Accelerating Wind Power Generation in Ethiopia

Danish Energy Agency

Wind Project Development Roadmap

Procedures, lessons learned and risk assessment

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List of Acronyms and Abbreviations

AEP	Annual Energy Production
AfDB	African Development Bank
AWPGE	Accelerating Wind Power Generation in Ethiopia
BIRR	Ethiopian Unit of Currency
BNDES	Brazilian National Bank of Development
BOO	Build-Own-Operate
BOP	Balance of Plant
bps	Basis Points (1bps = 0.01%)
BW	Bid Window
ca.	Circa
CCGT	Combined-Cycle Gas Turbine
CEF	Cost Estimate Fee
CEL	Application Letter of Grid Access
CFD	Computational Fluid Dynamics
DAFF	South African Department of Agriculture, Forestry and Fisheries
DEA	Danish Energy Agency
DFI	Development Financial Institution
DOE	South African Department of Energy
DBSA	Development Bank of Southern Africa
DSO	Distribution System Operator
DWA	Department of Water Affairs in South Africa
DWS	Department of Water and Sanitation in South Africa
EAPP	Eastern Africa Power Pool
ECA	Export Credit Agency
ED	Economic Development
EEA	Ethiopian Energy Authority
EEP	Ethiopian Electric Power
EEPC	Ethiopian Power System Master Plan Study
EEPCo	Ethiopian Electric Power Company
EEU	Ethiopian Electric Utility
EGP	Egyptian Pound
EHS	Environment, Health and Safety

EIA	Environmental Impact Assessment
EPC	Engineering Procurement & Construction
EPE	Environmental Policy of Ethiopia
ERA	Ethiopian Roads Authority
ESIA	Environmental & Social Impact Assessment
FEPA	Federal Environmental Protection Authority in Ethiopia
FX	Foreign Exchange
GDP	Gross Domestic Product
GoE	Government of Ethiopia
GTFP	Global Trade Finance Program
GTP2/GTPII	Growth & Transformation Plan 2
HFO	Heavy Fuel Oil
IBRD	International Bank for Reconstruction and Development
ICT	Information and Communication Technology
IDA	International Development Association
IEC	International Electrotechnical Commission
IFC	International Financial Cooperation
IMF	International Monetary Fund
IPP	Independent Power Producer
IRR	Internal Rate of Return
LIC	Low Income Country
LCR	Local Content Requirement
L/C	Letter of Credit
M	One Million
MASEN	Moroccan Agency for Solar Energy
MDB	Multilateral Development Bank
MIGA	Multilateral Investment Guarantee Agency
MoFEC	Ministry of Finance and Economic Cooperation in Ethiopia
MoEFCC	Ministry of Environment, Forest and Climate Change in Ethiopia
MOI	Ministry of Industry in Ethiopia
MOT	Ministry of Trade in Ethiopia
MoWIE	Ministry of Water, Irrigation & Energy in Ethiopia

MSD	Medium-Speed Diesel
NBE	National Bank of Ethiopia
NEA	National Energy Administration
NERSA	National Energy Regulator of South Africa
NIMBY	Not-In-My-Back-Yard
NMA	National Meteorology Agency in Ethiopia
NPV	Net Present Value
NT	National Treasury
OCGT	Open-Cycle Gas Turbine
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
O&M	Operational & Maintenance
ONE	Office National de l`Electricite´
POC	Point of Connection
PPA	Power Purchase Agreement
PPI	Public-Private Infrastructure
PPP	Public-Private Partnership
PCG	Partial Credit Guarantee
PRG	Partial Risk Guarantee
PRI	Partial Risk Insurance
Pxx	Probability Value
R	Rand (South African Unit of Currency)
RE	Renewable Energy
REIPPP	Renewable Energy Independent Power Producer Programme
RFP	Request for Proposal
ROE	Return on Equity
RSA	Republic of South Africa
SA	South Africa
ToR	Terms of Reference
TSO	Transmission System Operator
USD	United States Dollar
VAT	Value-Added Tax
WBG	World Bank Group
WT	Wind Turbine
WTG	Wind Turbine Generator
WTO	World Trade Organization

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Foreword

Ethiopia is one of Africa's fastest growing economies and has an ambition to maintain its growth in order to reach middle-income status and universal access to electricity within the next decade. In line with its Climate Resilient Green Economy Strategy, National Determined Contribution (NDC) and National Electrification Program the needed rapid growth in power generation will be based on renewables. This makes Ethiopia one of the most progressive developing countries in the global climate negotiations and an active leader in various forums, including the Partnering for Green Growth and the Global Goals 2030 (P4G Initiative). Hydropower will take the lion's share of the new generation capacity. However, several initiatives are being pursued to enhance Ethiopia´s power generation capacity, to diversify the energy mix and increase climate resilience, including protection from more frequent droughts due to climate change. Wind energy is expected to play a key role in this transition along with other renewable energy sources such as geothermal and solar energy. The national development objectives of the Government of Ethiopia, as set out in the Growth and Transformation Plan II, stipulates that the share of wind power should increase to 1,200 MW by 2020/21. This will require mobilizing of substantial private investments in a short timeframe and at a scale to ensure long-term sustainable growth and development.

The Government of Ethiopia has made concrete interventions to review the sector policy in relation to the successful agreement with Independent Power Producers (IPPs) and recently the Parliament ratified the comprehensive Public-Private Partnership Proclamation. At the same time, there is a great need for concerted support to develop robust institutional, regulatory and legal frameworks, required to create a conducive business environment, which in turn will attract private developers and investors

This Wind Project Development Roadmap address these issues and presents a thematic policy and action matrix for accelerating wind power generation in Ethiopia. These have been drafted by experts from the Danish Energy Agency in collaboration with various key Ethiopian agencies, including the Ministry of Water, Irrigation and Energy (MoWIE), Ministry of Finance and Economic Cooperation (MoFEC), Ethiopian Energy Authority (EEA) and Ethiopian Electric Power (EEP).

In this regard, the Roadmap should serve as a valuable blueprint for matching the new policy guidelines for public-private partnerships in the energy sector with the best international practises. Clarifying such procedures and potential investment risks will be paramount to ensure competitive tenders and optimal risk distribution, bringing down the costs for new wind energy substantially.

Successful implementation of this policy is in our hands. I wish to invite all the stakeholders in the energy sector – public and private, domestic and international - to ensure that the proposal and lessons learned provided in this Roadmap are accordingly taken into account.

Dr. Eng. Seleshi Bekele
Minister, Ministry of Water, Irrigation and Energy

Executive Summary

As specified in the Ethiopian Growth & Transformation Plan II (GTP2, 2015-2020), the Government of Ethiopia (GoE) plans to increase its power generation by 17,000 MW from different renewable sources, including wind (1,200 MW). Of this wind power expansion, about 900 MW are planned to be developed by the private sector through IPP wind auctions. The first round of onshore wind tenders will be auctioned for a number of projects with a total capacity of 500 MW, and developed in collaboration with the Ethiopian Ministry of Water, Irrigation and Energy (MoWIE), the Ministry of Finance and Economic Cooperation (MoFEC), the Ethiopian Electric Power (EEP), the Ethiopian Energy Authority (EEA), the World Bank Group (WBG) and the Danish Energy Agency (DEA).

This report provides guidance and extensive analysis concerning the development of procured onshore wind projects. The guide starts with a review of the role and scope of public-private partnerships (PPP) in emerging countries for the development of energy projects with special focus on Sub-Saharan countries. Deep dives and key lessons are provided in respect to the appropriate design of PPP in the energy sector and on the different phases and actors involved in the project process. The roadmap then analyses the different foundation blocks of the development of wind projects, from pre-feasibility stage until operation & maintenance.

The scope of this report is to offer insight for public, private decision makers and key stakeholders as well as to clarify best practices and potential risks in critical areas of wind project investments in new renewable energy markets including optimal distribution of these between public and private stakeholders. The themes mentioned above will be described in details, supplying international case studies and lessons learned. Furthermore, extensive analysis and guidance will be provided for Ethiopia focusing on future frameworks and regulation of wind power projects.

Public-private partnerships in the energy sector

The engagement of the private sector is perceived as an essential strategy for accelerating and implementing infrastructure projects, including the ones in the power generation sector (renewable energy included). Public-private partnerships in the power generation sector are typically represented by independent power producers (IPPs), which design, finance, build, operate, maintain and decommission a power generation plant and contract to sell the electricity generated to a publicly owned power utility. IPP projects have been developed in many different countries and power market environments, from purely deregulated electricity markets or power markets regulated by vertically integrated state-owned utilities to hybrid-market structures where public and private investments coexist.

The right setup of the PPP framework varies accordingly to the unique political and

institutional capacity of every separate country, but a strong leverage of the private sector can be achieved only through the implementation of a favourable, transparent and long-term sustainable PPP framework. Key factors for supporting the IPP´s enabling environment include a fair competition and transparency in the procurement and contracting process, the establishment of independent regulation and reforms in the electricity power market, long-term and cost-effective planning strategies for generation and transmission & distribution, and noteworthy efforts to improve financial health of off-takers (utilities or private companies).

PPPs programs indeed tend to have significant differences from traditional public forms of procurements. Quite often governments fail to identify or properly perform the new required processes and functions, due to the lack of expertise, strong political commitment to advance a PPP program or lack of transparency and coordination. Policy makers should not underestimate the complexity and the vital function of identifying a successful "champion" appointed to drive the PPP agenda and provide it with the necessary executive authority.

Wind Resource Assessment

Site-specific wind resources are the foundation for power generation in any wind power project. For project developers and governments which would like to exploit wind resources, the starting point of the wind resource assessment is the examination of wind resource maps (wind atlas) for a specific country or region. However, the large sensitivity of wind energy production to wind speed, topography, land cover, and obstacles requires microscale analyses and additional wind measurement campaigns directly on potential wind project sites. This is usually accomplished with the installation of wind monitoring equipment on-site, during the project feasibility stage.

When wind data has been collected and quality is checked, the annual energy production of a potential wind farm may be evaluated. The calculation is strictly dependent on several elements such as wind turbine power curve, which relates to each wind speed the energy produced by a specific wind turbine model, meteorology of the site (atmospheric stability, air density, etc.), project site size (which reflects the wind power capacity installed) and estimated losses due to wind turbine placement, electrical losses and unavailability. **The stochastic nature of the wind also has a direct influence, referred as uncertainty, on the estimation of the annual energy yield.** Sources of uncertainty are typically represented by wind speed measurement, wind extrapolation (spatial, vertical, and temporal), power curve, wake effect, air density, etc.

The business and investment case and bankability of wind power projects rely on accurate and objective estimates of wind data and annual energy output models. Bankable wind measurements require complex and costly campaigns, which are typically based on internationally recognized standards such as IEC 61400-12 standards and MEASNET guidelines. It is paramount both for governments, project developers and financiers to address credible independent specialists or measurement institutions for performing wind resource assessments (wind atlas and on-site wind measurements).

Ethiopia is one of the countries included in the World Bank Energy Sector Management Assistance Program (ESMAP). This initiative will guide the future scaling-up of wind power in Ethiopia estimating and verifying the wind energy resource potential of the country. The tangible output of the programme is the development of the Ethiopian wind atlas, which will provide long-term regional measurements and pre-screening information on deployable wind resource areas.

Concerning IPP wind tenders and on-site wind measurements, the choice of the GoE to appoint independent consultants for developing wind resource campaigns on specific sites for the first IPP wind tenders will make possible to produce early data in short time as well as objective estimates of the annual power production of wind farm projects for IPP developers and investors. **If the quality of the wind data collected is considered consistent by developers, investors, and lenders, this may sensibly reduce project pre-development costs for developers and therefore lead to competitive and lower bid prices.**

Site Selection

A wind resource estimate is simply a starting point for the identification of potential sites for wind farm projects. The process of site selection involves other important aspects that project developers and auctioneers should properly investigate during feasibility studies for selecting sites. These key topics that need to be clearly inspected are:

- *Wind Turbine Class.* Wind turbines are usually designed for specific wind conditions since different wind sites can have very different wind resources. Hence, one of the crucial parameters to take into consideration in the design of wind power plants is the wind turbine class. Turbulence, wind speed and extreme wind events are the key parameters, which determine the optimal wind turbine class.

- *Terrain description of sites.* The terrain features that influence the wind flow close to the ground are represented by the geometry of the terrain surface (elevation, slope, etc.), the surface characteristics of the terrain (roughness length) and the presence of nearby obstacles (buildings, forest, etc.).

- *Land rights, use and planning process.* Specific regulatory requirements, current and future land usage, the proximity of neighbouring dwellings, and/or military areas, civil aviation restrictions, environmental and social issues, habitats and cultural heritage are key constraints which may partially or entirely limit the realization of wind projects. Securing land and property rights are also very sensitive topics, which in some cases may be extremely time-consuming. In the whole process, it is advisable that Governments act as facilitators concerning the different acquisition procedures, settling also land acquisition rights beforehand, which could be subsequently passed to successful bidders and significantly reduce uncertainty regarding project-building.

- *Electrical connection access.* The analysis of grid assessment conditions for a selected wind project site is fundamental for ensuring the technical and commercial viability of the proposed wind farm. The grid connection location should not impose severe technical, economic, or practical problems due to the distance to the wind farm, the connection voltage level and the proposed routing of the cables.

- *Ease of construction and infrastructure*. During the feasibility and screening process of potential sites for wind farms, a decision maker should not underestimate the importance of the construction infrastructure of the preselected site. This assessment should be extended also to the road infrastructure of the site and the adjacent areas. Indeed, the development of a wind farm requires the use of bulky vehicles and components, which may be difficult to transport and move on-site. Therefore, the site should be also evaluated for its specific construction suitability.

After the evaluation of these constraints, it is possible to geo-localize areas, within a country or a specific region, where it is feasible to deploy wind projects. Thereafter, the main outcome of the wind feasibility study is to rank potential sites for assessing their suitability and value of interest. Typically, for IPP wind tenders, either the auctioneer is in charge for the site selection process or the project developer. The recent trend of international IPP wind tenders shows that whereas project developers are in charge of the process of site selection, governments impose location constraints to secure that site selected will be suitable for the development of wind projects.

The choice of the Government of Ethiopia to develop "site-specific" wind IPP auctions should be seen as part of an overall strategy to enhance local public acceptance and avoid public unrest, minimize costs and risks for project developers and financiers, as well as ensuring a smooth and on-track project implementation. Indeed, the land acquisition process is perceived as a significant risk in most African countries. Hence, choosing in advance project sites would ensure that several critical and onerous tasks of the pre-development project phase, such as securing land, assessment of the road & construction infrastructure of the sites, electrical connection access, and availability of the required transmission capacity will be handled beforehand by the GoE and relevant central and local authorities.

Grid connection

The analysis of grid assessment conditions for a selected project site is fundamental for ensuring the technical and commercial viability of the proposed wind farm. From the perspective of a project developer, discussions with grid operators and examination of local electricity transmission and distribution systems are necessary to evaluate whether an electrical connection to the proposed site is technically and commercially viable.

Speaking from the perspective of a Transmission System Operator (TSO), reinforcements and extensions of the power transmission and distribution networks should be envisioned on a long-term energy dispatch strategy, and should carefully consider the addition of large shares of variable renewable energy. In circumstances of high winds, the capacity of the grid may be locally limited and difficulties can rise to evacuate this power. International experiences, such as the ones in Germany and China among others, showed that the addition of wind generation capacity in remote areas quite far from large load centres is often translated in loss of potential wind power generation through curtailments and consequently loss of income and value for either the IPP or off-taker depending on the Power Purchase Agreement contract (PPA). Hence, future power plants investments (including wind power plants) and extensions on the transmission infrastructure should be strategically envisaged.

Recent wind power auctions showed that several winning projects rely on additional transmission reinforcements in order to dispatch their generation. This strategy requires a detailed allocation of liabilities, which in some auction cases have been assigned to project developers. In this way, project developers implicitly become responsible for potential defaults or delays of a completely separate entity (the one in charge of the transmission works). **This may result in high-risk premiums on auctions and in some cases discourage the wind power developers to bid.** If on the contrary, the liability relies on the transmission company, a proper risk-sharing strategy should be implemented for protecting project developers and split risks and penalties between the TSO and the power purchase buyer.

One of the most well-spread design procedures in wind auctions is the identification of a physical connection point (POC) of the wind farm within the transmission network. The POC represents then, the “watershed” of liabilities and costs associated with the grid connection process between the project developer and the transmission system operator.

For Ethiopia, the strategy of implementing site-specific wind IPP auctions should implicitly ensure that the required transmission infrastructure will be in place and projects will be optimally located to best match demand with power generation capacity. Despite the largest Ethiopian wind resources are located in the south and south-east regions of the country, the before mentioned areas are barely populated and served by transmission lines. Therefore, wind projects in these specific areas may firstly be complex to implement due to the missing transmission infrastructure needed. Secondly, they may be cost-prohibitive to implement and may not be optimally placed to serve load centres and aggregation points. **Hence, it is paramount that future power plants investments (including wind power plants) and extensions on the transmission infrastructure should be strategically placed to serve at best load and dispatch centres.**

Planning and Environmental Approvals

After the identification of a potential site by means of verified technical analyses, the further development of a wind project includes a proper determination of potential planning and environmental issues on the selected site of interest. Initial assessments are usually carried out consulting available data, environmental mappings, engaging with national as well as local planning authorities to make the project bankable both regarding development financing institutions (DFIs) and commercial banks. The main scope of the consultation with state and local authorities is to determine the “planning” suitability of the selected site. Furthermore, the development of a wind project should imply identifying main drivers and factors of the assessment analyses required to progress a planning application for the establishment of wind farms.

In frontier renewable energy markets, the planning process for wind project developers can be extremely time consuming and difficult to navigate in, based upon lack of experience and procedures for appropriate authorities. **For these reasons, the establishment of a nodal government agency can sensibly simplify and reduce lead times required for processing planning procedures.** The main role of th this central govenrment agency (often referred as “one-stop-shop”) is to grant and procure all the permits needed for the development of renewable energy projects (wind farms included) by coordinating the necessary permissions between different authorities and agencies both centrally and locally.

Generally, the development of a large wind farm requires carrying out and/or complying with a full Environmental and Social Impact Assessment (ESIA) study, which is subject to specific environmental and/or planning laws of a country. Again the ESIA is also a pre-qualification criteria’s for many investors and lenders, both DFIs and commercial banks as well as many institutional investors. The ESIA assessment identifies the relevant environmental, social and economic effects associated with the wind project proposal. The typical contents of an EISA study are:

- Data on developer
- Site description
- Project description
- Overview of main alternatives
- Review of the status of environment
- Description of potential significant impacts
- Assessment of effects in case of accidents
- Description of mitigation measures to reduce the impact
- Monitoring programme

The choice of implementing site-specific wind IPP auctions sets up the leadership role of the Ethiopian auctioneer in the administrative and regulatory framework needed for processing permits, licenses, planning procedures for the site of the IPP wind project. For IPP wind auctions, a proper strategy should be considered for assigning obligations and processing licenses. As previously cited, a fast-track and agile implementation plan can be represented by the establishment of a government agency in charge for granting and licensing the permitting approvals required in wind tenders. Specifically for environmental and social issues, the Ethiopian Environmental Impact Assessment Proclamation provides a strong regulative framework for an effective implementation of the ESIA system in the country. Furthermore, the recent transformation of the Environmental Protection Authority (EPA) into the Ministry of Environment, Forest and Climate Change is also a positive move to strengthen its capacity and legal means to enforce the law.

For the first wind energy tenders, it is advisable that the Ethiopian auctioneer will provide the necessary permits and ESIA studies to potential bidders, beforehand bid submission. Where needed, the Ethiopian national legislation and standards on Environmental Health & Safety (EHS) can be supplemented with the adoption of IFC`s Performance Standards and EHS guidelines. These international standards may be used as a comprehensive and exhaustive framework for carrying out ESIA studies for wind projects, on which bidders will be required to comply with. Excluding hydro power projects in fact, specific assessment documentation in Ethiopia is lacking for other renewable energy technologies, including wind energy facilities.

It is advisable that the GoE will start to process detailed guidelines for wind project planning and environmental impact assessment, identifying the potential effects that wind farms (and other RE plants) may have on the environment, and relative mitigation practices that may be applicable. The guidelines should provide a detailed analysis of the legislative framework, national and local centres of expertise in the Ethiopian RE sector. These detailed procedures should be envisaged as a powerful tool both for facilitating competent authorities in the implementation and monitoring of the ESIA process and for clarifying applicants on the relevant legislation and components of the authorization process.

Power Sale

Finding a creditworthy buyer of the power produced by a wind farm is one of the main prerogatives of project developers. Two main categories of power sales can be identified: sales on the spot market and bilateral contracts. Through the sale of power on the spot market, wind farm owners sell the electricity generated by the wind farm directly into the electricity spot market. Bilateral contracts are instead set by power purchase agreements (PPAs) between a power seller (project developer/project company) and a creditworthy buyer (or consortium), mostly referred as off-taker. PPAs prices for wind power are typically set either by competitive mechanisms such as renewable tenders (where the off-taker is mostly represented by a state-owned utility or a transmission system owner) or by feed-in-tariff / feed-in-premium (FiT/FiP) payment policies. Although FiTs and FiPs are very popular mechanisms, the use of competitive tendering procedures is increasing worldwide.

With the implementation of the Growth & Transformation Plan II (GTP2, 20015-2020), the Government of Ethiopia is planning massive financial investments to lift the power sector. The ambitious energy plan is driven by an intensive electrification programme of the country and by an increased demand for electricity (>25%), led to a great extent by the growing contribution of the industrial sector in the power side demand. To meet consumption demands, governments in Africa (including Ethiopia) are generally subsidizing electricity supplies. In this matter, Ethiopian electricity tariffs are the lowest among Sub-Saharan countries. Cost-reflective tariffs are necessary to reduce the financial gap in the sector over the medium to long-term and make a sustainable and bankable business model for the sector.

Project Financing and Bankability

For lenders and investors, it is essential to fix, to a great extent, project revenue streams and minimize risks of their loans and investments. Hence, a proper allocation and mitigation strategy of risks is necessary for making projects bankable and investment graded. **A well-structured and bankable power purchase agreement is typically based on different counterpart risks, guarantees and de-risking options.** The main elements of these risks and mitigating policies are described below.

- Off-taker payment support or guarantees
- Dispatch risk
- Foreign exchange
- Change in laws or in taxation
- Transmission or interconnection risk
- Force majeure
- Dispute resolution and termination payments
- Transferability of ownership

An appropriate risk mitigation strategy is fundamental for mobilizing private sector funding and for ensuring the viability, bankability and profitability of renewable energy projects in frontier markets such as Ethiopia. One of the main challenges in developing renewable energy projects in emerging countries is represented by the potential risk of the off-taker to fulfil payment obligations for the entire lifetime of a project (20-30 years). For these reasons, project developers and lenders require more security instruments compared to similar projects developed in OECD countries. **These security instruments (credit enhancement) that independent power producers commonly seek are among others the issuance of sovereign guarantees by the host government, liquidity letters of credit, and/or guarantees instruments offered by DFIs to backstop the PPAs obligations of the off-taker.**

The direct involvement of the World Bank Group in the Ethiopian wind auctioning process is fundamental to catalyse private financial flows through the activation of guarantees and risk mitigations instruments in PPA contracts. Typically, these financial products cover risks associated with payment obligations arising from contracts signed by Governments or Governments owned entities, regulatory risk (i.e. change in law, negation or cancellation of license, tariff adjustment, etc.), currency risk (convertibility and transferability), political force majeure (expropriation, war and civil disturbance) and frustration of arbitration. The activation of DFI guarantees usually requires that Governments will sign counter-guarantees (i.e. indemnity agreements) with the financial institution that provides such financial products. Besides the clear benefits of providing credit enhancement in favour of IPP financing, the GoE should not underestimate the impact of the different types of credit enhancement policies on their balance sheets and debt frameworks.

Concerning instead risks due to currency exchange rate, project developers are resolute on signing PPA contracts in hard currencies (USD, EUR), mostly due to the absence of a long-term capital market instruments in most developing countries. **Whereas PPA contract prices in hard currencies may shield project developers from local currency fluctuations, on the other side they expose governments to significant foreign exchange risks.** Hence, offset procedures need to be carefully implemented both for limiting foreign exchange volatility issues and for ensuring enough availability of foreign currency in the country.

Procurement Process and Construction

The financial closure of a wind project and its construction stage are strongly dependent on the negotiated procurement contracts for the different construction elements of the wind farm. Construction elements include all wind turbines components, their transport and assemblage, as well as civil and electrical works, which are often grouped together and referred to the category “balance of plant”.

Typically, agile and bankable wind projects are established through engineering-procurement-and-construction (EPC) contracting procedures by the developer or investor of the project. One of the major advantages of EPC mechanisms (both for primary and secondary contractors) is the ability to centralize and regulate liabilities through a single point of contact (EPC contractor). This is also the reason why among lenders and investors, EPC contracts are the most preferred contract topologies for achieving bankability in wind farm projects.

For a reliable and safe operation of wind farms, it should be mandatory that the procured equipment of wind IPP auctions comply with international technical standards such as the IEC 61400 standards. These standards have been adopted by several countries around the world and are used as foundation for the development of national standards for wind turbine generator systems. It should be mentioned that the use of wind infrastructure equipment complying with international standards does not represent a bond in procuring equipment locally and foster economic development criteria in auction tenders. The strict criteria of the South African renewable energy procurement programme (REIPPP) in terms of local content requirements (LCRs) and internationally certified equipment are a proof of this possible synergy in the procurement strategy.

In the design of local content rates in wind tendering auctions, it is advisable that before introducing LCRs, the Government of Ethiopia should conduct in-depth studies on the potentialities of Ethiopian manufacturing industries along the wind value chain to provide components and services. The GoE should investigate potential limits in the availability of skilled local suppliers and/or production facilities, quality of components and qualifications of the local workforce. Depending on the status of these crucial indicators, local content shares in wind auction tenders should be gradually phased in.

