Power Producers (IPP) in the near future.

The sites will most likely be pre-selected by the government, who will provide the wind resource measurements as well. This will be possible thanks to the measurement program that the Danish Energy Agency, together with the World Bank, is about to launch. The program entails the installation of 5 to 10 masts, the first ones being installed within 2017. This data acquisition campaign will be used by the Government to select the most suitable sites for the auctions, which will be published no earlier than the end of 2018.

Additionally, potential opportunities might also rise from projects that were originally tendered for Engineering, Procurement and Construction (EPC) with Financing Package and that EEP is currently considering switching to IPP modality.

In general, Ethiopia is following a top-down approach, where the private sector will be involved only once the site development is finalized. If, on the one hand, this approach mitigates part of the risk related to the permitting and licensing, it excludes the private companies from the development phase, where they usually can add significant value (especially in wind). While this approach is understandable at this early stage of wind development in the country (and related regulatory system), a smooth transition to a more bottom-up approach, taking also into consideration the hybrid scheme used in Brazil for hydro projects, could be beneficial.