An effective entry point for implementing LCRs in IPP wind tenders is represented by sourcing locally services associated with the balance of plant (BOP), construction, and operational & maintenance phases of the wind farm. Potentially, the manufacturing process of large wind turbine components close to their destination market could also reduce logistics and transportation costs. However, the production localisation of these components in new markets is often limited due to high quality standards and specialized manufacturing processes required for fabricating these items.

Another fundamental priority of Governments contracting renewable energy projects is the creation of local employment. **According to IRENA, the renewable energy sector employed worldwide 9.8 million people, directly and indirectly, in 2016.** Since 2012, the jobs in the solar and the wind sector have experienced the most consistent increase (more than doubling).

Operation & Maintenance

The Operation and Maintenance (O&M) process of a wind farm is the latest stage of the development of wind projects. The O&M management process is typically regulated through long-term agreements between the turbine manufacturer, the project developer and the wind farm operator. Developing the most appropriate O&M model is a complex matter and it varies from project to project. Due to most of the cost in a wind project is fixed capital cost it is very important that the wind turbines are available as much as possible when the wind is blowing. Constant monitoring wind turbines and preventive maintenance are important in an operating strategy to maximize the return of the investment in a wind power project. This also ensures a better predictability by the TSO taking into account the weather and wind forecasts.

Moreover, due to the volatility of wind energy, the power output of wind farms is highly depending on wind speeds. This fact also has a direct impact on reliability and security of supply into power systems, especially in countries with a high penetration of VRE sources. **Over the past years, stricter grid codes have transformed wind farms from passive power generation units to active generation units with grid support characteristics.**

In most EU states wind power generators are already balancing responsible in financial or legal terms. Hence, relying on accurate and iterative forecasts is paramount both for wind farm operators and TSOs. For TSOs, the fundamental idea with forecasting procedures is to plan ahead and base the dispatch planning procedure on the best available data at any time. The main target is to minimise the remaining imbalances to be handled with expensive automatic reserves by using cheaper manual reserves for anticipative balancing.

The frontier status of the Ethiopian wind energy market and more in general of the liberalized electricity market is backed up by a dispatch generation strategy which relies exclusively on a centralized function, where power generators are dispatched by the national TSO, EEP. **Efforts should be concentrated on the development of the necessary framework for implementing a well-functioning market with high penetration of renewable energy sources.** Tangible short and long-term recommendations in this regard are:

- Establishment of a functioning intraday and balancing market
- Ensuring proper market monitoring mechanisms and preserving market transparency to a satisfactory level
- Sophisticated forecast methods in place in the power system
- Market mechanisms that properly value the provision of ancillary or grid support services for all market participants including wind power
- Balancing market arrangements providing for the participation of wind power generators
- The necessary transmission infrastructure

Policy & Action Matrix for Accelerating Wind Power Generation in Ethiopia

The matrix is organized in thematic objectives for the deployment of IPP competitive tender procedures specifically for Ethiopia. The policy & action matrix draws upon the detailed suggestions and procedures described within the singular chapters of this roadmap. The matrix is organized in a logical and temporal framework and it aims to depict initial and high prioritized initiatives versus long-term sustainable procedures for developing and scaling up IPP wind power in large scale. Within the matrix, the different themes and sectorial focuses suggested for Ethiopia are directly addressed to the relevant implementing bodies and responsible units of the country.

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Ethiopian wind atlas	• Launch Phase II of the ESMAP programme to validate the mesoscale wind map prepared by DTU	• Drawing upon the outcomes of the Phase II, produce the final wind atlas for Ethiopia (Phase III of the ESMAP programme)	MoWIE
	• Install measurement masts in the sites identified with wind climate perspective for wind atlas deployment	• Include in the final version of the Ethiopian wind atlas, a higher resolution mapping output, including detailed values of topography and surface roughness	MoWIE
	• Start wind measurement campaigns and data acquisition	• Map country wind potential for strategic energy planning purposes	MoWIE & EEP

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Ethiopian wind atlas		• When enough data is gathered, make all existing meteorological and wind resource data accessible	MoWIE & NMA
		• Establish a national centre of excellence for directing and monitoring energy research and development, as well as undertaking specific programmes to promote the green energy agenda of the country	MoWIE
High quality wind data for IPP auctions	• Address credible independent specialists to perform wind measurement campaigns according to IEC 61400-12 and MEASNET guidelines	• Ensure a cost-reflective strategy for implementing on-site measurement campaigns (transfer costs to winning bidders or appoint project developers as responsible party)	IPP Unit
	• Prioritize and start on-site wind measurement campaigns for IPP tenders on the sites identified by the prefeasibility studies	• For future IPP wind projects, ensure that wind measurement campaigns will always comply with IEC 61400-12 standards and MEASNET guidelines	IPP Unit

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
High quality wind data for IPP auctions	• Ensure public access to existing topographic maps or undertake topographical surveys in prioritized sites. Include this data in tender documents	• If the auctioneer will be in charge of site selection of future IPP wind tenders, guarantee that geotechnical and topographic data for IPP wind sites are part of tender documents	IPP Unit
Identification of potential sites for IPP wind projects	• Address specialists for ranking and identifying high potential wind areas for the first round of IPP tenders. The geo-localization of wind sites should be carried out by a multi-criteria ranking methodology	• Whether the auctioneer or the IPPs will be in charge of site selection of future IPP wind tenders, limit project sites to specific and suitable zones for wind deployment	IPP Unit/PPP DG
	• Ensure a high involvement and coordination with the TSO for the determination of auction sizes and site selection		IPP Unit
	• Develop well-coordinated generation and transmission plans for proper prioritization of wind sites		IPP Unit
	• Conduct site visits on the sites identified to support the detailed assessment of each site		IPP Unit
	• Match the specific terrain complexity of the identified wind sites with an appropriate number of installed wind masts		IPP Unit

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Identification of potential sites for IPP wind projects	• Ensure that road infrastructure and access are strong evaluation criteria for wind sites selection	• Increase construction of quality road infrastructure and trunk roads to facilitate access to wind development areas	IPP Unit & ERA
	• Ensure a fast-track dispensation regarding width and height restrictions on trunk roads		ERA
Wind farm connection to grid	• For the first IPP wind tenders, limit project sites to specific zones where transmission capacity is already in place and in proximity of load centres	• Restrict wind project sites in specific zones where transmission capacity is already in place or it will be strategically upgraded	IPP Unit
	• In the evaluation of potential sites for the first round of IPP tenders, perform power flow assessments to determine the availability of transmission capacity	• Perform accurate grid studies, simulations models, and capacity expansion plans based on optimal investment policies for grid and off-grid expansion. Account also for dispatch and operational strategies, based on large shares of REs in the power system	EEP

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Wind farm connection to grid	• Ensure that wind turbines procured by IPPs during the first round of wind tenders comply with the latest version of Ethiopian grid codes for RE plants	• Continue to update grid codes, improve capacity building and competency on grid codes with respect to increasing levels of renewables and wind power	IPP Unit & EEA
	• Grant a grid connection permit to bidders	• Grant a grid connection permit to bidders (valid in case the auctioneer will be still responsible for the site selection process) or develop a detailed approval process for connecting new generation facilities, including wind farms (valid in case IPPs will be directly responsible for the selection of future wind sites)	EEP
	• In wind tender documents, separate costs for wind farm connection from the costs for grid reinforcement. Identify a suitable point of connection within the grid network, then allocate liabilities and costs among IPPs and the TSO		IPP Unit
Account for grid infrastructure constraints	• Within the wind PPAs, create a compensation scheme for IPPs in the occurrence of wind power curtailments and/or grid congestion (deemed generation clauses)		IPP Unit

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Account for grid infrastructure constraints		• Improve O&M of the transmission & distribution networks	EEP & EEU
		• Develop key transmission corridors for evacuating RE power	EEP
		• Where applicable, tender and roll-out transmission assets before new wind farms become operative	EEP
Planning & environment approvals	• Consider appropriate organizational anchoring and staffing of a dedicated government agency - this can sensibly simplify the planning procedure for granting licenses and permits for wind projects	• In respect to the future strategy for the selection of IPP sites (auctioneer or IPPs), either enforce the central role of the government unit appointed for IPP transactions or develop detailed planning guidelines for the regulatory environment of wind projects. Improve capacity building within the competent authorities	MoWIE, PPP DG & IPP Unit

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Planning & environment approvals	• Where applicable, supplement EHS national legislation and standards with IFC´s Performance Standards and IFC´s EHS Guidelines for Wind Energy	• Develop accurate documentation and legislative guidance for project planning and ESIA, specifically for wind farms and other renewable energy technologies	MoEFCC & FEPA
	• Prepare ESIA studies for selected IPP wind sites. Ensure ESIAs are part of the tender documents. The processing costs may be passed to winning bidders		IPP Unit/PPP DG,
	• Ensure an effective enforcement of ESIA studies, based on good monitoring systems, effective mechanisms for accountability and relevant capacity building within the competent authorities		MoEFCC, FEPA & MoWIE
	• Make sure that land rights and facility site lease agreements for IPP projects are settled beforehand bid submission		IPP Unit
PPA tariffs and payments	• It is advisable to denominate PPA tariffs in hard currencies (i.e. USD, EUR)	• Improve the growth and sustainability of the Ethiopian debt capital market and local currency financing. Then, PPA tariffs in local currency can be established	MoFEC & NBE

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
PPA tariffs and payments	• It may be necessary to provide financial instruments like Partial Risk Guarantees (PRGs) for wind tenders to mitigate potential risks of convertibility and transferability of foreign currency	• Expand foreign exchange generation and foreign exchange reserves of the country	EEP & MoFEC
	• For "hedging" foreign exchange exposure, project developers and lenders may require to include a foreign currency indexation formula in the PPA tariff (full-price indexation or only the O&M component of the tariff)	• Institute government intervention to reduce cost of loans through grant funding, credit guarantees and tax incentives	MoFEC & NBE
	• MOFEC through NBE will facilitate IPPs to have a series of FX accounts at any eligible offshore bank. These accounts however will be opened by Ethiopian Commercial bank to be approved by NBE. The accounts will be managed by a trustee fund agreement to be entered between the IPP, NBE, the commercial bank and the foreign bank. The money will be held on trust for the IPP by the commercial bank of Ethiopia. These accounts are basically used to hold the funding, insurance premium and debt service. The IPP is also allowed to open a local FX account at the Ethiopian commercial bank to mirror the offshore accounts		MoFEC & NBE

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Credit support for off-taker´s obligations	• For supporting the off-taker´s payment obligations of PPAs and attract foreign direct investments, it may be necessary to provide different risk mitigation instruments such as short term liquidity support, a sovereign guarantee and a letter of credit within the tender documents	• Enhance policies and electricity tariff regulations to improve the solvency of the off-taker	MoFEC & MoWIE
	• The sovereign guarantee itself may not be sufficient to provide comprehensive risk mitigation for lenders. Guarantees from international finance institutions and policy risk insurance should be then enforced in tender documents	• Continue to enhance the credit quality of the sovereign through export diversification, completion of infrastructure programmes, strengthening institutional frameworks and foreign exchange generation	MoFEC
Off-taker's protection	• Include delay-liquidated damages in the wind PPAs to account for potential failures by the project company to achieve commercial operation by the scheduled commercial operation date (COD)		IPP Unit/PPP DG

<table>
<tr><th></th><th colspan="2">Recommended policies and actions</th><th></th></tr>
<tr><th>Objective</th><th>Short-term</th><th>Long-term</th><th>Responsible Unit</th></tr>
<tr><td>Off-taker's protection</td><td colspan="2">• Include performance-liquidated damages in the wind PPAs to compensate potential failures by the project company to achieve minimum capacity and energy thresholds by the contracted wind project</td><td>IPP Unit/PPP DG</td></tr>
<tr><td>Procurement quality requirement</td><td colspan="2">• For a reliable and safe operation of wind farms, it should be mandatory that the equipment procured in wind IPP tenders comply with international standards such as the IEC 61400 standards</td><td>IPP Unit & PPP DG</td></tr>
<tr><td rowspan="2">Bid evaluation criteria</td><td>• Evaluate the inclusion of non-price components for bids evaluation to promote political and local community development and broaden the wind IPP programme´s success</td><td>• Appraise the inclusion of local ownership or benefit models and higher values of local content spending as non-price components for bids to promote public support and acceptance</td><td>PPP DG & IPP Unit</td></tr>
<tr><td>• It is advisable that local content requirements in bids will be phased in based on state-of-art of the Ethiopian manufacturing industry to provide services and components along the wind value chain</td><td>• Support domestic manufacturing and training to meet skills requirements, encourage foreign firms to delocalize manufacturing facilities in the country, and initiate targeted research projects</td><td>PPP DG & IPP Unit</td></tr>
</table>

	Recommended policies and actions		
Objective	*Short-term*	*Long-term*	**Responsible Unit**
Bid evaluation criteria	• Make sure that the weighting system for price and non-price components in the evaluation of wind/RE auction bids reflect government´s priorities (procure cheap and reliable wind/RE generation, prioritize socioeconomic development objectives, boost local manufacturing, job creation, LCRs)		PPP DG & IPP Unit
	• Ensure an effective on-going monitoring strategy of economic development criteria during construction and operation of wind projects (i.e. attach termination points in the PPA to underperformance in respect of economic and development criteria)		PPP DG & IPP Unit
System integration of wind power	• Revise national grid codes and require measures for voltage control, active and reactive power control by wind turbines	• Ensure that TSO and DSO operate according to international best practices for dealing with large shares of wind and RE energy (i.e. maximize the value of generated RE power, use of advanced forecasting techniques and procedures, adopt enhanced on-line monitoring tools and communication technologies)	EEA & EEP
	• Ensure proper market monitoring mechanisms and preserve market transparency	• Establishment of a well-functioning intraday and balancing market for the provision of ancillary and grid support services	EEA & EEP

Introduction

The Government of Denmark and the Government of Ethiopia have initiated a development partnership as there is mutual commitment to the global agenda on climate change and green growth. The "Accelerating Wind Power Generation in Ethiopia" (AWPGE) programme is a joint undertaking between the Ministry of Water, Irrigation and Energy (MoWIE), the Ministry of Finance and Cooperation (MoFEC), the Ethiopian Electric Power (EEP), the Ethiopian Energy Authority (EEA), Danish Energy Agency (DEA), the Danish Transmission System operator (TSO) Energinet.dk, the Danish Ministry of Foreign Affairs and the Royal Danish Embassy in Ethiopia. The AWPGE programme was signed by the GoE and the Danish Embassy in Addis Ababa on December 2016.

As specified in the Ethiopian Growth & Transformation Plan II (GTP2, 2015-2020), the GoE plans to increase its power generation by 17,000 MW from different renewable sources, including wind (1,200 MW). Of this wind power expansion, about 900 MW are planned to be developed by the private sector through IPP wind auctions. The first onshore wind tender will be auctioned for 100 MW and developed in collaboration with the Ethiopian Ministry of Water, Irrigation and Energy (MoWIE), the Ministry of Finance and Economic Cooperation (MoFEC), the Ethiopian Electric Power (EEP),the Ethiopian Energy Authority (EEA), the World Bank Group (WBG) and the Danish Energy Agency (DEA).

This report provides guidance and extensive analysis concerning the development of procured onshore wind projects. The guide starts with a review of the role and scope of public-private partnerships (PPP) in emerging countries for the development of energy projects with special focus on Sub-Saharan countries. Deep dives and key lessons will be provided in respect to the appropriate design of PPP in the energy sector and on the different phases and actors involved in the project process. The roadmap then analyses the different foundation blocks of the development of wind projects, from pre-feasibility stage until operation & maintenance.

The scope of this report is to offer insight for public and private decision makers and key stakeholders and clarify best practices and potential risks in critical areas of wind project investments in new renewable energy markets. The themes mentioned above will be described in details, supplying international case studies and lessons learned. Furthermore, extensive analysis and guidance will be provided for Ethiopia.

Role of public-private partnerships

In emerging countries, the estimated demand for investments in the power sector, the urgent need for increasing power generation capacity and the budget constraints of public funds had the effect to engage many governments in the development of PPPs, with the aim of improving infrastructure and enhancing public service delivery. In the last two decades, PPPs have been used in more than 134 emerging countries, contributing about 15–20 percent of total investment in infrastructure projects. On average, investments in PPPs were estimated at USD 79 billion annually during the period 2007-2011 (World Bank Group, 2014) with a cumulative investment of USD 815.5 billion during the time period 1990-2015. Among the different sectors, the largest investments have been concentrated in information and communication technology (ICT), followed by investments in the electricity and transportation sectors (see Figure 1 and Figure 2).

According to the World Bank Group, the PPPs expression identifies and defines "a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance. PPPs typically do not include service contracts or turnkey construction contracts, which are categorized as public procurement projects or the privatization of utilities where there is a limited ongoing role for the public sector" (The World Bank, 2015). The main benefits that long term PPP contracts can bring to governments for the delivery of public services can be summarized as follows (The World Bank, 2011):

- *Greater efficiency in the use of resources.* Splitting risks optimally between the public and the private sector, and implementing a robust PPP framework and bidding process can sensibly encourage a more efficient use of resources. In the realization of PPP projects in fact, it is a priority and interest of the private party to properly consider the long-term implications of the design costs, the construction quality of the asset and budget for long term maintenance, which is often lacking in traditional forms of public sector procurement.

- *Capital at risk to performance.* The explicit exposure of capital invested by the private sector gives an incentive to design and build the asset on time and within budget. Furthermore, the capital exposure to long-term performance of the asset/infrastructure service has the pronounced effect of bearing the asset over its entire lifetime.

- *Quality assurance.* Compared to standard public procured processes, PPP projects can ensure a greater level of quality assurance. The successful engagement of the public sector with the market and the effectiveness of long term PPP contracts rely on robust legal, regulatory and implementation frameworks. Moreover, private parties such as lenders and investors, which will directly provide capital, rely on revenue streams based upon the long term performances of the service delivered/asset built.

- *Close examination.* The long-term horizon of PPP processes requires a detailed breakdown analysis of risks, costs and benefits that the project will face. Therefore, more prominence will be placed on outcomes, outputs and associated standards compared to conventionally procured projects.

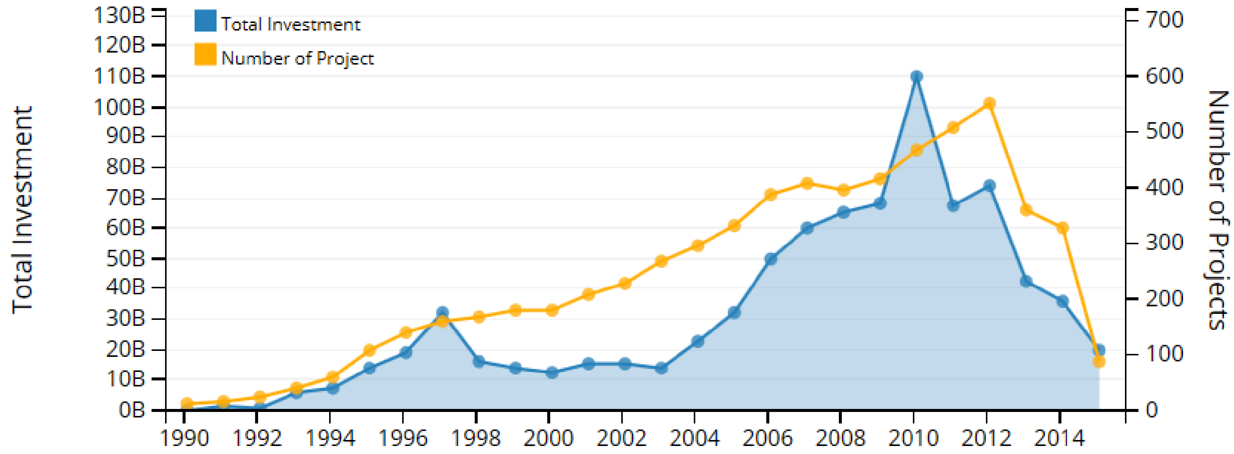


Figure 1: Investment commitments to public-private infrastructure projects in emerging countries, 1990-2015. Source: WBG, PPI project database.

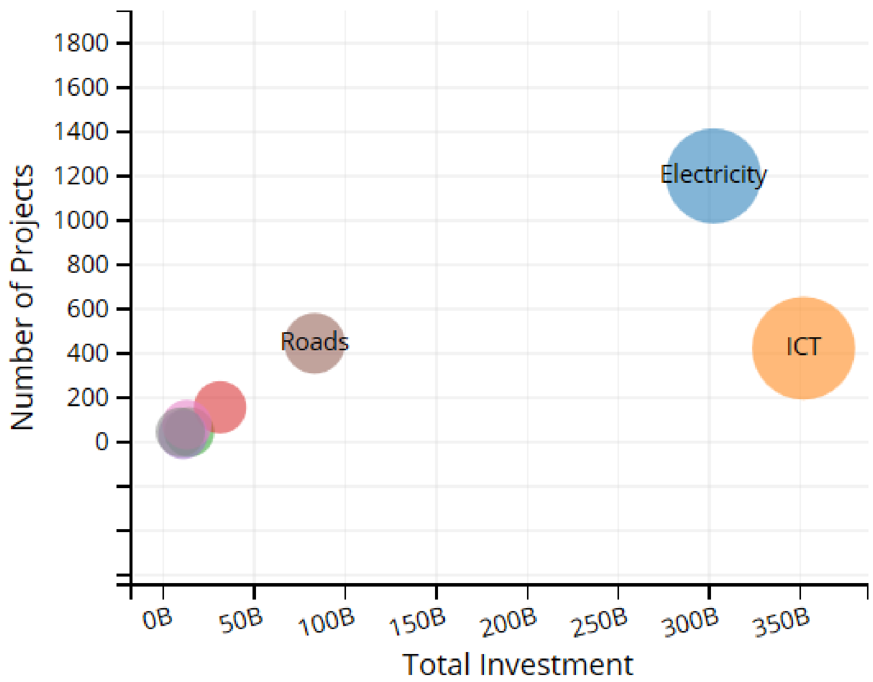


Figure 2: Breakdown analysis of investment commitments to public-private infrastructure projects in emerging countries, by sector, 1990-2015. Source: WBG, PPI project database.

The process of PPP projects can be summarized into a different series of well-defined phases (see Figure 3), many of which may also be used in the context of traditional public procured projects. However, it is paramount to underline that "traditional project procurement has usually more focused on inputs and so PPPs require a fundamental change in the way projects are prepared and in the nature of the information that needs to be provided to private sector bidders. In details, private sector investors will require contractual and regulatory certainty as a precondition of participation in PPP and expect to understand from an early stage the risks will be asked to assume and share" (The World Bank, 2011).

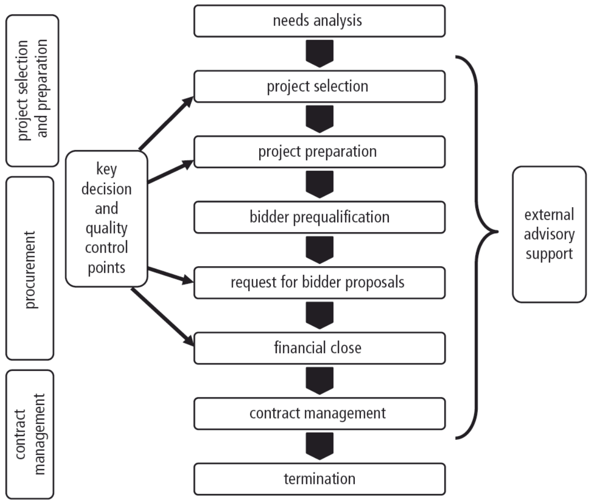


Figure 3: Fundamental phases of PPP project process (The World Bank, 2011).

Enabling framework for public-private partnerships

The engagement of the private sector is perceived as an essential strategy for accelerating and implementing infrastructure projects. At the same time, a strong leverage of the private sector can be only achieved by the implementation of a favorable, transparent and long-term sustainable PPP framework and management process. The setup of the right PPP framework varies accordingly to the unique political and institutional capacity of every separate country, but generalized guidelines can be provided for drawing a sustainable implementation route. These recommendations are:

- *Policy framework.* Setting up a clear policy framework is paramount to explain the core rationale and the implementation process of PPPs, both for the public and the private sector. The latter expects to operate counting on a PPP policy framework that can set out essential principles such as (The World Bank, 2011):

    1. PPP proclamation and detailed guidelines that will be used by the public sector to select, prepare, and procure PPP projects.
    2. Assigning key roles, obligations and core management responsibilities through the entire PPP value chain, from project selection and preparation to procurement and contract monitoring
    3. Process of handling and resolving disputes.

- *Legal and regulatory framework.* The engagement of the private sector and the likelihood of successful PPPs rely on the governments´ capacity of implementing an effective legal, regulatory, institutional and contractual framework, which will be able to ensure and support long term PPP contracts. The right legislation setup may range from allowing the public sector to contract with private bodies for the delivery of typically public infrastructure services (such as electricity or water) to the establishment of a transparent implementation process, driven by a sturdy independent regulator. Private investors will also look for financial viable contracts as well as for transparent mechanisms to monitor the project and clear out liabilities and potential disputes, which may rise during the lifetime of the project (The World Bank, 2011).

- Investment framework. Governments should undertake realistic and coherent investment plans and project pipelines to demonstrate how and in which extent the PPPs will play a credible role in the development of specific programs. It is also crucial both for the public and the private sector, that PPPs are envisaged as project-pipelines in specific sectors, rather than an isolated project-event. Establishing bankable PPP pipelines is fundamental to enhance the likelihood of receiving more bids from high-quality investors and the replicability in terms of costs and quality of the PPP process (The World Bank, 2011).

- *Implementation framework.* PPPs programs are generally successful only if the strong government commitment is backed up by the choice of a successful PPP DG or "champion" appointed to drive the PPP agenda (World Bank Group, 2014). PPPs programs indeed tend to have significant differences from traditional public forms of procurements and quite often governments fail to identify or properly perform the new required processes and functions. "When governments are unable to undertake these functions efficiently, for instance due to the lack of expertise or other constraints, various institutional solutions exist to implement these tasks such as a coordinating agency, PPP DG, external consultants, etc." (The World Bank, 2011). As highlighted by (Sanghi et al., 2007), "if a specialized PPP DG is created, it must be able to perform these functions effectively. That means it needs to be given the necessary executive authority rather than simply act as an advisory body".

PPP DDGs - International experiences and lessons learned

The qualitative assessment of eight PPP DDGs in various developing and developed countries points to some lessons with regard to the appropriate design and use of PPP DDGs and some reasons for the positive correlation between successful PPP programs and the use of PPP DDGs.

- Less effective governments tend to have less effective PPP DDGs. Lack of political commitment to advance a PPP program or lack of transparency and coordination within government agencies will reduce the chances of success for a PPP DDG. Even with a good design, a PPP DDG is unlikely to be effective in such an environment.

- Without high-level political support for the PPP program, a PPP DDG most likely will fail.

- Relatively successful PPP DDGs directly target specific government failures. A clear focus on responding to particular government failures is essential to ensuring the success of the institutional solution selected.

- The authority of a PPP DDG must match what it is expected to achieve. If a PPP unit is expected to provide quality control or assurance, it needs the authority to stop or alter a PPP that it perceives to be poorly designed. However, this executive power must be coupled with a mandate to promote good PPPs, or the unit may simply wield a veto without adding value.

- A PPP DDG's location in the government is among the most important design features, because of the importance of interagency coordination and political support for a PPP DDG's objectives. In a parliamentary system, a PPP DDG is most likely to be effective if located in a strong ministry of finance or treasury. In non-parliamentary systems, such as the presidential system of the Philippines and many Latin American countries, the best location for a PPP DDG is less clear. In a country with a strong planning or economic policy coordination agency, that agency might make a natural home for a PPP DDG.

Sources: (Sanghi et al., 2007), (The World Bank, 2011).

Public-private partnerships in the energy sector

Tapping and mobilizing private capital and resources is one of the key-components to scale up generation and transmission & distribution capacity, and increase electricity supply. Focusing only on power generation (renewable energy included), PPPs are typically represented by independent power producers (IPPs), which design, finance, build, operate, maintain and decommission a power generation plant and contract to sell the electricity generated to a publicly owned power utility.

The specific requirements and circumstances of a country contribute to determine the unique structure of the created partnership and its methodology of operation (The World Bank, 2015). IPP projects have been developed in many different countries and power market environments, from purely deregulated electricity markets or power markets regulated by vertically integrated state-owned utilities to hybrid-market structures where public and private investments coexist.

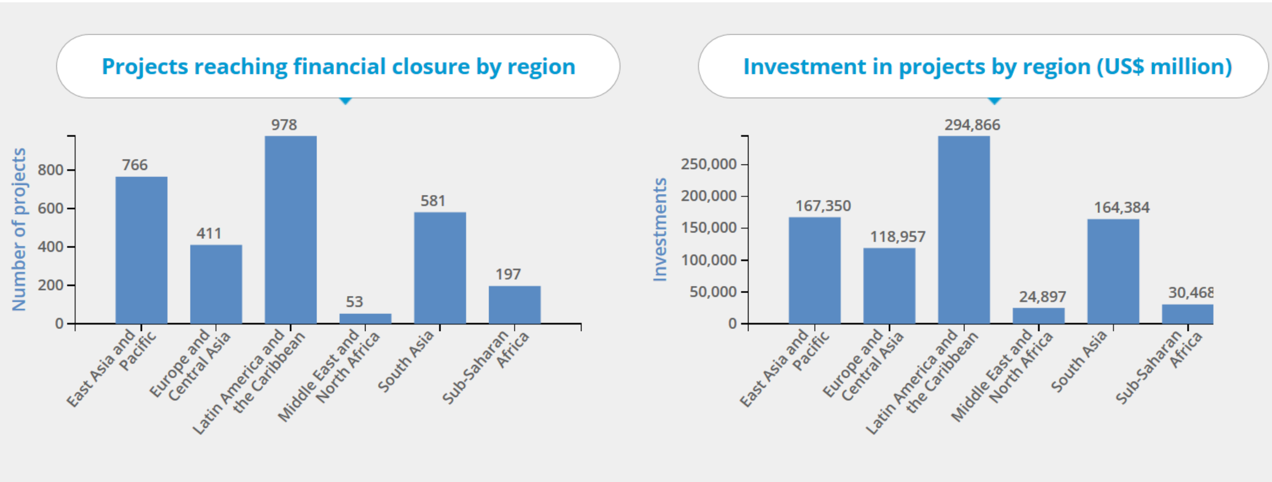


Figure 4: Private participation activity in the electricity sector, 1990-2015 (power generation plus transmission & distribution). Source: WBG, PPI project database.

Beyond the different topology of the enabling environment, deciding factors for supporting IPPs include a fair competition and transparency of the procurement and contracting process, the establishment of independent regulation and reforms in the electricity power market, long term and cost-effective planning strategies for generation and transmission & distribution, and noteworthy efforts to improve financial health of off-takers (utilities or private companies). The recent trend of transformation and liberalization of power markets in Latin America is indeed one of the best examples of this excellent synergy between public and private in the development of PPPs and IPP projects in the electricity sector (see Figure 4).

As pointed out by (Eberhard et al., 2016), different factors and elements are necessary to unlock sustainable IPP investments in emerging countries. The most representative ones for Sub-Saharan Africa have been summarized in the following table. The majority of them will be discussed and contextualized afterwards in this report (chapter 5 and 6), specifically for IPP wind projects.

Factor	Detail
Country level	
Stable country context	Stable macroeconomic policies Legal system allows contracts to be enforced, laws to be upheld, arbitration Good repayment record and investment-grade rating Previous experience with private investment
Clear policy framework	Framework enshrined in legislation Framework that clearly specifies market structure and roles and terms for private and public sector investments (generally for a single-buyer model, since wholesale competition is not yet seen in the African context) Reform-minded "champions" to lead and implement framework with a long-term view
Transparent, consistent, and fair regulation	Transparent and predictable licensing and tariff framework Cost-reflective tariffs Competitive procurement of new generation capacity required by regulator
Coherent power sector planning	Power planning roles and functions clarified and allocated Planning function skilled, resourced, and empowered Fair allocation of new build opportunities between utility and IPPs Built-in contingencies to avoid emergency power plants or blackouts
Competitive bidding practices	Planning linked to timely initiation of competitive tenders/auctions Competitive procurement process adequately resourced and fair and transparent

Project level

Favourable equity partners	Local ownership & local capital/partner contribution if possible Risk appetite for project Experience with developing country project risk Involvement of a DFI partner (and/or host country government) Reasonable, fair and competitive ROE Development-minded firms
Favourable debt arrangements	Competitive financing Local capital/markets that mitigate foreign exchange risk Risk premium demanded by financiers, or capped by off-taker, matches country/project risk
Creditworthy off-taker	Adequate managerial capacity Efficient operational practices Low technical losses Commercially sound metering, billing, and collections Sound customer service
Secure and adequate revenue stream	Robust PPA (stipulates capacity and payment as well as dispatch, fuel metering, interconnection, insurance, *force majeure*, transfer, termination, change-of-law provisions, refinancing arrangements, dispute resolution, and so on) Security arrangements where necessary (escrow accounts, letters of credit, standby debt facilities, hedging and other derivative instruments, committed public budget and/or taxes/levies, targeted subsidies and output-based aid, hard currency contracts, indexation in contracts)
Credit enhancements and other risk management and mitigation measures	Sovereign guarantees Political risk insurance (PRI) Partial risk guarantees (PRGs) International arbitration

Strategic management and relationship building	Sponsors who work to create a good image in the country through political relationships, development funds, effective communications, and strategic management of their contracts, particularly in the face of exogenous shocks and other stresses
Positive technical performance	Efficient technical performance high (including availability) Sponsors who anticipate potential conflicts (especially related to O&M and budgeting) and mitigate them

Table 1: Factors contributing to successful independent power project investments in emerging countries (Eberhard et al., 2016)

Independent power producer projects in Sub-Saharan Africa

According to the IEA New Policies Scenario in the World Energy Outlook (IEA, 2016), Sub-Saharan electricity demand is expected to more than triple by 2040, and reach 1,300 terawatt hours (TWh) under current and proposed government policies and measures. The cost of addressing the needs of Sub-Saharan Africa's power sector has been estimated at USD 40.8 billion a year, which is equivalent to 6.35% of Africa's gross domestic product (GDP). If a massive power sector development is to be successfully supported, significant investments are therefore needed, including a larger capitalization of private investments for accelerating this crucial transition (IEA, 2016).

Although public utilities and governments have historically been the major sources of funding for new power generation capacity, the trend is currently changing. In fact, the majority of African governments are unable to finance their power needs through public funds, and most African utilities do not have investment-grade credit ratings, so they cannot raise sufficient debt at affordable rates. Official development assistance (ODA) and development finance institutions (DFIs) have played and still play a key role in facilitating and filling gaps for attracting private investments in the region. Currently, private investments in IPPs projects and Chinese funding are currently the fastest-growing sources of finance for Africa's power sector (see Figure 5 and Figure 6). By the end of 2014, IPP projects have been developed in 18 different Sub-Saharan countries. Among them, 59 projects (6.8 GW of installed generation capacity with a total investment equal to USD 11.1 million) were located outside South Africa, mainly in Nigeria, Kenya, Côte d'Ivoire, Ghana, Uganda, and Tanzania. If South Africa is also included, the total number of IPPs projects rise to 126, with an overall installed capacity of 11 GW and investments of USD 25.6 billion (Eberhard et al., 2016).

Type of investment	*Debt and equity (US$, millions)*	*MW added*	*% of total MW*	*% of total investment*
Government and utilities	15,883.87	8,663.26	43.66	50.67
IPPs	6,950.12	4,760.60	23.99	22.17
China	5,009.80	3,263.73	16.45	15.98
ODA, DFI, and Arab funds	3,506.48	3,156.15	15.91	11.18
Total	**31,350.27**	**19,843.73**	**100.00**	**100.00**

Figure 5: Total investment in completed power generation plants: Sub-Saharan Africa (excluding South Africa), 1990-2013 (Eberhard et al., 2016).

The majority of the IPP capacity contracted in Sub-Saharan Africa is thermal power, mostly represented by open and combined-cycle gas turbines (OCGT, CCGT). Besides that, the momentum and growth of renewables in the power generation mix have been remarkable in several countries. Among them, South Africa has developed the most ambitious renewable energy IPP procurement programme (REIPPP), where solar PV and onshore wind represented the greatest portion of the added capacity.

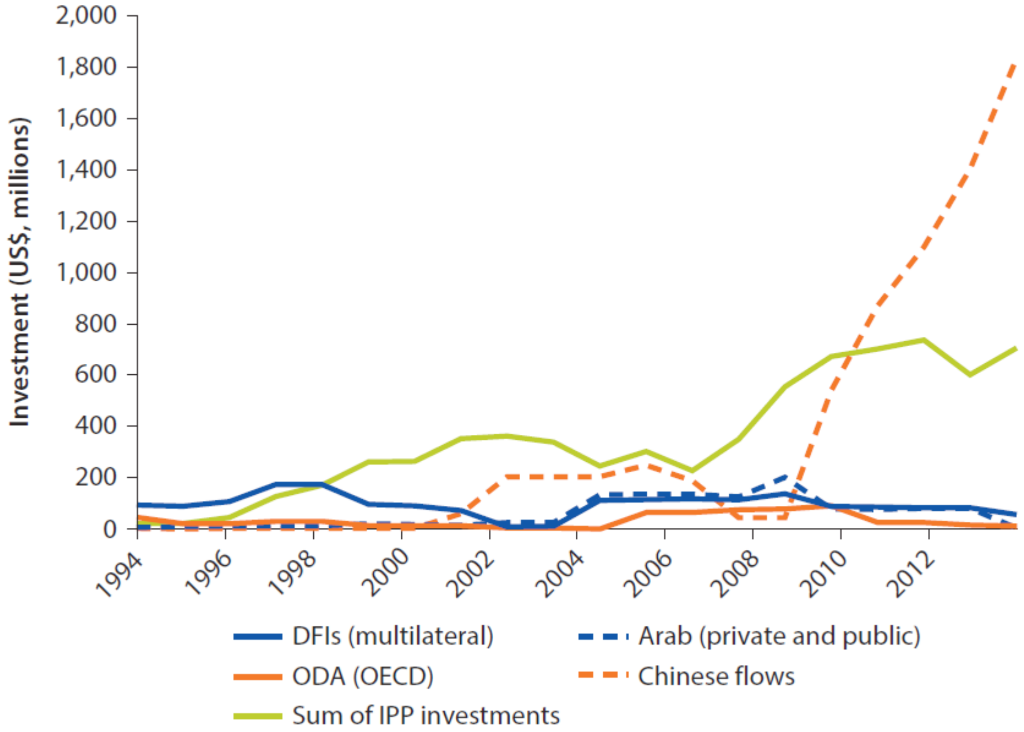


Figure 6: Investments in power generation in Sub-Saharan Africa (excluding South Africa), 1994-2013 (Eberhard et al., 2016). DFIs investments in IPPs are excluded from the analysis.

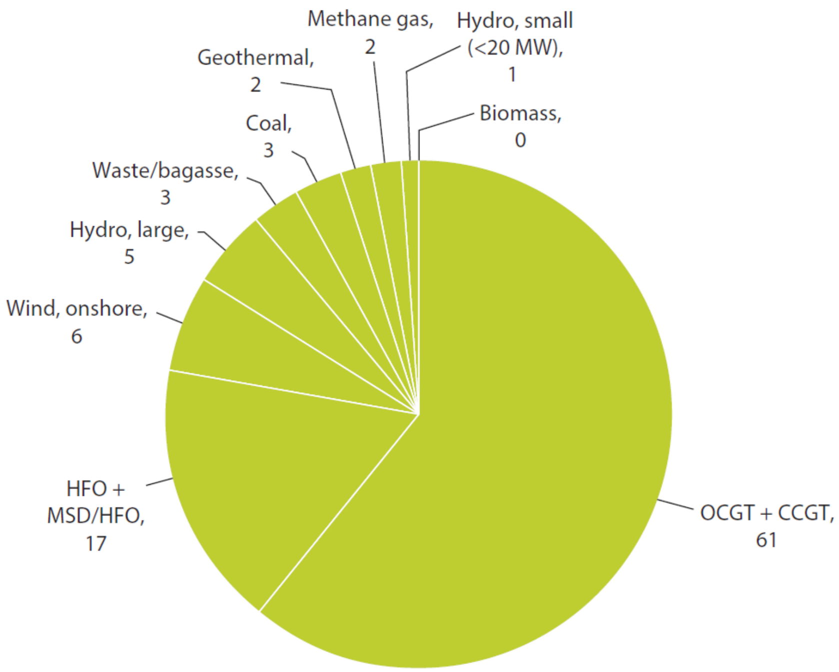


Figure 7: Independent power project technology capacity (% of MW) in Sub-Saharan Africa (excluding South Africa), 1994-2014 (Eberhard et al., 2016).

Ethiopia

In 2015, the country awarded its first-ever power purchase agreement to an Independent Power Producer (IPP) for the realization of the Corbetti 500 MW geothermal power plant. As specified in the Ethiopian Growth & Transformation Plan II (GTP2, 2015-2020), the GoE is planning to increase its power generation by 17,000MW from different renewable sources, including wind (1,200 MW). The majority of this power expansion is intended to be developed by the private sector through IPP tender auctions. The table below provides a detailed overview of the generation projects included in GTPII and their modalities of financial implementation.

No.	Energy Source	Power Plant	Size (MW)	Energy (GWh)	CAPEX (MUSD)	Project Finance
1	Hydro	Geba 1 + Geba 2	372	1749	572	Government
2		Genale 6	246	1542	588	Government
3		Sor	50	350	186	Private
4		Upper Dabus	326	1460	628	Private
5		KoYisha	2160	6500	2689	Government
6		Birbir	467	2759	1231.1	Private
7		Werabesa + Halele	436	2028.6	886	Private
8		Yeda 1 + Yeda 2	280	1101.8	540	Private
9		Genale 5	100	577.7	298	Private
10		Tams	1700	5760	3241.5	Private
11		WabiShebele	87	693.2	887.8	Private
12		Lower Didessa	550	987	619.2	Private
13		Tekeze II	450	2768	1690.4	Private
14		Lower Dabus	250	640	866.3	Private
15		Gojeb	150	569.7	526.8	Private
Total			**7579**	**29174.5**	**15282.7**	
1	Geothermal	Corbetti Phase I	200	1577	760	Private
2		Corbetti Phase II	100	788	760	Private
3		Corbetti Phase III	200	1577	1140	Private
4		Aluto II	70	552	266	Private
Total			**570**	**4494**	**2660**	
1	Wind	Ayisha	300	954	570	Private
2		Debrebirihan	100	318	190	Private
3		Adama III	150	477	285	Private
4		Other Sites	1050	3339	1995	Government
Total			**5200**	**18761**	**11210**	
1	Solar	Metehara	100	175.2	210	Private
2		Mekele	100	175.2	210	Private
3		Humera	100	175.2	180	Private
4		Other Sites (including 500 MW for IFC Scaling solar programme)	4900	8584.8	8820	Private
Total			**5200**	**18761**	**11210**	
1	Biomass	Different Sites	420	3091	865	Private

Table 2: Planned generation projects (2015-2025) with their implementation scheme (Lemma, 2017), (Fekede, 2017).

As highlighted by (UNDP, 2015), the implementation of sound and robust IPP/PPP projects depends on the existence of an appropriate legal framework as well as political certainty. In January 2018, the GoE has passed the comprehensive Public-Private Partnership Proclamation. The main scope of the PPP proclamation is the establishment of a legislation and institutional framework for PPPs, which will be led by a decision-making public agency with a full mandate at the federal level. So far, the lack of an appropriate PPP/IPP legislation, existing laws and regulation limits have been seen as main constraints for fostering IPP/PPP projects in the country.

Main constraints and challenges for IPP projects in Ethiopia

- Lack of regulatory and legal framework
- Lack of skilled taskforce of experts for PPPs
- Limited human resources
- Re-allocation of several projects from EPC to IPP procurement modalities
- “Fast-track” approach for the implementation of projects, regardless of their procurement modalities (EPC/IPP, direct negotiation/competitive bidding)
- Large amount of land required (especially for solar projects)
- Issues for guarantees instruments and letters of credit
- Convertibility and Transferability issues
- Use of Offshore Foreign Exchange (FX) Account Restriction
- Use of Onshore FX Account Limitation
- Priority Access to Foreign Exchange
- EEP Financial Viability
- Lack of Streamlined assistance from donors or DFIs

Source: Lemma, 2017

Development process for wind energy projects

The project viability of a wind farm is an iterative and multi-disciplinary process which encompasses technical, regulatory, commercial and financial elements. Due to the complex nature of the investment case, key stakeholders should approach the process through a step-by-step decision-making procedure, which will gradually assess the viability of the business case. The figure below provides a visual roadmap of the development process for onshore wind projects.

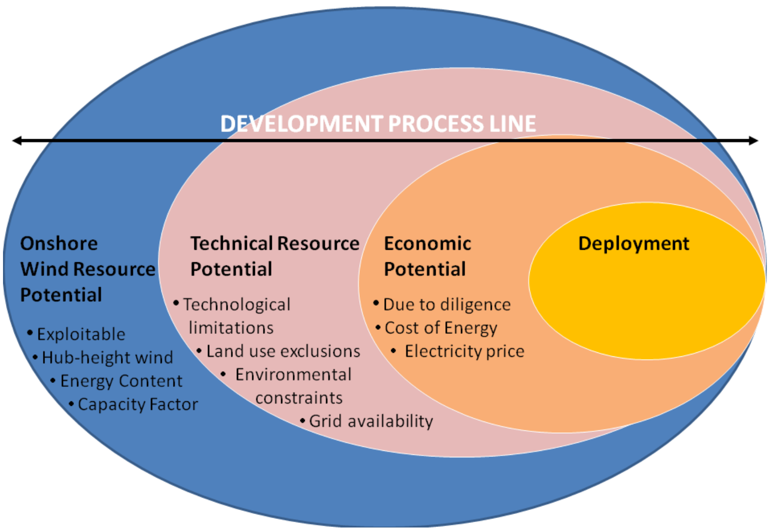


Figure 8: Development process line for onshore wind projects.

The diagram below shows the basic contractual structure of a project financed wind farm.

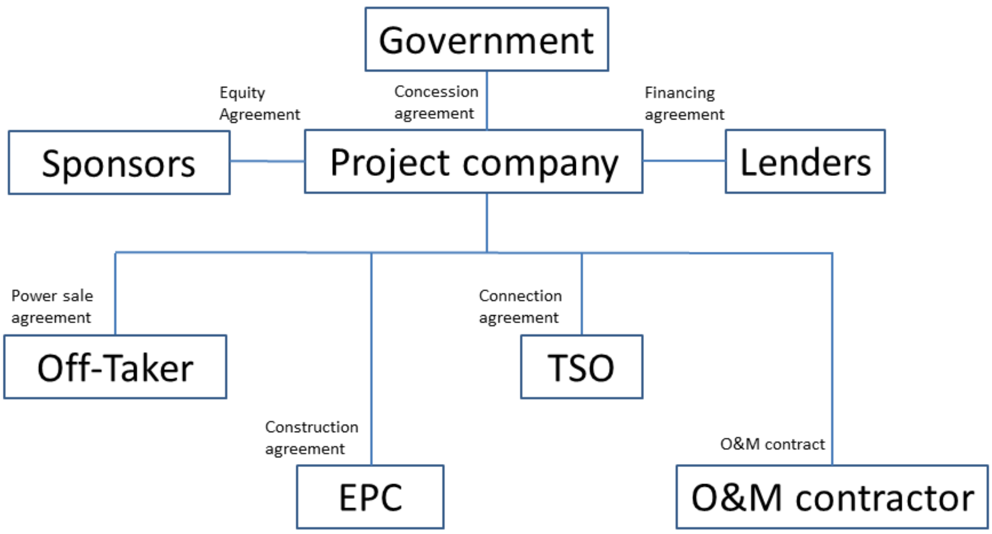


Figure 9: Stakeholders and parties involved in the development of wind energy projects.

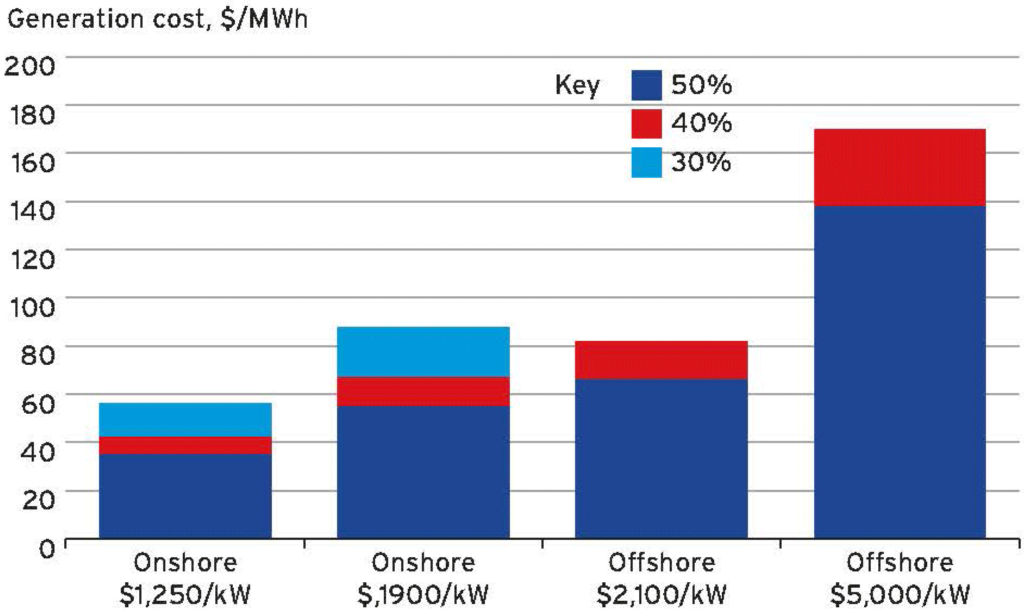
The detailed contractual structure will vary from project to project, depending also on the procurement strategy used, the contract terms and the allocation of liabilities and risks. Nevertheless, the business case of onshore wind projects may be enclosed in these main assessment areas:

- Wind resource assessment
- Site selection
- Grid proximity and connection
- Planning and environmental approvals
- Power sale
- Project financing and bankability
- Procurement process and construction
- Operation and maintenance
- Decommissioning or repowering

The themes mentioned above will be described in details, and specific analysis and guidance will be provided for the Ethiopian case. It should be mentioned that this report focuses on pre-development, project management and operational aspects of onshore wind farms. Therefore, analysis won´t be provided for the decommissioning or repowering process of wind farms, since it is out of scope for this specific work.

1. Wind Resource Assessment

An accurate wind energy resource assessment is probably one of the most important elements in identifying viable wind projects. Since the power available in the wind is a cube function of the wind speed, small changes in average wind speeds have a large impact on the energy output. Just for reference, if the wind speed is doubled, the wind power increases by a factor of 8. Hence, the project viability of a wind farm is extremely sensitive to accuracy and magnitude of wind resources. Figure 10 provides an exhaustive explanation of this strict correlation comparing the costs of wind projects as a function of the wind speed and the capacity factor.



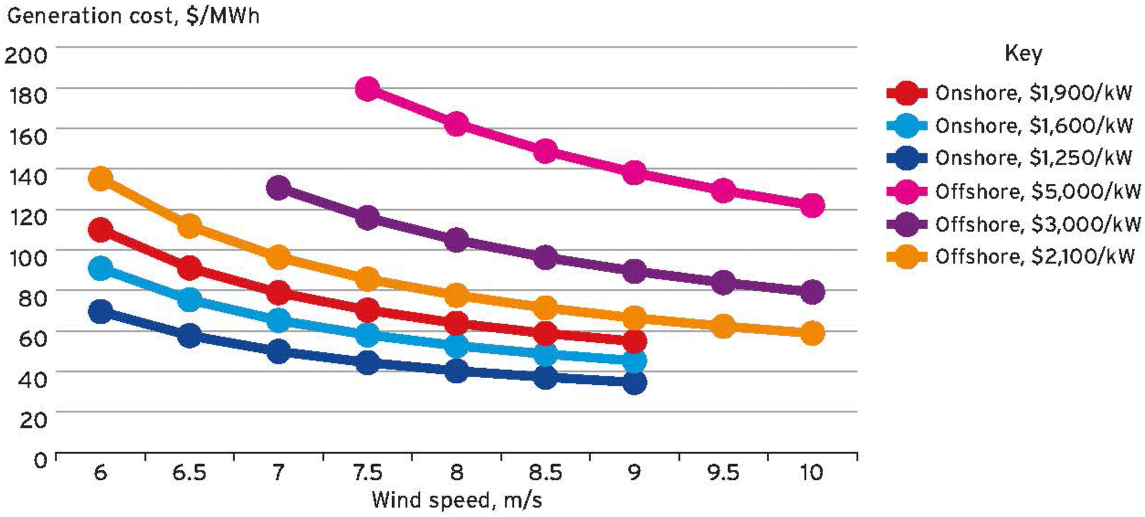


Figure 10: Wind energy costs as a function of wind speed and capacity factory (Milborrow, 2017).

Furthermore since winds vary both on short and long-term (time of day, seasons, etc.), accurate wind studies on specific sites have to focus on multiple aspects of the data such as mean annual wind speed, frequency distribution of the wind at various speeds, turbulence intensity, wind shear, and maximum gusts (extreme wind events). These parameters are critical for estimating the potential energy in the wind as well as the choice of turbine technology for the specific site.

For project developers and governments which would like to exploit wind resources, the starting point of the wind resource assessment is the examination of wind resource maps for a specific country or region (if they already exist). The most accurate way to develop wind resource maps is through the Wind Atlas methodology and advanced programs such as Computational Fluid Dynamics and WAsP/WindPRO. The method makes it possible to transform wind data from existing meteorological masts and extrapolate wind properties at specific sites with a radius up to 200 km. This new set of data enables project developers to develop accurate calculations on the expected energy yield at the selected sites.

However, the sensitivity of energy production to wind speed requires further analyses by actual on-site measurements. This is usually achieved during the project feasibility stage through the installation of wind monitoring equipment on-site. The longer the duration of the wind study is, the more accurate the production estimates will be. Generally, the time window of wind data acquisition for on-site wind measurement campaigns ranges from 1 to 5 years with a 10-minute time resolution.

The data collected can be then sorted into bins of wind speed classes of 1 m/s each and the energy contained in the wind at a certain site may then be expressed by a frequency distribution. Usually, the Weibull distribution is often a precise approximation for the wind speed distribution. From a mathematical point of view, the Weibull function is strictly dependent on two site-specific parameters: A and k. The former is called Weibull scale parameter, which is proportional to the mean wind speed of the site, while k is called shape parameter. Small values for k imply very variable winds with repeating extreme winds events, while constant winds are characterized by larger k values. For k=2, the Weibull distribution yields to a Rayleigh distribution.

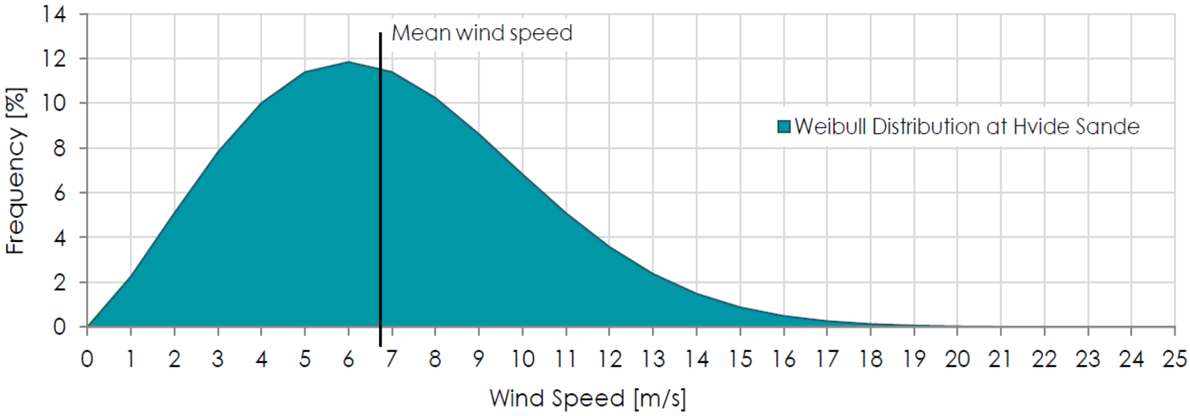


Figure 11: Weibull distribution of the wind speeds at the Danish site Hvide Sande (DEA et al., 2017).

Production estimate

When wind data has been collected and quality is checked, the annual energy production (AEP) of a wind farm may be evaluated. Its calculation is strictly dependent on several parameters:

- Wind turbine power curve (which relates for each wind speed the energy produced by a specific wind turbine model)
- Meteorology of the site (atmospheric stability, air density, etc.)
- Project site size (which reflects the wind power capacity installed)
- Estimated losses due to wind turbine placement, electrical losses and unavailability.

Since the AEP value varies from turbine to turbine, the choice of the appropriate wind turbine model for a specific site is a complex aspect of the development of a wind farm. Hence, a winning strategy for the selection of wind turbines should be based on optimizing the economic feasibility of the project as well as taking into account site-specific characteristics and constraints. On this last matter, topographical data of the site, proximity to obstacles and wind data collected are critical aspects for the selection and correct placement of wind turbines (micro-siting). The detailed wind turbine classification will be explained in chapter 2.

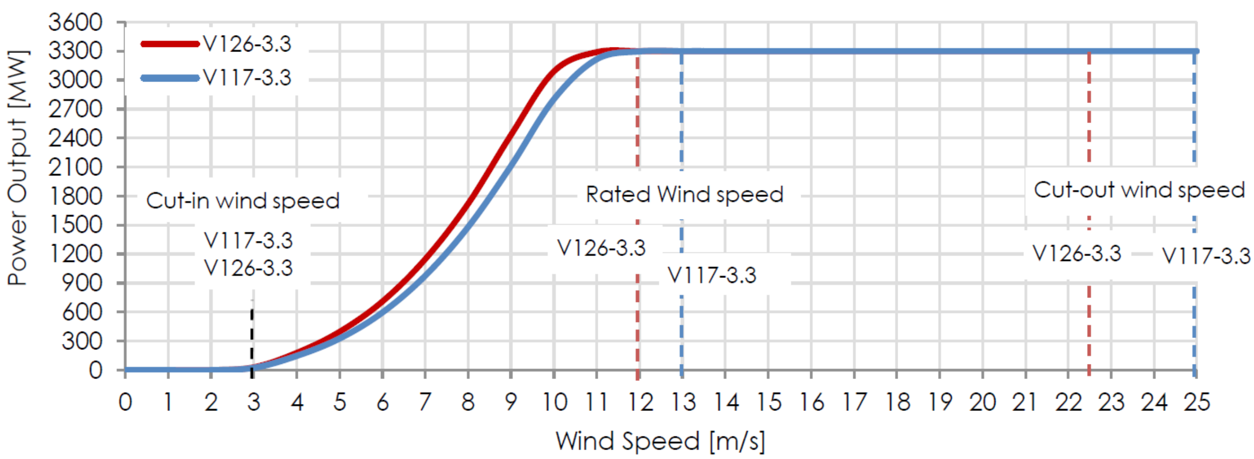


Figure 12: Power curve of the V117-3.3 and V126-3.3 turbine (DEA et al., 2017).

The stochastic nature of the wind has also a direct influence, referred as uncertainty, on the estimation of the annual energy yield. Typically, the expected yearly production of a wind farm is specified at different probability values (Pxx). These probability values represent the probability that the energy production estimate will be exceeded. In the wind industry, it is common modelling energy yields for P50, but financial institutes usually require P75 and P90 probability values. Higher the probability is, more conservative and less uncertain is the estimate of energy production for project developers and investors. It should be mentioned that recently financial institutions and governments start to require wind study documentation from independent consultants for obtaining project finance closure.

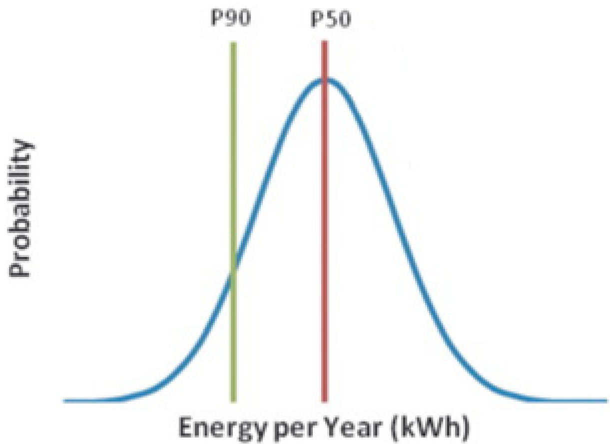


Figure 13: Probability distribution of annual energy production. Source: Renewable Energy Focus.

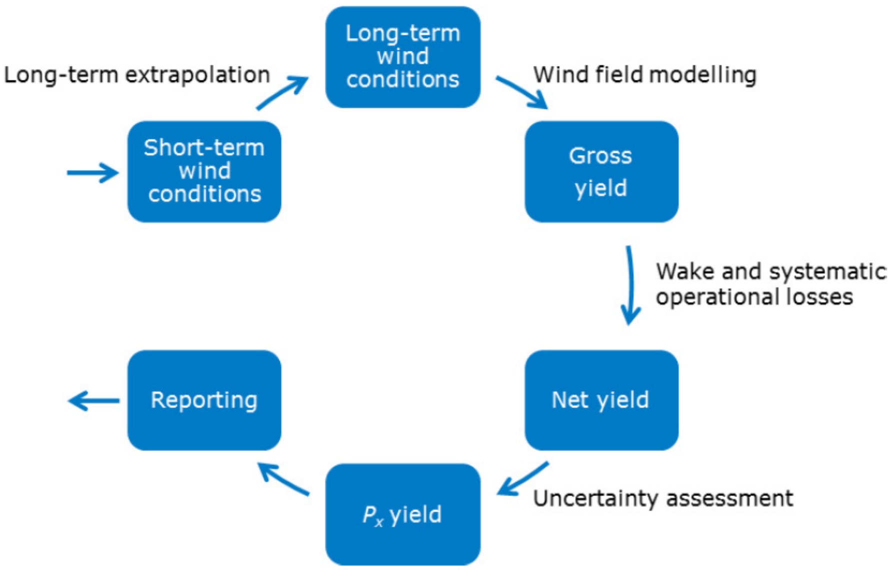


Figure 14: Main steps in the energy yield assessment process (MEASNET, 2016).

1.1 Ethiopia

Ethiopia is one of the countries included in the World Bank programme ESMAP. This initiative will guide the future scaling-up of wind power in Ethiopia by confirming the resource potential and supporting the GoE and commercial developers in utilizing the data obtained. The wind resource campaign can be divided into three different phases (ESMAP, 2016):

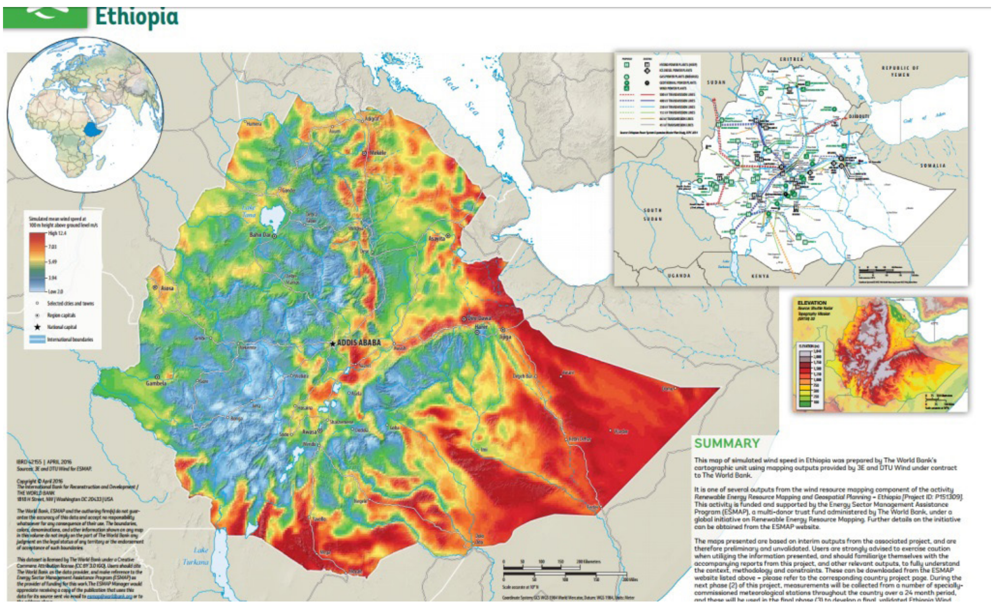


Figure 15: Mesoscale wind resource map of Ethiopia (ESMAP, 2016).

Phase 1

The wind mapping process is developed by means of a "model-measure-remodel" technique. The mesoscale modelling is derived from available global meteorological reanalysis data such as Modern-Era Retrospective Analysis for Research & Applications (MERRA). Based on this data, further modelling runs are implemented to obtain higher levels of resolution including as well climate effects outside the country of interest (trade winds). The final modelling run will usually cover a minimum of 10 years of historical wind data for each grid cell in the country, at multiple heights, down to a frequency of 10 minutes. An unvalidated mesoscale wind resource model of Ethiopia is presented in Figure 15.

Phase 2

To validate the modelling outputs of Phase 1, ground-based wind measurement data is needed from across the country at multiple heights. Sometimes wind data is available from meteorological weather stations, but usually, their use for wind power validation purpose is very limited due to poor maintenance or absence of wind masts at 50+ meters above the ground level. Hence, it is often necessary to commission a series of wind measuring sites. Generally, a standard wind measurement site consists of a lattice or tubular tower, where at least anemometers and wind vanes at vertical intervals of 20m are mounted to take wind speed and direction measurements. The current industry standard height is set at 80m (with anemometers at 20m, 40m, 60m and 80m). Usually, such data is measured from sites of high interest to developers. It is also essential that this measurement data is accompanied by other relevant metadata, such as full site reports, installation reports, photographs, and other supporting evidence that will enable the mesoscale modellers to determine the characteristics and quality of the data being provided.

The properties of a high-quality measurement campaign, according to (Jain, 2010) and (McCrone et al. 2014), can be summarized as follows:

- Use a high-quality (Class I anemometer) calibrated anemometer, as close to hub height as possible (preferably > 2/3 of hub height). Install anemometers, preferably at three heights, so that vertical extrapolation may be accurately performed.
- Use redundant anemometers so that potential for loss of data due to tower shadow or sensor failure is minimal. Use long booms to minimize the impact of flow distortion.
- Deploy two or more met-masts for a wind farm site, preferably one met-mast for every 5-8 turbines or 10–20 MW capacity (the lower number is for a complex terrain and the higher number for a simple terrain).
- Collect and analyse daily data feeds rigorously. Ensure that raw data is archived and an audit trail exists for data corrections, so that the data can be independently verified.
- Collect data for at least 1 year; if the measurement is done for more than 1 year, then collect data for a full 2 or 3 years.

Phase 3

When sufficient data is gathered to enable validation, a final, validated Ethiopia Wind Atlas will be developed and made publicly available. Specifically for the first Ethiopian IPP wind tenders and for other prioritized sites, 17 different wind masts and one LIDAR will be erected and wind measurements will be carried out for one to two years in compliance with the international standard IEC 61400-12-1 (MEASNET, 2016). Furthermore, due to the complexity of terrain in many of the relevant Ethiopian sites, more than one measurement mast may be needed per site. It should be emphasized that having measurements for more than one year can further improve the accuracy of the wind data and reduce the uncertainty of the availability of wind resources as well as estimates of AEP. The possibility to relay on wind measurements data for two years is one of the main scopes of the measurement programme, but its successful implementation may be affected by delays in implementation. The measuring campaign is led by the World Bank Group.

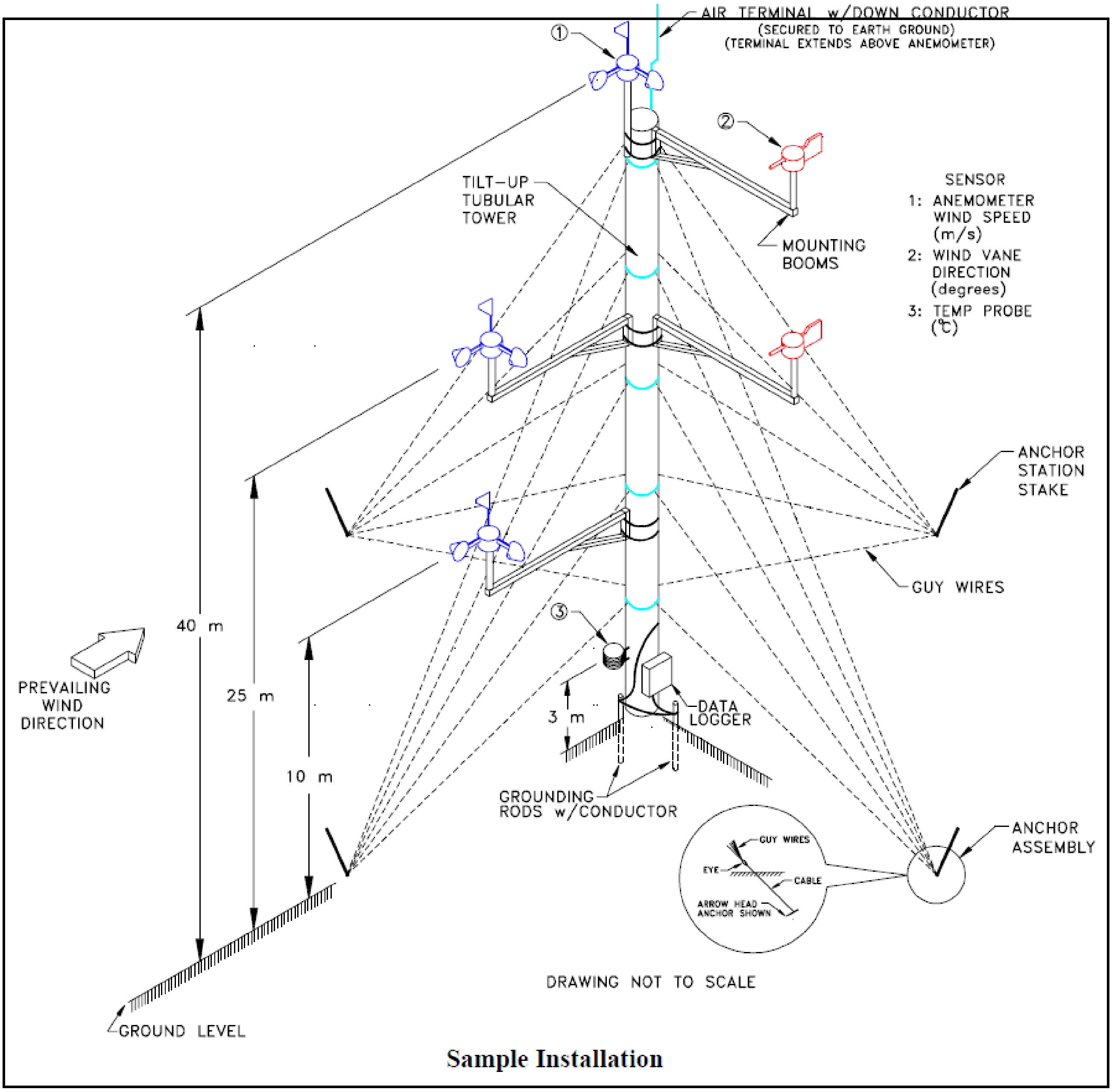


Figure 16: Sample installation configuration for wind sensors and equipment (NREL, 1997).

Burden and regulatory framework

The choice of developing wind resource campaigns on specific sites makes possible to produce early data in short time as well as estimates of annual power production for IPP developers and investors. These on-site measurements have to be correlated with regional long-term wind data, usually acquired from meteorological weather stations. The accuracy of this data in Ethiopia may be objected by project developers and investors and introduce high uncertainty on the AEP estimate, especially for correlating short-term wind data with the long-term one. The reason is that there may be few or no long-term quality wind measurements at 50+ meters above the ground level (referred to as observed data sets), which form the primary input to computing long-term wind data sets. By lacking good-quality long-term wind data and low correlations with concurrently measured data, financiers may require developers to measure wind speed up to 3–5 years (Asian Development Bank, 2014). Figure 17 further clarifies the impact of short and long-term wind conditions on the estimated yearly production of a wind farm sited in Egypt. The AEP value indeed varies by ±12% from the long-term average during the 11-year time horizon.

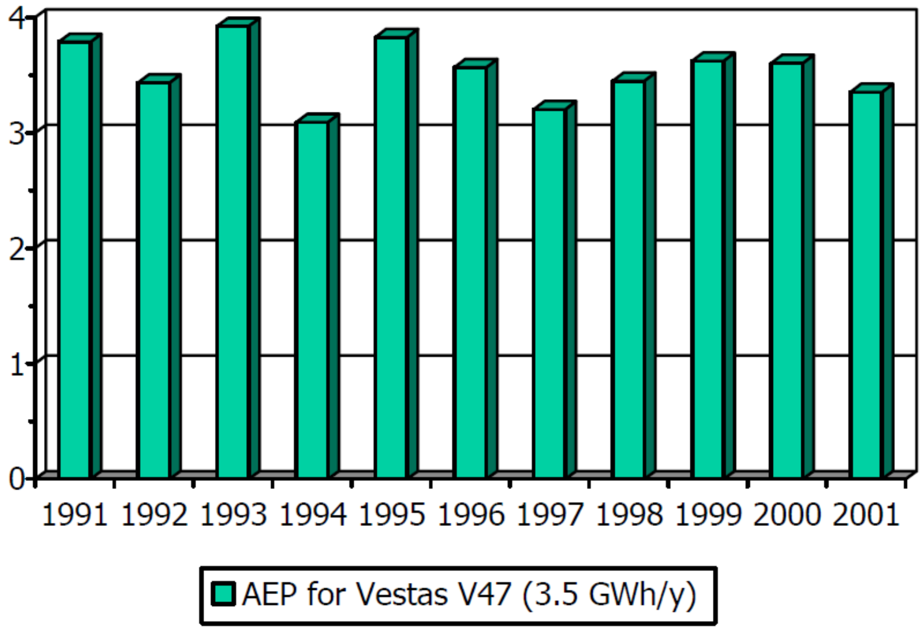


Figure 17: Year-to-year variation of the estimated production from a Vestas V47 wind turbine close to Abu Darag. The average production for the 11-year period is 3.5 GWh/y (DTU, 2004).

As previously stated, whereas on the one hand financial institutions and governments have recently required documentation of wind resource assessment from independent professionals, on the other hand, project developers are usually the responsible ones to appoint consultants for performing wind studies. Concerning this specific issue, let´s provide an example for an exhaustive analysis (see Figure 18).

One should consider leading an on-site wind measuring campaign. The results of the measurement campaign may lead to uncertainties of the actual wind farm performance. Sources of uncertainty are usually represented by wind speed measurement, wind speed extrapolation (spatial, vertical, and temporal), power curve, wake, air density, etc. In developed renewable markets and regions with well-documented wind data, total uncertainty (measured in terms of standard deviation of AEP as a percentage of average AEP) is about 10-16%, and for newer renewable markets, it may easily reach values up to 20–25% (Asian Development Bank, 2014).

Considering the results of Figure 18, let´s assume a reference case with no uncertainty in the wind measurement campaign (δ= 0.0%) and a scenario with a negative uncertainty of δ= -16% (lower wind speed than the base case campaign estimate). The latter leads to an energy estimate 30% lower than the reference case and to an internal rate of return (IRR) value 56% lower. Hence, the impact of the wind speed estimate is crucial for the project economy, and consequently, the uncertainty associated with the AEP has a strong lock-in effect on the project bankability.

Wind Speed Estimate δ	Energy estimate δ	Annual Income	IRR	NPV
14.0%	30.0%	$ 13.00	11.54%	$ 25.59
9.5%	20.0%	$ 12.00	10.32%	$ 16.50
4.9%	10.0%	$ 11.00	9.06%	$ 7.41
0.0%	0.0%	$ 10.00	7.75%	$ (1.68)
-5.1%	-10.0%	$ 9.00	6.39%	$ (10.77)
-10.6%	-20.0%	$ 8.00	4.96%	$ (19.87)
-16.3%	-30.0%	$ 7.00	3.44%	$ (28.96)

Figure 18: Impact of wind resource estimate on project economy (Krohn, 2012).

In the design of wind energy tenders, transferring the liability of accurate wind resource data to the auctioneer may lead to high-risk premiums for bidders on the final auction bid prices. At the same time, if the quality of the wind data collected is considered consistent by developers and private investors, this may sensibly reduce project pre-development costs for developers and therefore let to competitive and lower bid prices.

An important point of discussion should be open on the impact of the production estimate (P50, P75, P90) for pricing bids. The use of less conservative estimates such P50 has the great advantage of driving down bid tariffs as shown in the Brazilian and South African auction experiences. Whereas these two countries used the same production estimate method (P50) for pricing bids, different outcomes occurred during financial closure. In details, after bidders were awarded, Brazil's IPPs struggled to secure financing for their projects, resulting in significant delays. This happened because financial institutions (both commercial and institutional) are typically more conservative and, specifically for Brazil, they only financed projects on the basis of P90 data (GIZ, 2013). On the contrary, this risk was eliminated in South African IPP auctions by requiring financing to be locked-in at bid submission (Eberhard & Naude, 2016).

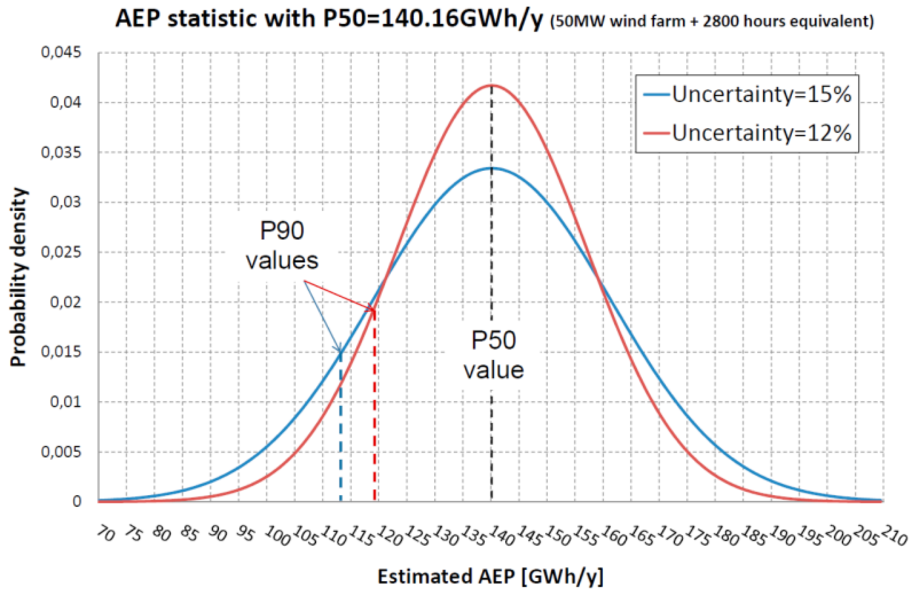


Figure 19: Annual energy production estimates for a 50MW wind farm (Boquet et. al., 2010).

At the end, it is paramount to advise the auctioneer of the IPP wind auction in opting for wind turbines designed and certified in according to IEC 61400 standards for strengthening reliability and safety of operation of wind farms. At the same time, the auctioneer should not narrow down too much the catalogue of suitable wind turbines, since the model which best fits a specific site should be pointed out by project developers, by fulfilling bid requirements (legal aspects, planning criteria, grid codes, etc.) and maximizing capacity factor and project economy. The figure below illustrates a clear example of this cost-benefit mechanism for the selection of a suitable wind turbine model during a wind tender in Egypt, procured through a build-own-operate (BOO) concession arrangement.

Type	Power (kW)	Rotor diameter (m)	Hub height (m)	AEP (MWh/year)	Full load hours (MWh/MW)	Capacity factor	Turbine price (M EGP)	Project investment (M EGP)	Investment (EGP/MWh/yr)
V90-3.000	3000	90	80	7,088.58	2,363	27%	18.5	22.2	3,132
V90-3.000	3000	90	90	7,496.98	2,499	28.5%	19.5	23.4	3,121
V112-3.000	3000	112	94	10,383.68	3,461	39.5%	27.2	32.6	3,143
V90-1.800	**1800**	**90**	**80**	**6,046.65**	**3,359**	**38.3%**	**15.5**	**18.6**	**3,076**

Figure 20: Wind turbine selection for a site in an Egyptian BOO wind tender (Krohn, 2014).

	Responsible Stakeholder	
Auction feature	**Auctioneer (Government)**	**Project Developer**
Development of wind resource campaigns	*Wind Atlas:* ✓ Wind measurements are usually performed by independent consultants, ensuring a high degree of objectivity of the data produced ✓ Extreme relevance for providing long-term regional measurements and pre-screening information on deployable wind resource areas *On-site wind measurement campaigns* ✓ In frontier RE markets with few experienced developers, it may be necessary to appoint the auctioneer as responsible unit ✘ Limited scope for governments to measure site wind resource for auctions ✘ Bankable wind measurements require complex and high costly campaigns (IEC 61400-12 standards)	*Wind Atlas:* ✘ Very limited scope, since no developer is in a position to make the required investment on a country-scale *On-site wind measurement campaigns:* ✓ Lead to a more exhaustive assessment both for wind resource quality and risk management ✓ Other important factors can be evaluated simultaneously, such as micro-siting, site layout, technology choice and proper O&M strategy ✘ It may be redundant that pre-qualified bidders will perform similar wind measurement campaigns on the same site. ✘ Bankable wind measurements require complex and costly campaigns (IEC 61400-12 standards)

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
Absence of public data on wind energy resources	For developers it may limit the attractiveness to conduct feasibility studies	Governments should make public and accessible all existing meteorological and wind resource assessment data. If wind resource data does not exist, governments should initiate a wind resource assessment program	*Low risk* It is the main outcome of the ESMAP measurement campaign (currently under development) and wind assessment part of the AWPGE programme
Inaccurate or limited wind data	The bankability and the investment viability of wind power projects rely on accurate and objective estimates of wind data and annual energy output models	Address credible independent specialists or measurement institutions in performing wind resource assessments	*Medium risk* Best case scenario, the wind measurements for the 1st IPP auction will be based on 1 year of collected data. The on-site measurements need to be correlated with regional long-term wind data, whose accuracy may be objected
Wind turbine model for the site	The choice of the wind turbine model should be based on a trade-off strategy between WTG price and site-specific power generation potential (cheap WTG but low power generation - expensive WTG but high power generation)	Project developers should only use turbines designed and certified along IEC 61400 Standards	*Recommendation* GoE should find a right balance in ensuring the use of wind turbines IEC certificated for the auction, not imposing at the same time too strict constraints on the catalogue of usable turbine models

Inaccuracy or unavailability of topographic data	The topography of the site has a direct impact on the assessment of the annual energy yield of the wind farm. This may lead to erroneous considerations on	Ensure public access to existing data or undertake topographical surveys in priority areas	*High relevance* due to complex terrain morphology of the country. For the first auctions is a *low-risk* factor, since it should be mitigated by accurate wind resource measurements with several masts at the specific auction

2. Site Selection

A wind resource estimate simply represents a good starting point for the identification of potential sites for wind farm projects. The site selection process involves other important aspects that project developers and auctioneers should properly consider during feasibility studies for selecting sites. The key constraints that need to be clearly addressed are:

- Wind turbine class
- Terrain description of sites
- Potential size of sites
- Process of securing land
- Ease of construction
- Electrical connection access

Wind turbine class

Wind turbines are usually designed for specific wind conditions since different wind sites can have very different wind resources. Hence, one of the crucial parameters to take into consideration in the design of wind power plants is the wind turbine class. Turbulence, wind speed and extreme wind events are the key parameters, which determined the turbine class. The table below provides a better understanding of the wind turbine classification based on the IEC 61400-1 international standard published by the International Electrotechnical Commission.

Wind turbine class		I	II	III	S
V_{ave} (m/s)		10	8.5	7.5	User defined
V_{ref} (m/s)		50	42.5	37.5	
$V_{50,gust}$ (m/s)		70	59.5	52.5	
I_{ref}	A	0.16			
	B	0.14			
	C	0.12			

Figure 21: Wind turbine class according to IEC 61400-1 standard (DEA et al., 2017).

Referring to Figure 21, the roman number defines the reference wind speed Vref. Hence, the reference wind speed with class I, II and III represent sites with the high, medium and low wind speeds, respectively. In the standard wind turbine classes, the average annual wind speed at hub height is calculated as V_{ave}= 0.2* V_{ref} where Vref is defined as the 50-year extreme wind speed over 10 minutes and $V_{50,gust}$ represents the extreme 50-year wind gust over 3 seconds. The extreme 50-year wind speed by definition is the wind speed, which is statistically exceeded once in 50 years (DEA et al., 2017). The letter of the turbine classes defines instead, the mean turbulence intensity Iref calculated at 15 m/s. Hence, the turbulence intensity with class A, B and C represents sites with higher, medium and lower turbulence characteristics, respectively. The turbulence characteristics are strongly dependent on the surface roughness, terrain and surface heat flux and atmospheric stability. The category S in the wind turbine class is used for values specified by the developer which fall outside of the general categories (DEA et al., 2017).

Terrain description of sites

The terrain features that influence the wind flow close to the ground and therefore have a large impact in the wind resource assessment of a specific site can be divided into three groups (DTU, 2004):

- The geometry of the terrain surface (elevation, slope, etc.)
- The surface characteristics of the terrain (roughness length)
- Nearby obstacles (houses, trees, etc.)

An accurate description of the overall geometry of the terrain surface is a prerequisite for reliable modelling of the wind flow over the terrain. The most important feature is the elevation of the terrain surface above sea level. The terrain slope of a site instead has direct consequences both on the ease of construction of a specific site as well on the accuracy to model the wind flow accurately when the terrain gets steeper. As a rule of thumb, the upper limit to accurately predict linearized wind flows with a linear model such as WASP is placed at slopes of about 30% (~17º) (DTU, 2004).

The surface characteristics of the site terrain are usually envisaged within the roughness length. In general, the more pronounced the roughness of the site surface is, the more the wind will be slowed down. For example, forests, long grass and bushes will slow the wind down considerably, while water surfaces are smoother and will have less influence on the wind. Furthermore, the identification of the proper roughness class for a site should also reflect the proximity of obstacles placed nearby the wind farm. In general two different types of approach should be considered when dealing with obstacles in wind resource assessment (DTU, 2004):

- If a wind turbine is closer than about 50 obstacle heights to the obstacle and closer than about three obstacle heights to the ground, the object should be considered as an obstacle. In this case, the obstacle should not at the same time be considered as a roughness element

- If the wind turbine is further away than about 50 obstacle heights or higher than about three obstacle height, the object should most likely be included in the roughness class description

Potential size of site

As also highlighted in the previous chapter, the economic viability of a wind project is strongly dependent on site size and consequently on the power capacity that can be installed. Crucial constraints may be represented by regulatory requirements, current and future land usage, the proximity of neighbouring dwellings and/or military areas, civil aviation restrictions, environmental and social issues, habitats, cultural heritage. These topics will be object of detailed analyses on chapter 4.

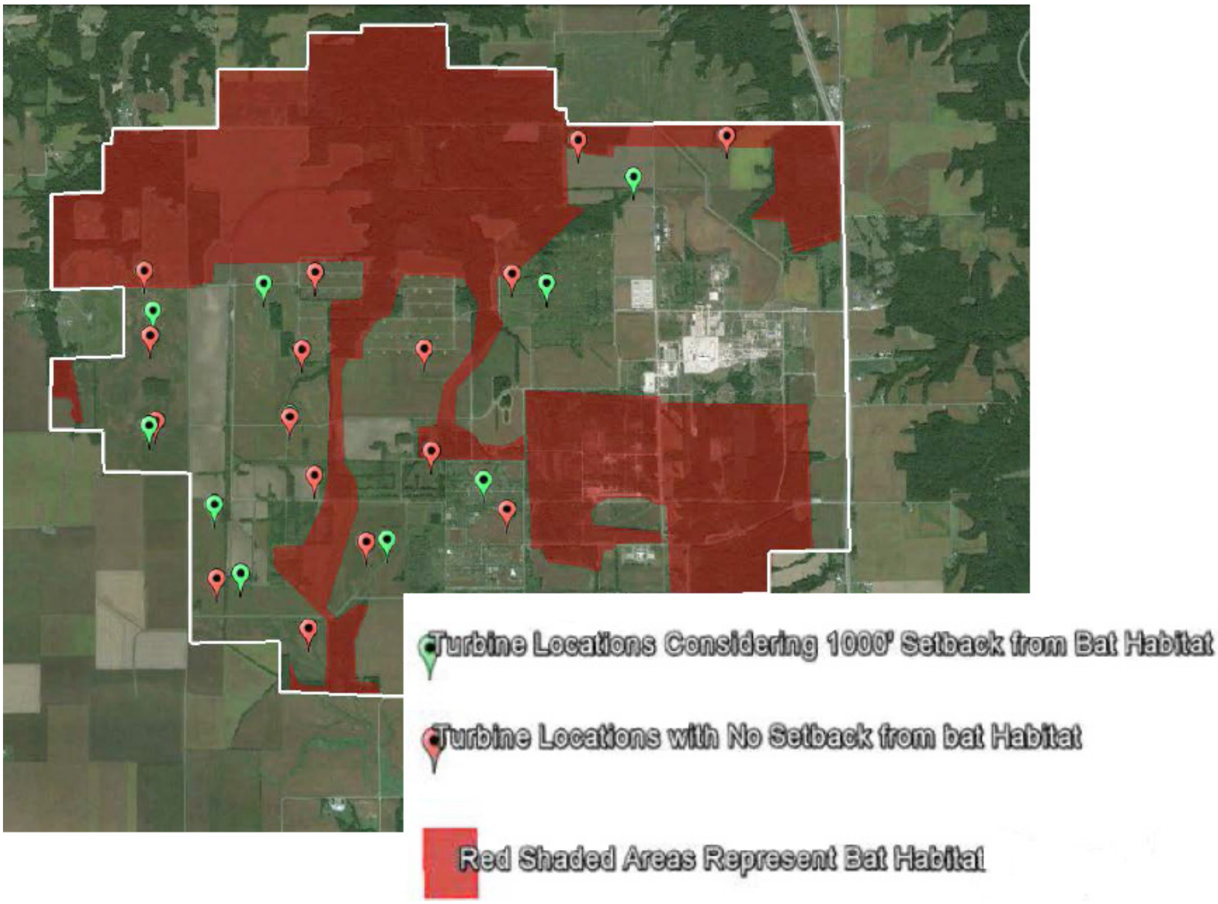


Figure 22: Potentially developable areas for a wind farm in Newport Chemical Depot (NREL, 2013).

Securing Land

Project developers should carefully evaluate the potential number of landowners affected by the development of the wind farm and the actual and future use of lands involved in the development of the wind power infrastructure. A good practice for project developers is to find out information on land ownership through consultation with land registries. Based on the different topology of landowners and land use, project developers should initiate negotiations for securing land through appropriate ownership/lease models.

Construction issues

During the feasibility and screening process of potential sites for wind farms, a decision maker should not underestimate the importance of the construction infrastructure of the selected site. This assessment should be also extended to the road infrastructure of the site and the adjacent areas. Indeed, the development of a wind farm requires the use of heavy and bulky vehicles and components, which may be difficult to transport and move on-site. Therefore, the site should be also evaluated for its specific construction suitability. Moreover, in some geographical areas, potential sites for wind turbines are only accessible through dirt roads, which during specific time intervals of the year (raining seasons, bad weather conditions) might be flooding. This aspect may have severe consequences on the construction timeline causing undesirable delays.

Electrical connection access

The analysis of grid assessment conditions for a selected project site is fundamental for ensuring the technical and commercial viability of the proposed wind farm. Due to the complexity of the topic, this subject will be analysed in detail in chapter 3.

Site ranking

After the evaluation of the constraints presented before, it is possible to geo-localize areas within a country or a specific region where it is feasible to deploy wind projects. Thereafter, the main outcome of the wind feasibility study is to rank potential sites for assessing their suitability and value of interest.

A ranking methodology for evaluating sites is presented below (3E, 2017). In details, different weights are applied for evaluating different features. Please note that some constraints such as terrain complexity and environmental and social constraints are assumed to be already considered in the pre-screening process of the site selection.

Wind Power Density weight: 30%		Distance to Grid weight: 30%		Capacity of Site weight: 15%		Road Infrastructure weight: 15%	
Value [W/m2]	**Score**	**Value [km]**	**Score**	**Value [MW]**	**Score**	**Value [Class, km]**	**Score**
>1200	10	Substation < 10 km	+2.5 extra	>700	10	Class A to C, <10 km	10
1100	9	0-2 km	10	400-700	7.5	Class D to E, <10 km	7.5
1000	8	2-5 km	7.5	100-400	5	Class A to C, 10-50 km	5
900	7	5-10 km	5	50-100	2.5	Class D to E, 10-50 km	2.5
800	6	10-20 km	2.5	<50	0	Any Class >50 km	0
700	5	>20 km	0				
600	4						
500	3						
400	2						
300	1						
200	0						

Table 3: Ranking methodology for wind site selection (3E, 2017).

2.1 Ethiopia

The first IPP wind tender has been envisioned allocating the responsibility of the site selection process to the auctioneer. The auctioneer has also clarified the size of the first round of IPP wind tenders (500 MW) deployable on five different location sites.

Moreover, according to the Ethiopian law, all land is owned by the State, which defines also proper regulatory guidelines on how to acquire land and pay compensation. Under the constitution of Ethiopia, Article 40(3) says: *"the right to ownership of rural and urban land, as well as of all natural resources, is exclusively vested in the State and in the peoples of Ethiopia. Land is a common property of the Nations, Nationalities and Peoples of Ethiopia and shall not be subject to sale or to other means of exchange".*

Further, a rural land holder whose land has been presently expropriated shall, in addition to the compensation payable under the article of Proclamation number 455/2005, be paid as displacement compensation which shall be equivalent to ten times the average annual income secure during the five years preceding the expropriation of the land. As shown by (Alemu, 2015), in some cases land expropriation in the Ethiopian country has encountered resistance from farmers, because compensation payment is seen too unfair for sustaining life after eviction. This has created and still creates various economic and social problems especially within the farming communities (Alemu, 2015).

It may be useful to provide indicative numbers and direct experience on this matter specifically for the two wind farms already implemented in Ethiopia. According to a research initiative (SAIS China-Africa Research Initiative, 2016), the owner of the two wind farms (Ethiopian Electric Power) paid a total of 39.1 million birr (USD 1.81 million) in compensation for the land used to construct the Ashegoda Wind Farm (EPC contractor Vergnet), and a total of 17.5 million birr (USD 810,000) in compensation for the Adama Wind Farm Phase II (EPC contractor HydroChina). Compensation was distributed and farmers were highly encouraged to use banks to save their money. The project manager of the Ashegoda Wind Farm recalled that many farmers were able to use the extra income to buy large farming equipment. Vergnet reported that there was no problem with land acquisition. On the other hand, HydroChina reported that the payment process was slow and the company had to pay out of its own pocket first so that the project could move forward (SAIS China-Africa Research Initiative, 2016).

In the ongoing Ethiopian IPP solar tender developed in collaboration with Power Africa, the successful bidder is designated as the responsible party for securing access to the facility site and he is also required to conclude the facility site lease agreement. During the whole process, the GoE will act as a facilitator concerning the different acquisition procedures and it will also provide guarantee for land acquisition in the remote event that the successful bidder has "diligently" attempted to procure such acquisition right for more than 120 days without positive result. In this context, the term "diligent" refers to *"pursue all reasonably available procedures for obtaining such interest, including the offer of a rent or purchase price which a* *person carrying out the successful bidder´s activities would reasonably expect to pay for such an interest"* (Power Africa, 2017).

Burden and regulatory framework

Framing the compensation process for land expropriation due to the establishment of wind turbine facilities, it should be noted that in the majority of the cases the land allocated for wind infrastructure may be still used for mostly of the agriculture and ranching purposes. In relation to this matter, it is essential to highlight that the compensation process should not be only limited to the expropriated landholders, but it should also be extended to all the residents located within a certain distance from the wind turbines. In Denmark for example, all the real estate owners within a distance equal to 6 times the wind turbine height are entitled to compensation for potential loss of property value.

The choice of the GoE to develop a "site-specific" wind IPP auction should be seen as part of an overall strategy to ensure local public acceptance and avoid public unrest, minimize costs and risks for project developers and financiers and ensure a smooth and on-track project implementation. Indeed, the land acquisition process is perceived as a significant risk in most African countries. Hence, choosing in advance the project site would ensure that several critical and onerous tasks of the pre-development project phase, such as securing land, electrical connection access and assessment of the road & construction infrastructure will be handled and coordinated by the GoE.

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
Restricted developable areas	Regulatory requirements and key constraints may narrow down the size of a site that may be deployable. This may limit economies of scale and prevent commercial viability of specific projects	Wind atlas should be developed and used to identify potential wind development zones in line with the strategic environmental and planning framework	*Low risk*, since the ESMAP programme and the on-site measurement campaigns from the World Bank should lead to a priority list of potential sites for wind development (Outcome 1.1 of the AWPGE programme)
Limited height allowance for selected site	The deployable energy yield for a specific site is constrained by regulatory permits on height limit. This limits the choice of the hub height and rotor size for turbines	If regulatory constraints for specific sites are not specified or available, project sites should be analysed for different hub heights and rotors	*Recommendation* This issue need to be investigated in more details
Sites are inaccessible to construction	Inadequate access infrastructure in combination with bad weather conditions may generate delays in the project implementation as well as increasing sensibly the project costs	If it is appropriate for the project economy, new access and road infrastructures should be implemented	*Low risk* It should be mitigated by Outcome 1.1 of the AWPGE programme. The selection of potential sites will be also based on the conditions of the road infrastructure, which can be directly supported by planned site visits

3. Grid Connection

The analysis of grid assessment conditions for a selected project site is crucial for ensuring the technical and commercial viability of the proposed wind farm. The grid connection location should not impose severe technical, economic, or practical problems due to the distance to the wind farm, the connection voltage level, the proposed routing of the cables, etc.

Discussions with grid operators (mostly referred as transmission and distributor operators) and examination of local electricity transmission and distribution systems are necessary to evaluate whether an electrical connection to the proposed site is technically and commercially viable. As a rule of thumb, the farther away the existing high voltage grid is, the more expensive the connection grid will be. The figure below provides an order of size about the costs associated with the grid connection both for onshore and offshore wind farms.

Comparison of capital cost breakdown for typical onshore and offshore wind power systems

Cost share of:	Onshore (%)	Offshore (%)
Wind turbine	64-84	30-50
Grid connection	9-14	15-30
Construction	4-10	15-25
Other capital	4-10	8-30

Figure 23: Comparison of capital cost breakdown for typical onshore and offshore wind power systems (IRENA, 2016).

Project developers, grid and utility planners, and governments should also be aware of potential impacts of other power generation developments that may be under consideration in the areas designated for wind projects. Further, the capacity of the grid may be locally limited and in extreme conditions wind power curtailments may occur. Hence, reinforcements and upgrades of transmission and distribution networks should be carefully planned and envisioned on a long-term energy dispatch strategy. For instance, recent experience in wind power auctions showed that several winning projects relay on additional transmission reinforcements in order to dispatch their generation. This strategy requires a detailed allocation of liabilities, which in some cases have been assigned to project developers. In this way, project developers implicitly become responsible for potential defaults or delays of a completely separate entity (the one in charge of the transmission works). This may result in high-risk premiums on auctions and in some cases discourage the wind farm development (IRENA & CEM, 2015).

If on the contrary, the liability relies on the transmission company, a proper risk-sharing strategy should be implemented for protecting project developers and split carefully risks and penalties between the transmission operator company and the power purchase buyer (off-taker). This mechanism may be implemented identifying a physical connection point (POC) of the wind farm within the transmission network. The POC represents then, the “watershed” of liabilities and costs associated with the grid connection process between the project developer and the transmission system operator. For instance, this beforehand “cost-sharing” approach is implemented in Denmark for the realization of wind onshore projects above 1.5 MW and it is described in the following section.

Approval process of wind power plants in Denmark

Project developers that wish to build wind power plants in Denmark are responsible for connection costs from the wind turbines until the POC, which is specified by the transmission system operator (TSO) or the distribution system operator (DSO). Beyond this point, the TSO/DSO is the entity responsible for potential costs and works of grid expansion/reinforcement due to the wind farm construction. Figure 24 provides a detailed graphical overview of the Danish grid connection process for large onshore wind farms, connected to the high voltage side (HV) of the power grid managed by the Danish TSO (Energinet).

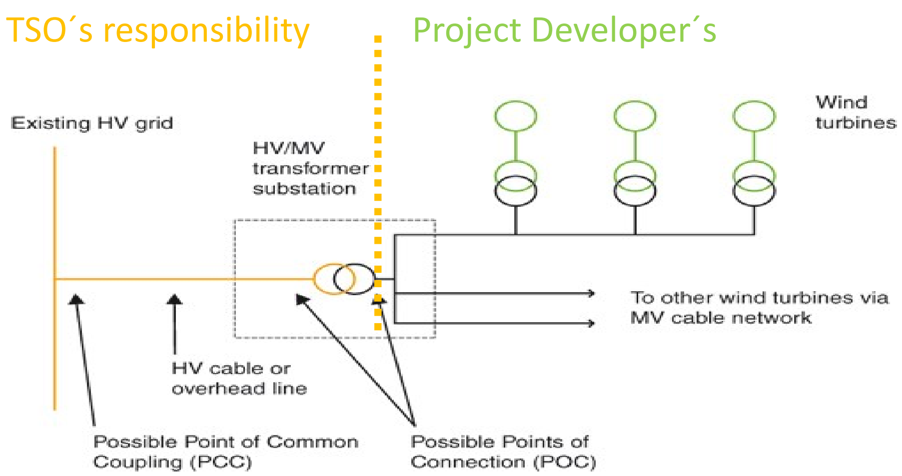


Figure 24: Graphical representation of liabilities and costs in the grid connection process of wind farms between wind project developers and the Danish TSO.

Moreover, wind turbines that are installed, maintained and serviced in Denmark must be certified according to the requirements in the Danish Certification Scheme (executive order no. 73 of January 25th 2013), which are grounded on international standards. Based on the certificated wind turbines, a wind power plant can be designed and approved by the relevant authorities. Based on the executive order from the Danish government, the TSO (Energinet) and DSO’s is obligated to bring the grid connection point in the proximity of the wind power plant site (DEA et al., 2017).

When a project developer is applying for a grid connection permit, the facility owner has to follow the process depicted in Figure 25. The procedure for granting grid connection is the same whether the new power generating facility is located in the transmission or in the distribution system. As stated earlier, the electricity undertaker (TSO/DSO) is the authority which decides where the point of connection will be located inside the existing grid. The facility owner is allowed to operate the facility only after that the grid operator will issue a final operational notification, which is based on a compliance test document approved by the grid operator.

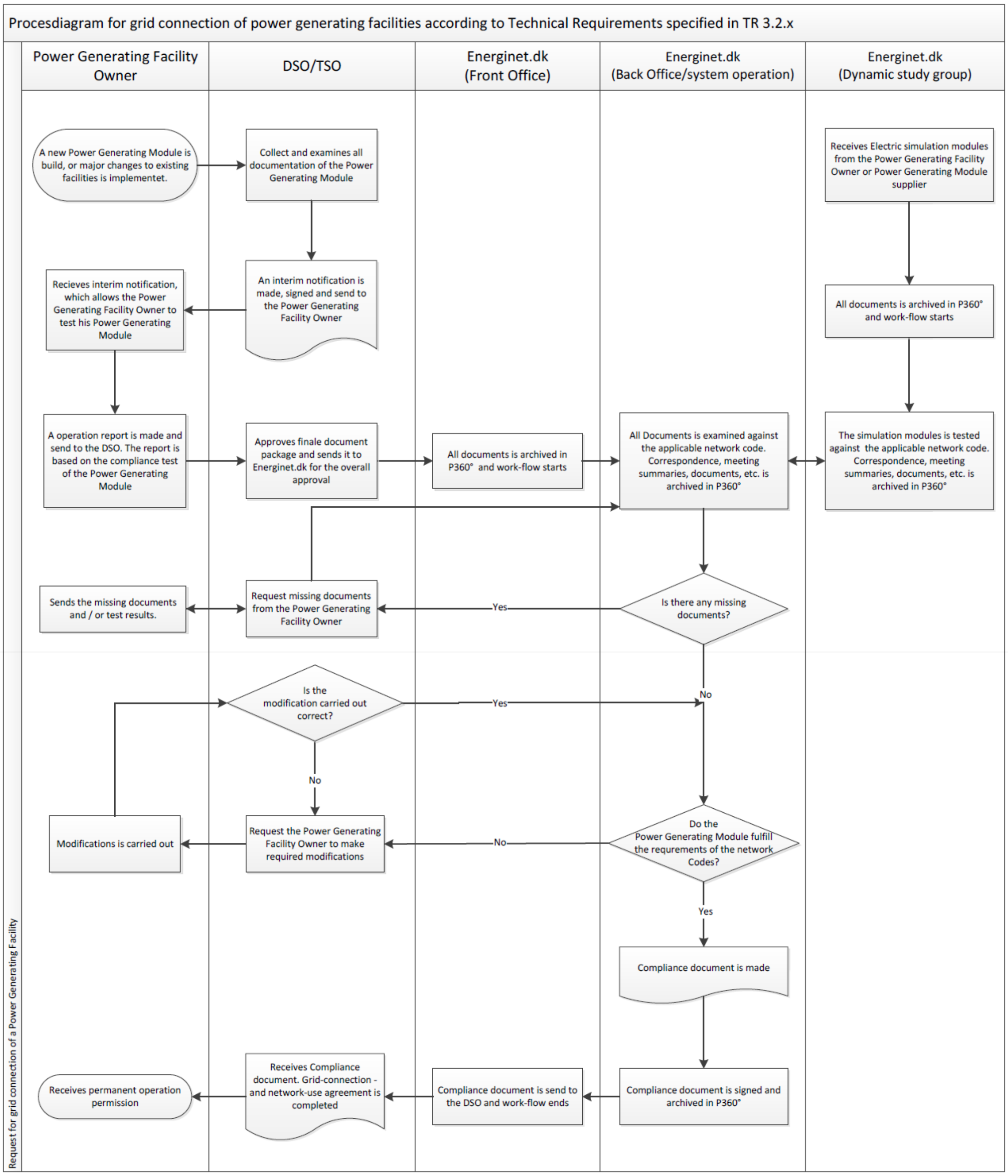


Figure 25: Grid connection granting procedure applied in Denmark (DEA et al., 2017).

Every third year a regular review and inspection of the actual compliance status are performed. Such an inspection could result in an interim operational notification and a new compliance test shall be performed after a maintenance or repair (DEA et al., 2017). Additionally, project developers and decision makers may underestimate the potential complexities in gaining authorization of connection to the local electrical network. These requests of access can be protracted for a long time and they may be technically complex to be handled simultaneously by grid operators, especially in countries newly exposed to low carbon transition programs and with high green incentives and/or subsidies.

In 2011 for example, Turkey adopted an innovative procedure in order to face three-year delays in wind and solar applications due to connection permits. In this new mechanism, the Turkish regulator EMRA provides licenses only to projects which not require additional grid expansion or reinforcement. If supplementary grid works need to be performed, the transmission system operator initiates an auction to determine the allocation of connection rights for a specific substation. Each bidder specifies a fee per MW of installed capacity (referred as "contribution margin") that he is willing to pay if the license is obtained (IRENA & CEM, 2015).

Grid connection – The case of Brazil

The first exclusive wind energy auction in Brazil was realized in 2009, where 2 GW were contracted. As of April 2017, there were 14 auctions with a participation of wind energy and the installed wind energy capacity reached approximately 11 GW.

Figure 26 provides a snapshot of the wind projects contracted during the first three Brazilian wind auctions (2009-2010-2011). One of the aspects that stands out is the percentage of delayed projects in the 2010-2011 auctions, respectively 80% and 92% of the overall awarded projects. Delays were not caused by project developers, but they were related to problems in obtaining environmental licences and due to grid expansion. In details, 30-35% of delayed projects were due to grid connection delays.

Wind auctions	Reserve Energy Auction 2009	Reserve Energy Auction 2010 and Renewable Energy Auction 2010	Reserve Energy Auction 2011 and A-3 2011
Operation start date as stated in the contract	July 2012	September 2013 & January 2013	July 2014 & March 2014
Number of projects	71	70	78
Number of projects in operation	64	13	6
Number of delayed projects	7	57	72
Percentage of delayed projects (of the total)	10%	81%	92%
Number of delayed projects because of the transmission connection (capacity)	0	20 (257 MW)	23 (263 MW)
Percentage of delayed projects be-cause of the transmission connection	0%	35%	32%

Figure 26: Overview of wind project delays in Brazil. Data refers to September 2014 (IRENA & CEM, 2015).

Old scheme:

- After auction winners were announced, usually 3 years before the contractual delivery date, transmission was planned, auctioned and built (co-planning of transmission and generation)
- Shorting the time horizon of contractual delivery time to ca. 2 years, critical environmental constraints for transmission facilities & underbidding in transmission auctions led to unforeseen and prolonged delays
- In the auctions, the risk of such constraints to the provision of generation was allocated almost entirely to energy buyers due to deemed generation clauses in PPA contracts

Solution (new scheme):

- The Brazilian Energy Planning Agency tenders transmission facilities before auctioning new generation (based on technical info and availability of wind resources)
- Removal of deemed generation clauses due to transmission delays (risks allocation to sellers)
- Sellers have comparatively more certainty about the reinforcements to the transmission networks will be online at the time of the contractual date of delivery

Source: (IRENA & CEM, 2015)

3.1 Ethiopia

The choice of a site-specific wind IPP auction should implicitly ensure that the required transmission infrastructure will be in place and the project will be optimally located to best match demand with power generation capacity. Indeed, this aspect is one of the most crucial elements for a successful implementation of any renewable energy auctioning programmes. Figure 27 clarifies the complexity and the cross-disciplinary elements that need to be considered to strategically allocate wind projects, transmission investments and extensions.

Despite the largest Ethiopian wind resources are located in the south and south-east regions of the country; these areas, earlier mentioned, are barely populated and served by transmission lines. Therefore, wind projects in these specific areas may be firstly complex to implement due to the missing transmission infrastructure needed. Secondly, they may be cost-prohibitive to implement and finally, it may not be optimally placed to serve load centres and aggregation points. Recent experience showed that the latter phenomenon may lead to congestion problems on transmission lines, which in turn may origin wind curtailments. According to the China's National Energy Administration (NEA) for instance, China in 2016 curtailed 49.7 TWh of wind electricity, wasting 20% of the entire annual wind power generated.

Hence, it is paramount that future power plants investments (including wind power plants) and extensions on the transmission infrastructure should be strategically placed in proximity of load and dispatch centres. The outcomes of the Ethiopian Power System Expansion Master Plan Study (EEPC) highlight the results exposed beforehand.

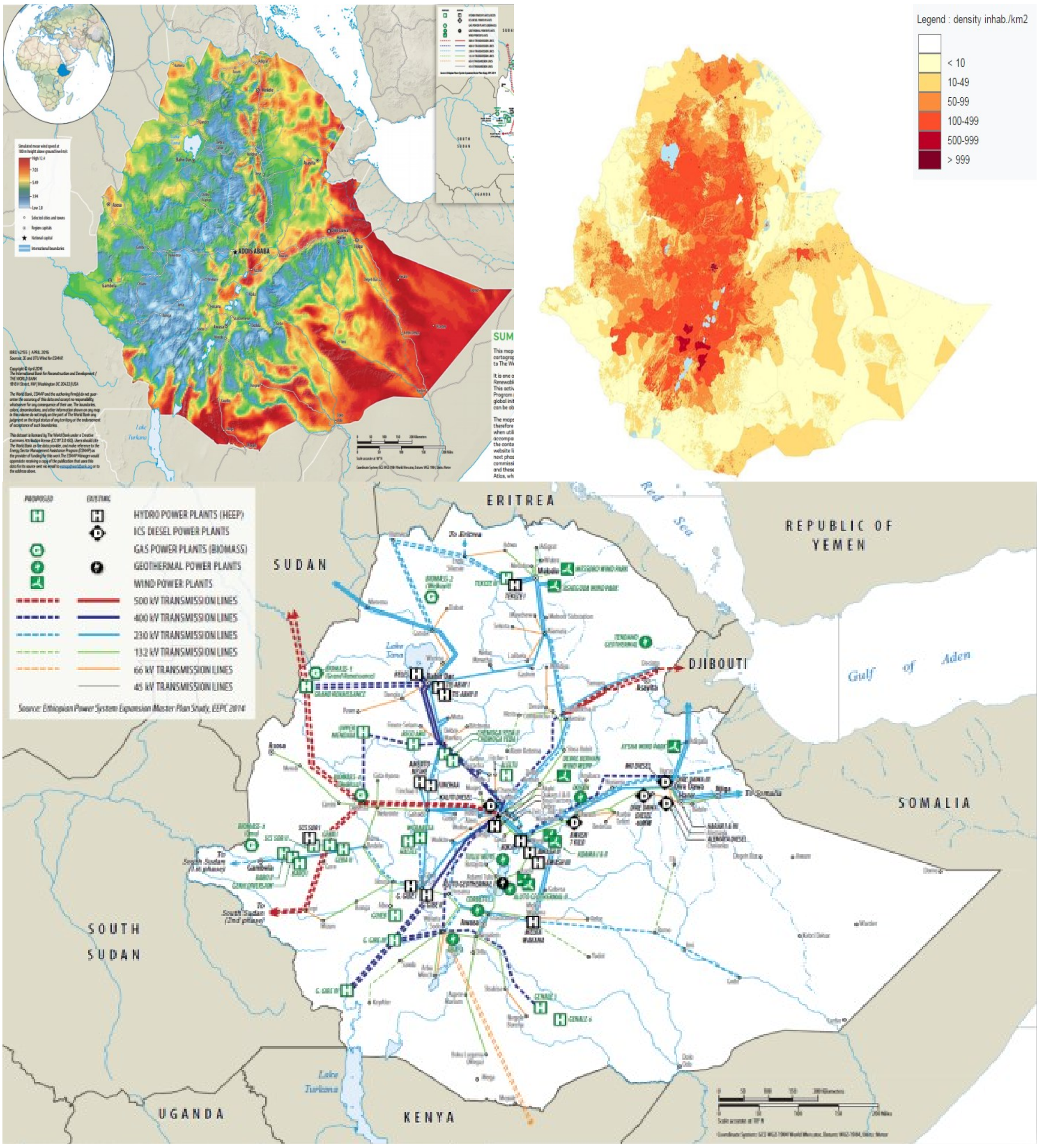


Figure 27: Top left: ESMAP mesoscale wind resource map of Ethiopia. Top right: Ethiopian population density map. Bottom: Ethiopian power system expansion master plan study. Sources: ESMAP, AfriPop and EEPC.

Burden and regulatory framework

It is necessary that the Ethiopian auctioneer during the first IPP wind auction and throughout the broader renewable auctioning programme will effectively coordinate with the Ethiopian transmission system operator (TSO) EEP, in order to identify adequate transmission planning and investment programmes to support tender procedures.

In line with this planning strategy, two critical auction criteria need to be properly clarified:

- Location constraints for wind IPP auctions
- Distribution of grid connection works and costs among project developers and TSO

The latest trend of renewable energy auctions in the African Continent (Egypt, Morocco, Zambia, Uganda and South Africa Round 5) seems to encourage geographical constraints and/or specific site-locations for IPP renewable tenders. Limited grid power capacity, long-term dispatch strategies and optimization of transmission investments are the main reasons that lead auctioneers to choose project sites beforehand. Probably, the South African REIPPP programme represents one of the most valuable lesson learned on the decisive role of the grid connection process on the auctions outcomes.

The REIPPP auction programme started in 2011 envisaging project developers as responsible of the selection of project sites. Unfortunately, a lack of effective coordination between Eskom (the South African TSO) and the DOE (Department of Energy) on Eskom´s transmission planning caused unexpected delays on financial close of some projects and additional transmission costs for the TSO, which have been followed by repeated increases in consumer power prices. During the years, the grid connection procedure became the key-risk for the continuity of the South African programme. This endless and critical threat led the government to change the auctioning criteria concerning site location for the new bidding window (round 5, which has not be set already), limiting project sites to specific zones where transmission capacity is already in place, or will be strategically upgraded to follow the “focused” expansion of South Africa’s grid (Eberhard & Naude, 2016).

The other auction criterion which may have a large influence on the grid connection process is the allocation of liabilities and costs for the connection of the wind farms to the national grid. It is common practice in auctioning procedures to split costs and works between project developers and transmission grid operators. In details, project developers are usually accountable for the internal grid interconnection facilities of the wind farm, while TSOs are responsible for ensuring that adequate transmission infrastructure is in place before projects reach commercial operation date. This implementation strategy implicitly places a heavy burden on auctioneers and transmission operators, since both parties are required to provide beforehand tenders, detailed documentation and studies on grid stability, feasibility studies, grid interconnection information as well transmission planning.

Indeed, the effectiveness of this cost-allocation strategy and the ability to reduce risks and burden for project developers are highly enhanced in conjunction with the choice of site-specific auctions. Let´s refer to the REIPPP programme again. Since bidders were free to choose projects location (until bid round 4), Eskom had cumulatively processed 1,120 application letters of grid access (CELs) from project developers by the end of round 4a. Ultimately, only 83 preferred bidder sites were supported, which leads to a bare success rate of 7.4%. This high working load and low success rate associated with these CELs placed a huge strain on Eskom's resources, which at the end of 2013 led Eskom to introduce a Cost Estimate Fee (CEF) to process and issue a CEL (Smit, 2015).

It is also advisable for a reliable grid connection procedure to ensure that bidders will select wind turbine generators (WTGs) and equipment compliant with strict grid code requirements. Currently, the Ethiopian Energy Authority (EEA) is developing new transmission and distribution grid codes. The first draft of these documents is already available online. Moreover, on this matter, the Danish TSO, Energinet, will be responsible to coordinate with the GoE the capacity building program related to an effective wind power integration strategy, which is part of the Government-to-Government cooperation programme between Denmark and Ethiopia (Outcome 2.2 of the AWPGE programme). This wind power integration strategy includes a detailed review of connection codes, a least-cost wind deployment plan and an optimal dispatch strategy for power systems with a significant share of wind and renewables.

The general grid connection codes structure includes requirements to be fulfilled for the following technical areas (DEA et al., 2017):

- Stability impact and requirements related to facility size
- Requirements on facility robustness
- Requirements on power quality
- Requirements on controllability
- Requirements on information exchange & security
- Requirements on documentation & verification

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
Underestimating the procedure for grid connection	Long distance between potential site and grid access point can be a cost-prohibitive aspect for projects	At an early stage, developers and governments should engage with grid operators to clarify grid access, studies needed and indicative connection costs	Through a careful site selection strategy, the risk can be minimized. Outcome 2.2 of the AWPGE programme should further mitigate this risk for future prioritizing sites
Ambiguous and weak procedure for grid connection	Transmission and/or distribution grid operators may not wish or be able to connect all the potential wind farm projects. Long feeder lines may be difficult and expensive to acquire and permit	Governments should develop clear and agile policies to allow grid access to Independent Power Producers and regulate the process application	Through a careful site selection strategy, the risk can be minimized. Moreover, EEA is currently developing new transmission and distribution codes. Outcome 2.2 of the AWPGE programme should also further mitigate the risk
Delays in grid connections	Connection fee may be inappropriate. Point of connection may be disputed among project developers and transmission operators	Connection rates should reflect real costs. Split connection costs from grid reinforcement costs and assign liabilities among stakeholders	*Low risk* for the first auctions, potentially *medium-high*risk to fulfil the ambitious GTP II deliverables. The results of Outcome 2.2 of the AWPGE programme may provide long-term guidance and strategy
Bottlenecks and congestion in the power capacity system	The capacity of the grid may be locally limited and in extreme conditions wind power curtailments may occur	Reinforcements and upgrades of transmission and distribution networks should be carefully planned and envisioned on a long-term energy dispatch strategy. Furthermore, in case of curtailments, a compensation scheme to the developer may be established	*Medium-high risk* due to the poorness of the grid capacity. Outcome 2.2 of the AWPGE programme will provide guidance and strategy for robust dispatch strategies and capacity building on grid planning

4. Planning and Environmental Approvals

After the identification of a potential site by means of verified technical analyses and agreements with landowners, wind farm project developers need to properly determine potential planning and environmental issues on the selected site of interest. Initial assessments are usually carried out consulting available data, environmental mappings, engaging as well with national and local planning authorities. The main scope of the consultation process with state authorities is to determine the "planning" suitability of the selected site. Furthermore, project developers should identify main drivers and factors of the assessment analyses required to progress a planning application for the establishment of wind farms.

In frontier renewable energy markets, the planning process for wind project developers can be extremely time consuming and difficult to navigate in. For this reason, the establishment of a nodal government agency (often referred as "one-stop-shop") can sensibly simplify and reduce lead times required for processing planning procedures. The main role of the one-stop-shop agency is to grant and procure all the permits needed for the development of renewable energy projects (wind farms included).

Generally, project developers of wind farms are required to carry out or comply with a full Environmental Impact Assessment (EIA), which is subject to specific environmental and/or planning laws of a country. The assessment identifies all the relevant environmental, social and economic effects associated with the wind project proposal. Hence, the study will encompass detailed analyses on the proposed wind project design (including number and position of wind turbines) as well as extensive information on the life cycle of the proposed wind farm (from construction and operation through decommissioning).

Typically, the following issues are investigated and cleared out in an EIA study:

Landscape and visual assessment

The existing site landscape has to be described and the visual impact of the proposed wind farm needs to be evaluated and clearly described. Typically, large and uniform landscapes are more suitable for large wind turbines, since such landscapes can match better the large dimensions of the turbines.

Noise assessment

A noise analysis is fundamental to demonstrate that turbines will comply with the relevant noise guidelines of the location of the proposed wind farm. In Denmark for example, wind turbines must respect noise limits in accordance with the Statutory Order. In open country, the noise level must not exceed 44 dB (A) at any dwelling at 8 m/s wind velocity and 42 dB (A) at 6 m/s. These noise limits are to be kept outdoors at a maximum distance of 15m from the dwelling.

In housing areas and noise sensitive recreational areas such as e.g. camping sites or summer cottages – more restrictive levels are required of 39 and 37 dB (A) at 8 and 6 m/s respectively. In 2012, an additional limit for the low frequency noise indoors was added to the legislation, equal to 20 dB both at 6 and 8 m/s. It is the developer's responsibility to demonstrate these limits are met before that the wind turbines can be installed, and after they are established the owner covers also the cost to undertake supplementary noise measurements and calculations, if demanded by the authorities (Danish Energy Agency, 2015).

Shadow flicker

The number and predicted duration of shadow flicker effects from wind turbines have to be addressed for all the nearby buildings. Planning guidelines should regulate the phenomenon appropriately as well as to indicate the permitted location of wind turbines in respect to the nearest neighbours. This restriction is usually described as a minimum distance of wind turbines from surrounding neighbours, but also from roads. These values are provided as multiple numbers of the wind turbine height. In Denmark, the location of new wind turbines must respect a distance from the nearest neighbours of minimum 4 times the total height of the wind turbine. Furthermore, no more than 10 hours with shadow effects can occur on a yearly basis towards neighbours (Danish Energy Agency, 2015).

Flora and fauna

The wind farm impact on the ecosystem of the selected site needs to be assessed. This may be extended to potential alterations of vegetation and fauna habits due to the construction of the wind farm. Particular attention should be also placed on the potential impact to any bird or bat species that may use the site. These impacts include the risk of collision with wind turbines and if the construction of a wind farm may affect the way species use the site. If a bird study is needed, this should be implemented both in spring and autumn in order to properly account migrating species as well.

Hydrological assessment

Based on the particular location of the wind farm, the EIA may cover an assessment of the wind farm impact on surface and underground water systems. The analysis may also be protracted to potential impacts of erosion, sedimentation and contamination of the nearest watercourses during the wind farm construction phase (Clean Energy Council).

Heritage assessment

For some sites with high historical or aboriginal importance, the EIA should cover an assessment of the heritage values present at the selected wind farm location and include specific consultations with local communities.

Socio-economic assessment

This specific assessment addresses the effects of the wind farm in the local community. It encompasses potential impacts on health and infrastructure services up to the ones on the local and regional economy.

Transport and road infrastructure assessment

The study includes potential impacts on the traffic and road infrastructure to accomplish the development of the wind farm. Movements of heavy and bulky vehicles might require special road reinforcements and modifications, which need to be carefully considered.

Electromagnetic interference and aircraft safety

The analysis covers the influence of the wind farm on communication devices and radar instruments (electromagnetic impact). Moreover, an assessment of aircraft safety should be provided, which usually includes consultation with military and civil aviation authorities.

Hazard and fatal flaw management

The EIA clears out also the potential hazards and incidents that may occur during the development and construction of the wind farm. The analysis should include an emergency response plan, carefully settled after consultation with local and regional emergency institutions. Project developers should notice that before obtaining a wind farm concession agreement and so construction works can start, all necessary consents and authorizations must be granted.

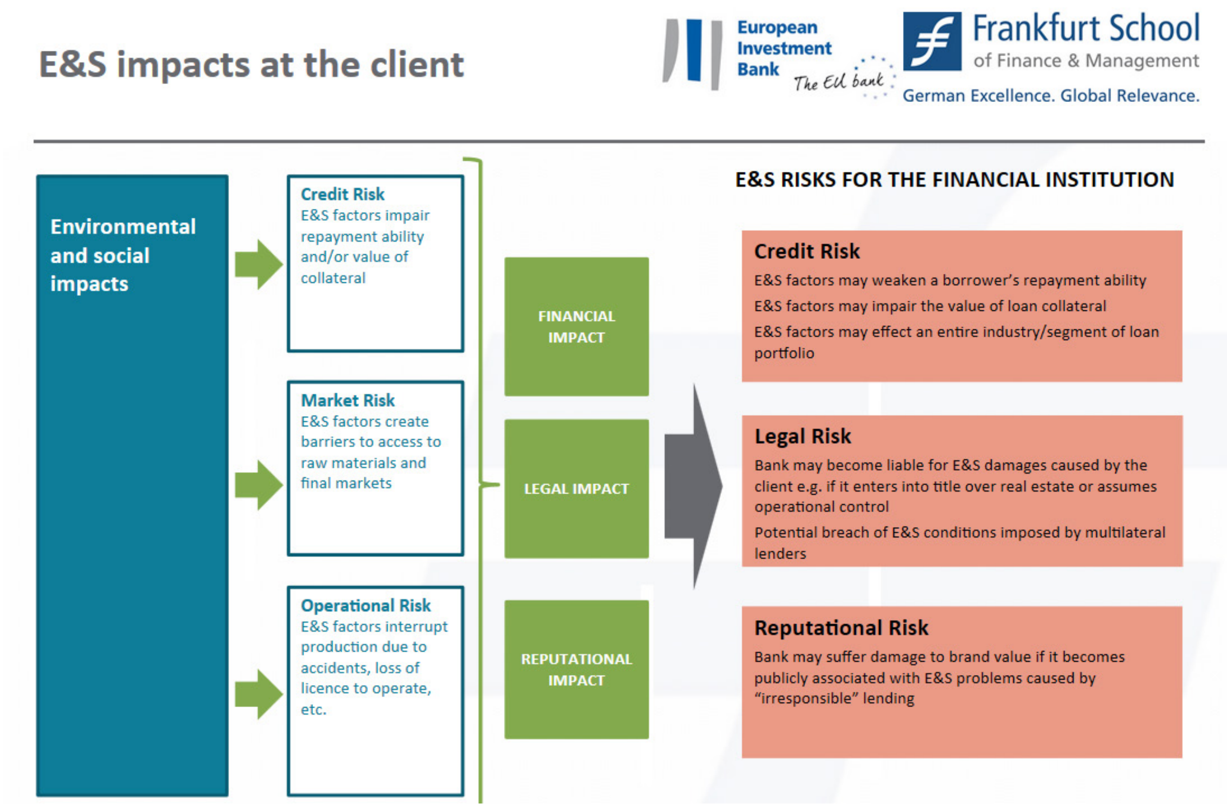


Figure 28: Environmental and social risks for financial institutions (EIB & Frankfurt School of Finance & Management, 2017).

4.1 Ethiopia

The choice of implementing site-specific wind IPP auctions sets up the leadership role of the auctioneer for granting and processing permits, licenses, planning procedures for the sites of the first IPP wind projects. Recent IPP auctions on specific site locations confirm this trend (Zambia, Egypt, Morocco, and Denmark offshore among others). Furthermore, releasing project developers from the acquisition of planning approvals and environmental permits is extremely relevant for ensuring a rapid implementation of projects, avoiding delays and potential social and environmental challenges.

Due to the nature of wind energy facilities, the proposed wind farm may be particularly associated with cumulative socio-environmental impacts for the various project stages (preconstruction, construction, operation and decommissioning). When an EIA includes also social elements, then it is usually referred as environmental and social impact assessment (ESIA). The section below summarizes the Ethiopian and international environmental and social regulations applicable to wind energy facilities.

The Environmental Policy of Ethiopia (EPE, 1997)

This policy, issued in 1997, provides a number of guiding principles that indicate and require a strong adherence to sustainable development. The overall environmental policy goal is determined to improve and enhance the health and quality of life, to promote sustainable, social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole to meet the needs of the present generation without compromising the ability of future generations to do so.

The Environmental Policy of Ethiopia provides a number of guiding principles that require adherence to principles of sustainable development. In particular the need to ensure that an environmental impact assessment (Abdi, 2012):

- Considers impacts on human and natural environments
- Provides for early consideration of environmental impacts in projects and programs design
- Recognizes public consultation
- Includes mitigation and contingency plans
- Provides for auditing and monitoring
- Is a legally binding requirement

For the effective implementation of the Environmental Policy of Ethiopia, the policy encourages the creation of an organizational and institutional framework from federal to community levels.

Environmental Impact Assessment Proclamation (299/2002)

EIA proclamation of Ethiopia (proc.no.299/2002) has made the environmental and social assessment a mandatory legal prerequisite for the implementation of major development projects, programs and plans. It is a proactive tool and a backbone for harmonizing and integrating environmental, economic, cultural, and social considerations into a decision-making process, in a manner that promotes sustainable development. The proclamation requires the proponent of the project (whether it is public or private) must prepare an ESIA following the requirements specified in the legislation (article 8) and associated guidelines (Gubena, 2016).

The Ministry of Environment, Forest and Climate Change (MoEFCC) or the sector Ministries delegated by it and relevant Regional Environmental Agencies will then review the ESIA and either approve the project (with or without conditions) or reject it. Proclamation 295/2002 requires regional states to establish or designate their own regional environmental agencies. The regional environmental agencies are responsible for coordination, formulation, implementation, review and revision of regional conservation strategies as well as environmental monitoring, protection and regulation (Article 15). Relating to ESIA specifically, Proclamation 299/2002 gives regional environmental agencies the responsibility to evaluate ESIA reports of projects that are licensed, executed or supervised by regional states and that are not likely to generate inter-regional impacts. Regional environmental agencies are also responsible for monitoring, auditing and regulating the implementation of such projects. The institutional standing of regional environmental agencies varies among regions. In some regions, they are established as separate institutions, while in others they are within Regional Sector Bureaus (e.g., Bureau of Land Use Administration).

To put this Proclamation into effect the Ministry of Environment, Forest and Climate Change has issued an ESIA Directive (Directive no.1/2008) and other draft procedural guideline documents, which provide details of the ESIA process and its requirements (The Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Natural Resource, 2016).

Environmental Pollution Control (Proclamation No. 300/2002)

Complementary to the Environmental Policy of Ethiopia and the EIA Proclamation, the Pollution Control Proclamation requires ongoing activities to implement measures that would reduce their degree of pollution to a set limit or quality standard. Thus, one of the dictates of the legislation is to ensure, through inspection, the compliance of ongoing activities with the standards and regulations of the country through an environmental audit.

Process and procedures for Environmental Impact Assessments in Ethiopia

These steps are stipulated in the EIA Procedural Guideline (2003), which largely follows the standards for environmental management procedures and processes under the World Bank operation Guideline.

Screening

The screening process enables the Competent Authority to decide on:

- The need for and level of assessment required
- The level of government responsible for the project (Federal or Regional)
- Other necessary permits or approval processes required (e.g. rezoning, etc.),
- Merit-based acceptability of the consultant to assist the proponent
- The public participation process
- The total life-cycle of the project

Therefore, a proponent is required to submit a screening report to the Competent Authority, based on which the different decisions will be made on whether an EIA is required and the type of EIA that will be required (full or partial/preliminary) (Sileshi Consultants PLC, 2012).

Scoping

The EIA Procedural Guideline (2003) outlines that during the scoping process a proponent should prepare a detailed plan of study for the scoping exercise. This plan of study is important for ensuring whereas public consultation is required and for the identification of all the relevant parties including other government departments. The plan of study for EIA should contain the following topics (Sileshi Consultants PLC, 2012):

- A description of the environmental issues identified during scoping that may require further investigation and assessment
- A description of the feasible alternatives identified during scoping that may be further investigated
- An indication of additional information required to determine the potential impacts of the proposed activity on the environment
- A description of the proposed method of identifying these impacts
- A description of the proposed method of assessing the significance of these impacts

Mitigation and Impact Management

The EIA proclamation explicitly states that an environmental impact study report shall contain, as a minimum, a description of mitigation measures proposed to eliminate, minimize, or mitigate negative impacts. In practice, the process of impact identification begins during screening and continues through the scoping phase, where key issues are identified and classified into impact categories for further study. However, in the mitigation phase, the likely impacts are analysed in greater detail in accordance with the terms of reference (ToR) developed by the proponent and approved by the Competent Authority. (Abdi, 2012).

Monitoring and Reporting

The EIA Proclamation states that:

- The Authority or the relevant regional environmental agency shall monitor the implementation of an authorized project in order to evaluate compliance with all commitments and obligations imposed on the proponent during authorization
- When the proponent fails to implement the authorized project in compliance with the commitments entered into or obligations imposed upon him/her, the Authority or the relevant regional environmental agency may order him/her to undertake specified rectification measure
- Any other authorizing or licensing agency shall, in tandem with the Authority's or the relevant regional environmental agency's decision to suspend or cancel any authorization to implement a project, suspend or cancel the license it may have issued in favour of the project

Public Consultation and Disclosure

The EIA proclamation stipulates that the Competent Authority or the relevant regional environmental agency shall:

- Make any environmental impact study report accessible to the public and solicit comments on it
- Ensure that the comments made by the public and in particular by the communities likely to be affected by the implementation of a project are incorporated into the environmental impact study report as well as in its evaluation

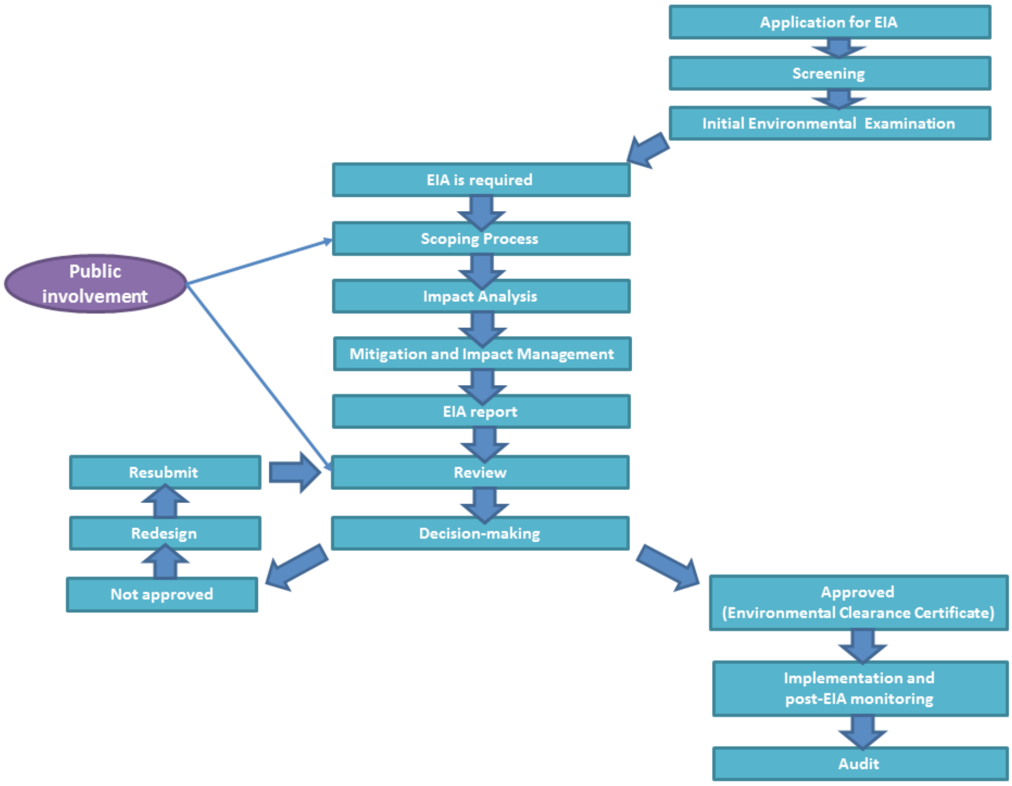


Figure 29: EIA flowchart and process (The World Bank, 2017).

IFC Performance Standards on Environmental and Social Sustainability

IFC's Performance Standards on Environmental and Social Sustainability have become globally recognized as a benchmark for environmental and social risk management in the private sector. These standards are generally considered as "gold" standards for infrastructure projects. The Performance Standards are directed towards providing guidance on how to identify risks and impacts and are designed to help to avoid, mitigate and, manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of direct investments for the IFC (including project and corporate finance provided through financial intermediaries), the IFC requires that its clients apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced. In addition, investors and lenders start to require compliance with these standards even in the absence of IFC (World Bank Group) funding (Meyer et. al., 2015). These standards can be divided into 8 different areas:

1. Assessment and management of environmental and social risks and impacts
2. Labour and working conditions
3. Resource efficiency and pollution prevention
4. Community health, safety and security
5. Land acquisition and involuntary resettlement
6. Biodiversity conservation and sustainable management of living natural resources
7. Indigenous people
8. Cultural heritage

IFC PERFORMANCE STANDARDS ON ENVIRONMENTAL AND SOCIAL SUSTAINABILITY	
Performance Standard 1: **ASSESSMENT AND MANAGEMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS** Underscores the importance of identifying E&S risks and impacts, and managing E&S performance throughout the life of a project.	Performance Standard 5: **LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT** Applies to physical or economic displacement resulting from land transactions such as expropriation or negotiated settlements.
Performance Standard 2: **LABOR AND WORKING CONDITIONS** Recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection of basic rights for workers.	Performance Standard 6: **BIODIVERSITY CONSERVATION AND SUSTAINABLE MANAGEMENT OF LIVING NATURAL RESOURCES** Promotes the protection of biodiversity and the sustainable management and use of natural resources.
Performance Standard 3: **RESOURCE EFFICIENCY AND POLLUTION PREVENTION** Recognizes that increased industrial activity and urbanization often generate higher levels of air, water and land pollution, and that there are efficiency opportunities.	Performance Standard 7: **INDIGENOUS PEOPLES** Aims to ensure that the development process fosters full respect for Indigenous Peoples.
Performance Standard 4: **COMMUNITY HEALTH, SAFETY AND SECURITY** Recognizes that projects can bring benefits to communities, but can also increase potential exposure to risks and impacts from incidents, structural failures, and hazardous materials.	Performance Standard 8: **CULTURAL HERITAGE** Aims to protect cultural heritage from adverse impacts of project activities and support its preservation.
WHAT ARE THE BENEFITS OF THE PERFORMANCE STANDARDS	
GUARD AGAINST UNFORESEEN RISKS AND IMPACTS Implementing the Performance Standards helps companies identify and guard against interruptions in project execution, legal claims, brand protection, and accessing international markets. **IMPROVE FINANCIAL AND OPERATIONAL PERFORMANCE** IFC believes that meeting the Performance Standards helps clients improve their bottom line. Implementation of the Standards can help optimize the management of inputs such as water and energy, and minimize emissions, effluents, and waste, leading to a more efficient and cost-effective operation.	**SOCIAL LICENSE TO OPERATE** In addition, the Standards help clients find ways to maximize local development benefits and encourage the practice of good corporate citizenship. This often results in greater acceptance of the project by local communities and governments, allowing companies to acquire a social license to operate. Enhanced brand value and reputation may also be attractive to new investors or financiers. **GAIN AN INTERNATIONAL STAMP OF APPROVAL** The "Equator Principles," which have been adopted by more than 70 of the world's leading investment banks in developed and developing countries, are based on IFC's Performance Standards. These principles are estimated to cover nearly 90% of project financing in emerging markets.

Figure 30: IFC performance standards on environmental and social sustainability (IFC, World Bank Group, 2012).

As recently shown in the IPP solar auctions in Uganda (GET FiT) and Zambia (Scaling Solar Programme), due to a lack of comprehensive national environmental standards and regulatory framework in these countries, bidders were required to comply directly with International Financial Corporation's (IFC) Environmental and Social Performance Standards. For the short term, this solution could be also adopted in Ethiopia.

IFC Environmental, Health, and Safety Guidelines

The IFC Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of "Good International Industry Practice" (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. In addition, when host country regulations (i.e. Ethiopia) differ from the levels and measures presented in the EHS Guidelines, projects will be required to achieve whichever is more stringent. General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. They can be accessed at the following website (www.ifc.org/ehsguidelines) and a brief summary is provided in the table below:

1. Environmental	2. Occupational Health and Safety
1.1 Air Emissions and Ambient Air Quality 1.2 Energy Conservation 1.3 Wastewater and Ambient Water Quality 1.4 Water Conservation 1.5 Hazardous Materials Management 1.6 Waste Management 1.7 Noise 1.8 Contaminated Land	2.1 General Facility Design and Operation 2.2 Communication and Training 2.3 Physical Hazards 2.4 Chemical Hazards 2.5 Biological Hazards 2.6 Radiological Hazards 2.7 Personal Protective Equipment (PPE) 2.8 Special Hazard Environments 2.9 Monitoring
3. Community Health and Safety	**4. Construction and Decommissioning**
3.1 Water Quality and Availability 3.2 Structural Safety of Project Infrastructure 3.3 Life and Fire Safety 3.4 Traffic Safety 3.5 Transport of Hazardous Materials 3.6 Disease Prevention 3.7 Emergency Preparedness and Response	4.1 Environment 4.2 Occupational Health and Safety 4.3 Community Health and Safety

Table 4: Overview of the IFC Environmental, Health, and Safety Guidelines.

The "IFC General EHS Guidelines" are designed to be used together with the "IFC Industry EHS Guidelines", which provide guidance to users on EHS issues in specific industry sectors such as the wind industry. The "IFC EHS Guidelines for Wind Energy" should be applied to wind energy facilities from the earliest feasibility assessments, as well as from the time of the environmental impact assessment, and continue to be applied throughout the construction operational and decommissioning phases. It should be noted that EHS issues associated with the construction and operation of transmission lines (often associated with the construction of wind energy facilities) are addressed separately in the "IFC EHS Guidelines for Electric Transmission and Distribution". A summary of the IFC EHS Guidelines for Wind Energy is presented in Table 5.

1. Environment	2. Occupational Health and Safety
1.1 Landscape, Seascape, and Visual impacts 1.2 Noise 1.3.Biodiversity 1.4 Shadow Flicker 1.5 Water Quality	2.1 Working at Height 2.2 Working over Water 2.3 Working in Remote Locations 2.4 Lifting Operations
3. Community Health and Safety	**4. Construction and Decommissioning**
3.1 Blade and Ice Throw 3.2 Aviation 3.3 Marine Navigation and Safety 3.4 Electromagnetic Interference and Radiation 3.5 Public Access 3.6 Abnormal Load Transportation	4.1 Environment 4.2 Occupational Health and Safety 4.3 Community Health and Safety

Table 5: Overview of the IFC EHS Guidelines for Wind Energy.

Burden and regulatory framework

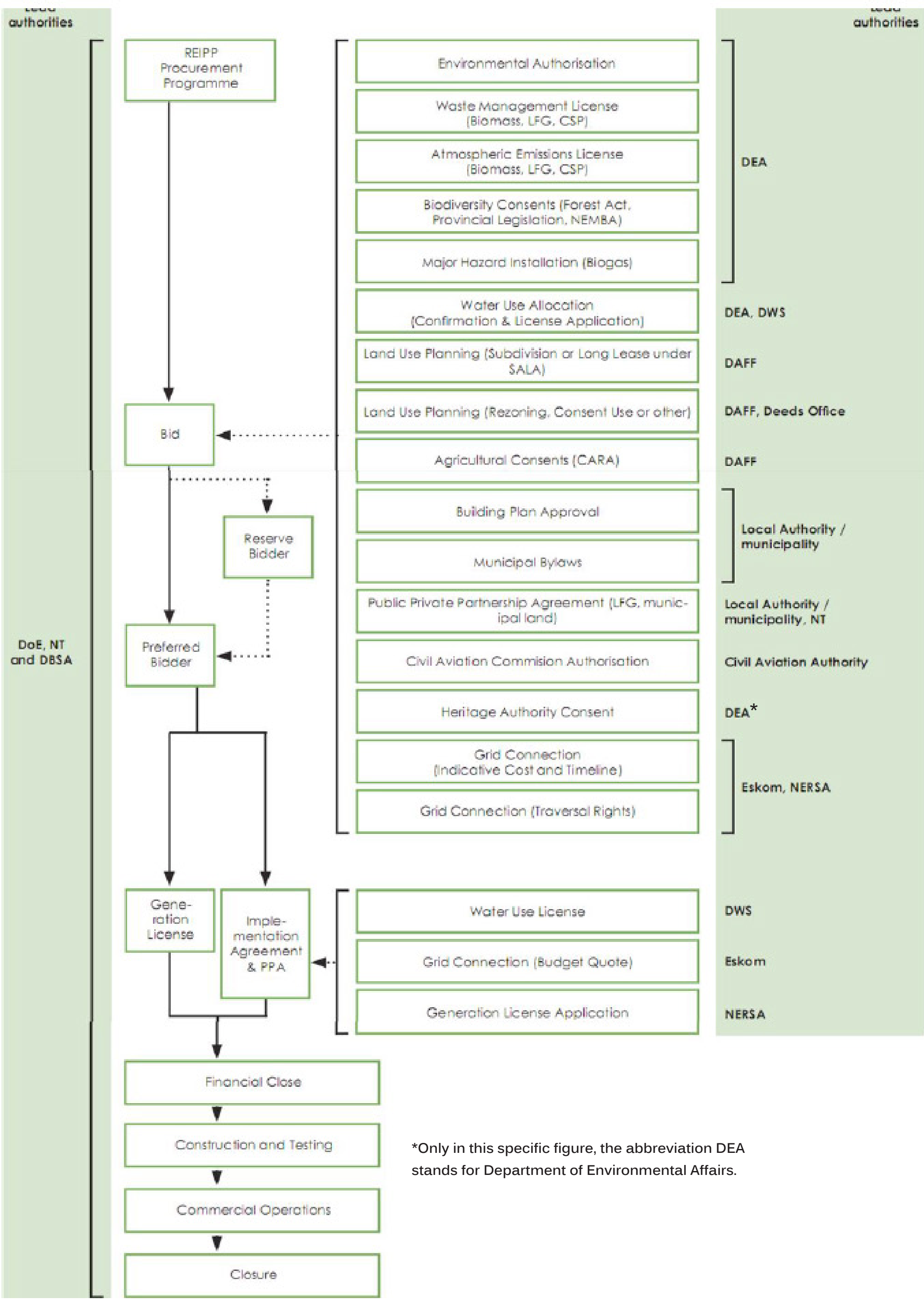
For the first round of IPP wind auctions in Ethiopia, a proper implementing strategy should be considered for assigning obligations for approvals and permits as well as for establishing an agile regulatory environment to process and permitting licenses. As previously cited, this approach may be strictly correlated with the choice of implementing site-specific wind IPP auctions and with the decision to establish a dedicated governmentunitin charge for granting and licensing the permitting approvals required in wind tenders.

As a basis of comparison, it may be useful to provide specific references on the collateral effects of proceedings and management of permitting approvals in site-agnostic auctions, mentioning again the REIPPP programme of South Africa. In details, IPP bidders are in charge for obtaining all the planning approvals and environmental permits before the bidding process. Figure 31 illustrates the complexity and the extent of cooperation required from all the South African authorities who had to license IPPs with necessary consents and approvals. Among others, the Department of Energy (DoE) had to coordinate closely with the Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), the Department of Agriculture, Forestry and Fisheries (DAFF), and provincial and municipal departments (Eberhard & Naude, 2016). In addition, by the end of 2013 more than 1,500 environmental authorization applications had been processed to the DEA in respect of REIPPP projects (Mulcahy, 2014).

The severe burden and the high costs faced by the different governmental departments of South Africa have been sustained by different auctioning fee schemes. In details, bidders are required to pay a registration fee to obtain the IPP auction documentation (Request for Proposal) and preferred bidders must also pay a pre-development project fee equal to 1% of their total project costs. From the IPPs' perspective, the environmental authorization of the REIPPP programme (which is part of the pre-qualification criteria) represent one of the largest costs in the bidding process (USD 150,000-450,000) and has the longest lead-time of all the permissions required. In some project cases, for instance, more than 20 different permissions were required, taking up to 24 months (Mulcahy, 2014), (Kruger & Eberhard, 2016).

Specifically for Ethiopia, the Environmental Impact Assessment Proclamation provides a strong regulative framework for an effective implementation of the EIA system in the country. Furthermore, the recent integration of the Federal Environmental Protection Authority (FEPA) into the Ministry of Environment, Forest and Climate Change can be seen as a positive move to strengthen its capacity and legal means to enforce the law. For the implementation of the first wind energy tenders, it is advisable that the Ethiopian auctioneer will provide potential bidders necessary permits and an ESIA beforehand bid submission. As previously specified, national legislation and standards can be supplemented with the adoption of IFC`s Performance Standards and EHS guidelines. They may be used as a comprehensive and exhaustive framework for implementing the ESIA, on which bidders will be required to comply with.

Excluding hydro power projects, in fact, specific assessment documentation is lacking for other renewable energy technologies, including wind energy facilities. It is advisable that the GoE will start to process detailed guidelines for project planning and environmental impact assessment, identifying the potential effects that wind farms (and other RE plants) may have on the environment and relative mitigation practices that may be applicable. The guidelines should provide a detailed analysis of the legal framework, centres of expertise and applicable roles in the Ethiopian RE sector. These procedures should be envisaged as a powerful tool both for facilitating competent authorities in implementing and monitoring the ESIA process and for clarifying the relevant legislation and components of the authorisation process for applicants.



*Only in this specific figure, the abbreviation DEA stands for Department of Environmental Affairs.

Figure 31: Representation of the coordination among South African departments for the REIPPP programme (Eberhard & Naude, 2016).

ESIA – The case of Gulf of Suez in Egypt

Egypt is one of 38 countries in the world with a published national wind atlas, developed in collaboration with DTU. Based on the outcomes of the wind atlas, policy decision makers were able to spot the Gulf of Suez, as an excellent location for wind deployment, with average wind speeds in the range of 10.5 m/s. At the same time, the Gulf of Suez is situated along one of the major flyways for birds breeding in Europe and Asia and wintering in Africa. Very large numbers of birds, therefore, migrate through the region twice a year.

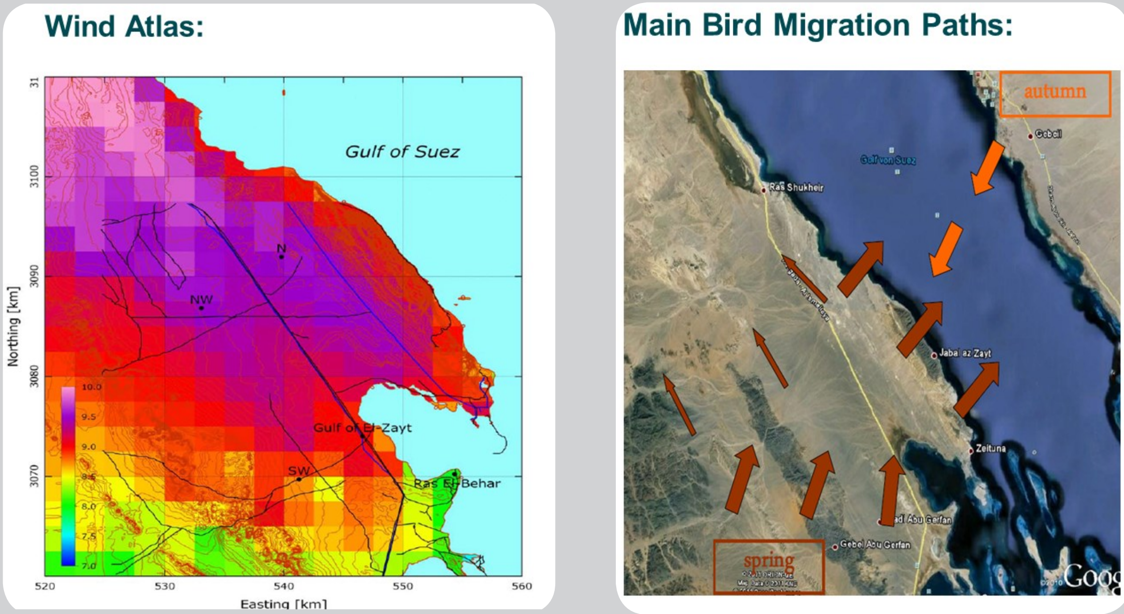


Figure 32: Left figure: mean wind speeds over the Gulf of Suez (DTU, 2004). Right figure: main migration paths in the Gulf Of Suez area (World Bank Group, 2012).

ESIA – The case of Gulf of Suez in Egypt

Before tendering wind projects in the Gulf of Suez area, the Government of Egypt procured an ESIA study covering a total area of 200 km^2 to evaluate the potential impact of wind turbines could have on migrating birds. The full study on birds led to the identification of different areas classified as green yellow and red in according to the potential hazard represented by potential wind turbines on migrating birds. In addition, the ESIA study provided detailed guidelines on appropriate operational strategies for wind turbines to attenuate their impact on birds.

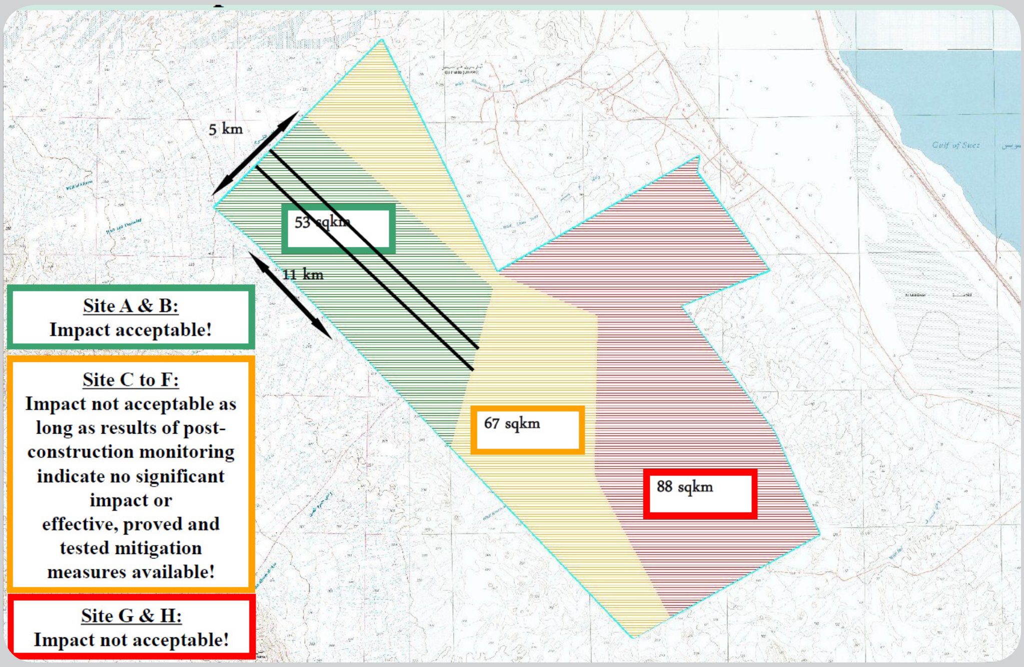


Figure 33: Recommendations from the ESIA study (World Bank Group, 2012).

Several mitigation strategies were proposed including:

- WTs shutdown for 10 weeks during spring migration (10% energy loss)
- WTs shutdown on demand in times of high migratory activity (1-2% energy loss)
- Bird corridor, 1 km wide (0% energy loss, but loss of 15-20% of valuable windy land and the shutdown of WTs in the yellow zone was needed anyway)

Solutions adopted by the Government of Egypt for tendering wind projects in the Gulf of Suez:

- WTs shutdown on demand – best strategy in terms of cost-efficiency (2% energy loss)
- For avoiding potential conflicts of interest, the Egyptian Environmental Authority was appointed to administer the WT shutdown scheme together with a team of ornithologists
- The off-taker of the PPA (Egyptian Electricity Transmission) will compensate bidders for deemed electricity generation during WT shutdown events
- Imposing a maximum tip height of 120 m for the procured wind turbines

Source: (World Bank Group, 2012)

Auction feature	Auctioneer (Government)	Project Developer
Procuring approvals and environmental permits	✓ Require a one-stop-shop or a central government agency model for simplifying and coordinating planning procedures ✓ Minimization of risks due to land securitization and competition in the land usage ✓ Ensure that several steps and risks of the pre-development phase are implicitly evaluated and attenuated ✓ High processing costs faced by the auctioneer may be passed to winning bidders ✗ Disputes and social conflicts may rise due to land expropriation and/or inadequate compensation schemes	✓ Require that a robust regulatory framework is already in place ✓ The high processing burden faced by the different government departments may be compensated by different fees applied to bidders ✗ High costs and burden both for project developers and auctioneers ✗ Project developers may lack competence in preparing local planning applications ✗ The involvement of multiple government parties can make licensing process overly complex and lengthy ✗ Institutions may lack the capacity to manage applications ✗ Disputes and social conflicts may rise due to land expropriation and/or inadequate compensation schemes

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
Undefined or unclear guidance documentation	Poor guidance documentation may cause unforeseen delays in project implementation or in extreme cases may lead project developer to abort projects	To facilitate planning and approval procedures, governments should prepare detailed guidelines for project planning and environmental impact studies on wind farms and other renewable energy technologies	*Medium-high risk* More accurate documentation and legislative guidance have to be specified and developed from the GoE. An effective enforcement of EIAs should rely on good monitoring systems, effective mechanisms for accountability, significant capacity building and awareness. On the short term, the auctioneer can be responsible for providing ESIAs to potential bidders before bid submission, requiring bidders to comply with the relevant national legislation, complemented by IFC`s Performance Standards and EHS guidelines
Underestimating planning approvals time	The time required to obtain planning approvals can be quite long. This may lead to serious delays and on projects timetable and/or on timing of tenders	Private and public entities should be established to provide consultancy to project developers to navigate in the regulatory environment and permitting process of wind power development	*Medium risk* Due to the complexity of the multi-disciplinary process delays may incur in respecting the tender time frame. A crucial role should be played by the Ethiopian competent authority that will be appointed for granting all the licenses and permits needed
Adverse public acceptance	The opposition of local population affected by the wind power infrastructure may generate social	Public consultation and specific compensation schemes are key elements of the consents process in several countries.	*Medium risk* The country has general rules and regulations regarding public consultation and

	and economic conflicts	Governments should prevent not-in-my-backyard (NIMBY) syndromes, enhancing policies and strategies, which encourage the positive impact of wind energy projects on local job creation, economy and environment benefits and/or compensations	compensation for all projects and it has been implemented in all previous projects. Butthe amount settlement and delay of compensation payment often has been a challenging issue
Noise and flicker issues	Legal claims due to weak planning procedure may lead to stop the operation of wind turbines that cause harm	Planning guidelines should regulate the phenomenon appropriately as well as indicate the permitted location of wind turbines in respect to nearest neighbours	*Low-medium risk*, since the potential sites for first auctions will be properly chosen. On long-term, proper guidelines need to be implemented.
Wild life	The impact of WTGs on birds and wild life may have serious consequences	The majority of large infrastructure projects, including wind projects, require an Environmental Impact Assessment (EIA) before bidding	*Low-medium risk* It is a matter of fact that an EIA will be carried out for the sites selected. Informationismissing on who will be the responsible authority for its implementation (auctioneer, public agency, bidders)

5. Power Sale

Finding a creditworthy buyer for the power produced by the wind farm is one of the main prerogatives of project developers. Two main categories of power sales can be identified:

- Spot market
- Bilateral contracts

Through the sale of power on the spot market, the wind farm owner sells the electricity generated to the electricity spot market. Hence, the returns of electricity generation are subjected to the price volatility of the market. The economic viability of project needs to be assessed by average electricity tariffs as well as forecasts of the tariffs development, making it difficult for companies to accurately budget and foresee cash flows. This risk can be mitigated by entering into hedge agreements, which can provide a certainty of revenue.

Bilateral contracts instead are usually set by power purchase agreements (PPAs) between the power seller (project developer/project company) and a creditworthy buyer (or consortium), mostly referred as off-taker. The typical profile of an off-taker is a utility, an electricity market representative, a municipality or a large commercial/industrial corporation. For the power seller, the main advantage of bilateral contracts is represented by the capacity of securing a stable and predictable cash flow for a large part (10-25 years) of the operational lifetime of the wind farm. This feature increases also the confidence of investors and the bankability of the project is consequently enforced.

PPAs prices for wind power are set either by competitive mechanisms such as renewable tenders (where the off-taker is mostly represented by a state-owned utility or a transmission system owner) or by feed-in-tariff / feed-in-premium (FiT/FiP) payment policies. As highlighted in the picture below, although FiT and FiP are still the most popular mechanisms, the use of tendering procedures is increasing worldwide.

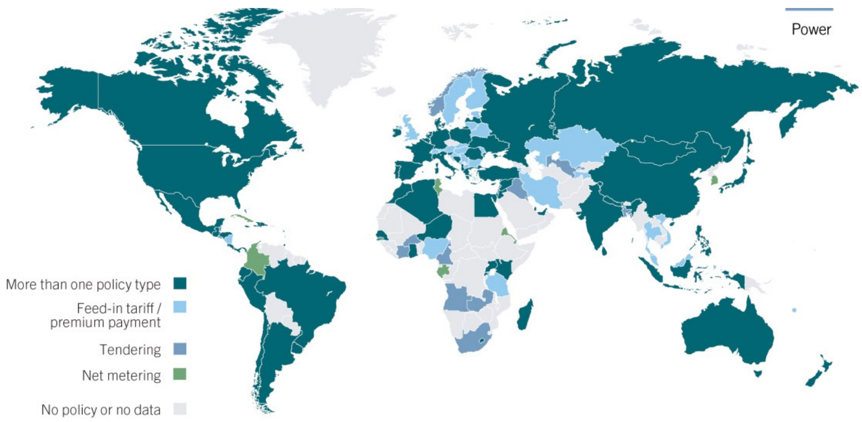


Figure 34: Mechanisms implemented for supporting renewable energy policies (REN 21, 2015).

5.1 Ethiopia

Historically, the Ethiopian electricity sector has been operated and strictly regulated by a vertically integrated state-owned utility EEPCo. Its range of activities ranged from generation and power planning to transport and distribution. The unbundling process of the electricity market started in 2013 when EEPCo was split into two entities Ethiopian Electric Power (EEP) and Ethiopian Electric Utility (EEU). EEP is the sole provider of bulk electricity to users as well the responsible for generation and transmission. EEU instead, owns, operates and manages electricity distribution networks. Another body was created as well - Ethiopian Energy Authority (EEA) with the scope of regulating the electricity and energy efficiency sectors. The Ministry of Water, Irrigation & Energy (MoWIE) is the lead institution for the Ethiopian Energy Sector and supervises the three institutions mentioned beforehand. The organizational diagram of the Ethiopian energy sector is represented in the figure below.

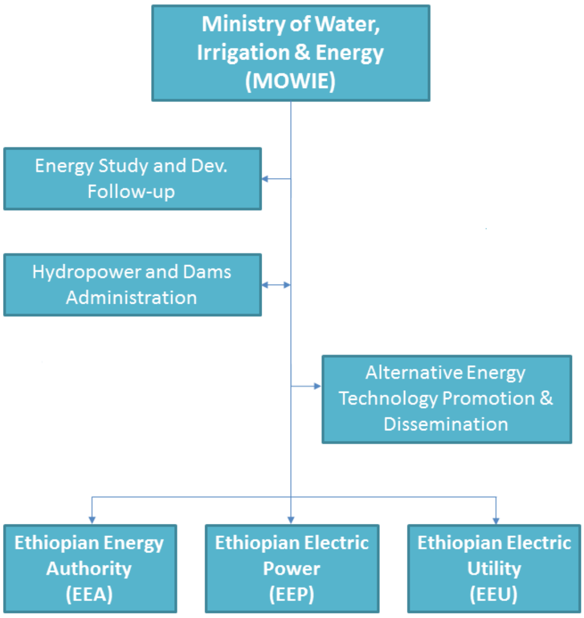


Figure 35: Organizational diagram of the Ethiopian Energy Sector excluding fossil fuels (Azeb Asnake, 2015).

In 2015, the country awarded its first-ever power purchase agreement to an Independent Power Producer (IPP) for the realization of 500 MW geothermal power plant. Consequently, as one can clearly deduce the country's electricity market liberalization has just started, but it is an ongoing process with prospects for strong growth in the Ethiopian power supply. This fact is also confirmed by the participation of Ethiopia in the Eastern Africa Power Pool (EAPP), whose main purpose is to facilitate power trade and cross-border transactions among its members.

At the same time, with the implementation of the Growth & Transformation Plan II (GTP2, 20015-2020), Ethiopia plans to increase its power generation of 17 GW from different renewable sources, including up to 1,200 MW of wind power capacity. Of this wind power expansion, around 900 MW are planned to be developed by the private sector through IPP wind auctions.

The ambitious energy plan is driven both by an intensive electrification programme of the country and by an increased demand for electricity (>25%) driven to a great extent by the growing contribution of the industrial sector in the power side demand.

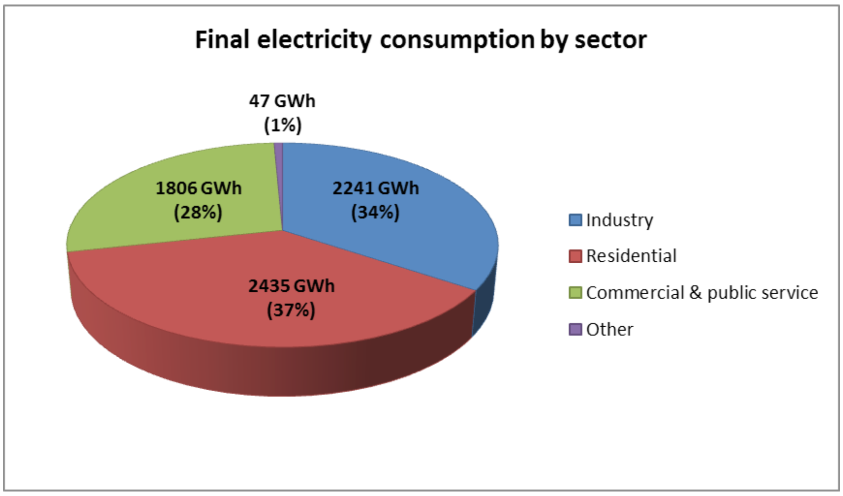


Figure 36: Breakdown of final electricity consumption in Ethiopia for 2014. Source: IEA Statistics.

The table below summarizes benchmarking data of the Ethiopian power sector derived from the World Bank Group in 2014.

	Unit	Ethiopia
Power consumption	kWh/capita	110
Access to electricity	%	26.6
Urban access to electricity	%	100
Rural access to electricity	%	7,6
Power outages	No./month	8.2
Duration of a typical electrical outage	hours	4.6
Firms' value lost due to power outages	% of annual sales	4.6
Time to obtain an electrical connection for firms	days	194.3
Percent of firms owning or sharing a generator	%	49.1
Transmission & distribution losses	% of production	19
Average electricity tariff	USD/kWh	0.04
Electricity supply cost	USD/kWh	0.10-0.17
Bill collection rate	%	87
Cost recovery	% of total cost	23.5

Table 6: Benchmarking data of the Ethiopian power sector (World Bank Group, 2014).

The GoE has already secured and he is still planning massive financial investments to lift the undermined power sector. In facts, the Ethiopian power consumption is approximately at 110 kWh per person per year, which is more than four times lower than the annual average power consumption per capita in Sub-Saharan Africa (488 kWh per capita). Moreover, despite an exceptionally high level of urban access to electricity (100%), the majority of the rural population has no access to electricity (92,4%). Furthermore, the overloading of the network frequently disrupts the power supply of large commercial and industrial customers. To overcome this

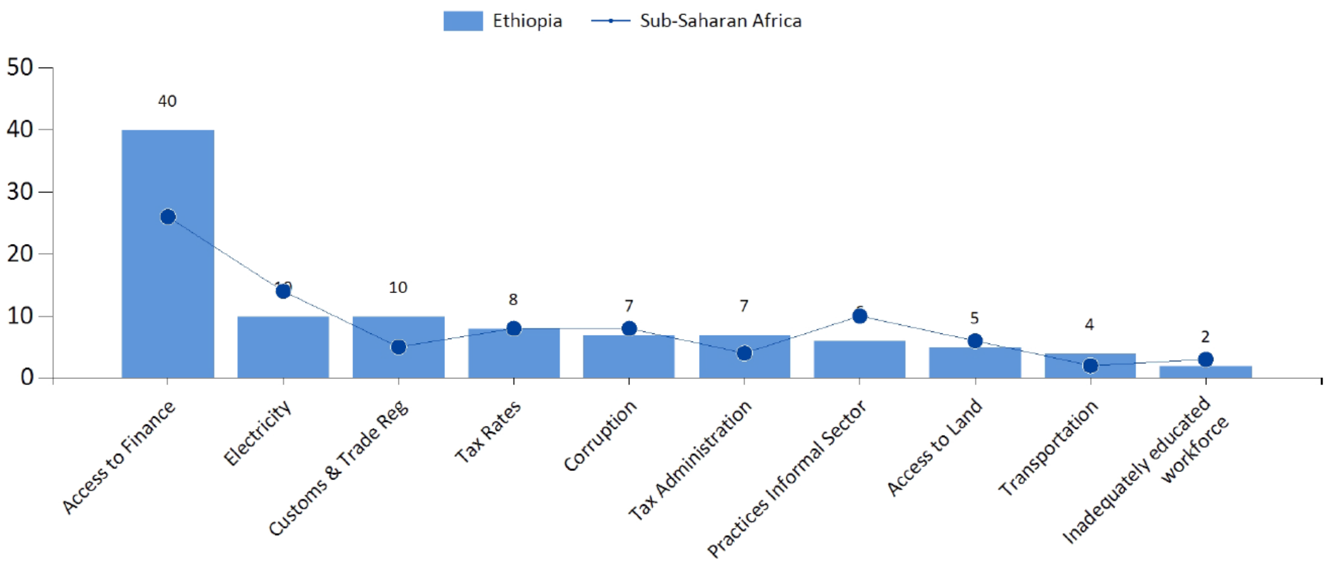
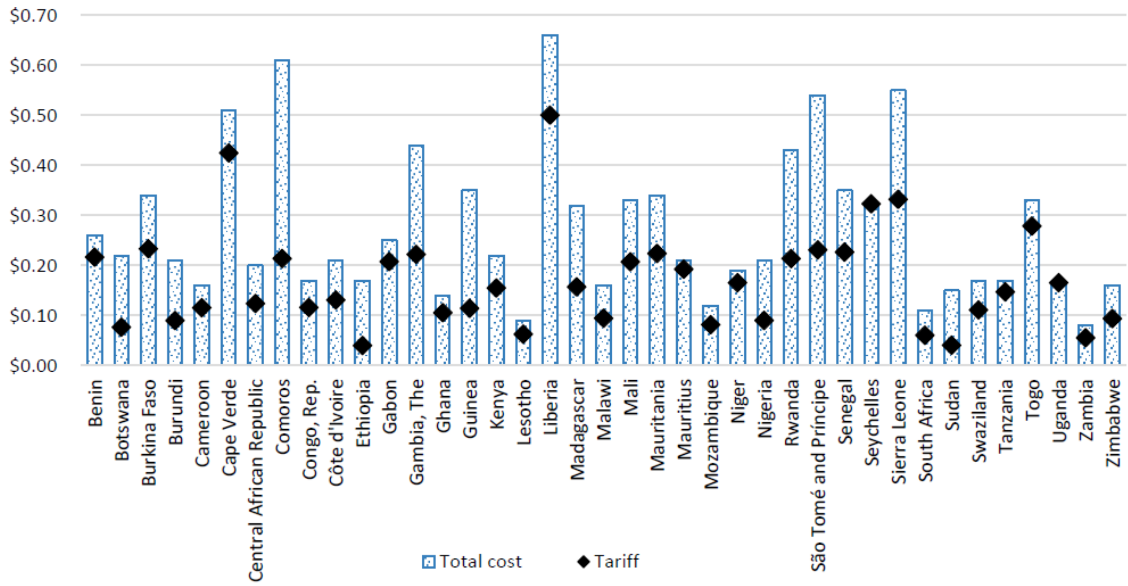


Figure 37: Top ten business environment constraints (World Bank, 2015).

discrepancy, backup systems such as diesel-power generators have become a common and necessary solution among Ethiopian enterprises to hold back power shortages. Around 50% of businesses in Ethiopia operate their own backup generators and electricity is perceived as the second biggest constraint in their business operations (The World Bank, 2015).

Burden and regulatory framework

Ethiopian electricity tariffs are among the lowest in the Sub-Saharan countries. For clarity, it should be mentioned that since power consumers pay VAT and other taxes and fees not captured by utilities, the actual payments of the electricity users can be higher than the ones reported in Figure 38 (Trible et. al., 2016). Although the long-term marginal cost of generation in Ethiopia is low at USD 0.04 per kilowatt-hour (mostly associated with the enormous potential hydropower generation capacity), the major investment needed in the country's transmission and distribution networks and the aggressive power sector expansion embarked by the GoE had the effect to push up the overall long-term marginal cost of power to around USD 0.17 per kilowatt-hour. This large deficit between actual electricity tariffs and marginal costs (power sector under-pricing) is estimated to be equivalent to 1.7% of the GDP. This latter finding and the associated methodology is explained in details in (Trible et. al., 2016) and (Foster & Morella, 2010). As new generation plants started to become operative and the number of connections increases, the total power sale value is increasing and therefore the marginal cost is expected to be reduced at USD 0.10 per kWh billed in the medium time horizon. Despite this encouraging forecast, the financial gap in the power sector needs to be bridged with further measures in order to not hamper investments in the sector and increase concurrent risk in the overall system. This means that Ethiopian power tariffs will need to be adjusted upward in the short and medium term. This trend is also acquiring momentum due to the recent increases in export sales in the share of power sales and the market opening to IPPs and international power companies.



Source: World Bank staff calculations based on utility data.
Note: Tariff revenue excludes rebated taxes, such as VAT.

Figure 38: Comparison of costs with cash collected in 2014. U.S. dollars per kWh billed from African utilities (Trible et. al., 2016).

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
Selling energy directly on the spot market	Major risks are associated with uncertainties of cash flows and economic returns	This risk can be mitigated by entering into hedge agreements, which can provide some certainty of revenue	Not relevant for Ethiopia, due to the absence of a spot market for electricity trade
Power purchase agreement (PPA)	The creditworthiness of the off-taker is fundamental for the economic feasibility of the project	Evaluate the creditworthiness of the off-taker through an investment grade credit. Ensure a smooth and transparent coordination process among the key-stakeholders (credit rating agency, treasury department, legal and accounting department, etc.)	*Medium risk* EEP´s financial status is currently unknown. Specific financial assessments and independent reports should be carried out to determine EEP`s financial health
Auction mechanism	Strict pre-qualification requirements may lead to high planning and transaction costs, which may reduce competition and auction participation, especially for small and new companies	Pre-qualification requirements should be carefully designed with a trade-off principle to guarantee enough participation and reliability of the auction process	*Medium-high risk* due to the inexperience of Ethiopia on IPPs auction procedures and the infant status of the Ethiopian renewable market (excluding hydro)
Feed-in-tariffs mechanism	It may be difficult to control the overall policy costs and burden on consumers	FIT schemes require a continuous administrative commitment to set the payments accurately. This may include caps and or progressive allocation of capacity	*Not relevant*, since no “open door” feed-in-tariffs have been planned yet in Ethiopia
Subsidization of electricity tariffs	To meet consumption demands,government s in Africa are forced to subsidize electricity supplies, generating quasi-fiscal deficits averaged at 1.5% of GDP	Robust and fair political and economic considerations should drive the restructuring of electricity tariffs	*Medium-high risk* Ethiopia has one of the lowest electricity tariffs of Africa. Cost reflective tariffs are necessary to reduce the financial gap in the sector over the medium to long-term to reduce risk premiums added by lenders

			for underfunded power projects

6. Project Financing and Bankability

The financing process of wind projects is strongly affected by the pre-development steps presented so far. During the maturation stage of the wind farm project, the required capital must be procured and the optimal capital structure must be defined. The most common form of financing wind farm projects is through project financing, often referred as “non-recourse” financing. This definition implies that the revenue stream generated by the project must be sufficient to support the financing process. This includes detailed estimates of the expected level and conditions of debt and equity funding required, exposure to inflation, long-term currency mismatch, interest rate movements, etc..

For lenders and investors, it is essential to be able to anticipate to the greatest extent project revenue streams and minimize risks of their investments. Hence, a proper allocation and mitigation strategy of risks is necessary for making projects bankable. Typically, a well-structured and bankable power purchase agreement is always based on the creditworthiness of the off-taker, different counterpart risks, guarantees and de-risking options. The main elements of these risks and mitigating policies are described below (OPIC).

Off-taker payment support

Depending on the creditworthiness of the off-taker and the development of the energy sector in a certain country, short-term liquidity support (e.g. through an escrow account or a letter of credit) and/or a sovereign guarantee may be required to support the off-takers payment obligations.

Dispatch risk

This risk implies the possibility that the off-taker may not dispatch the generating facility (in this case the wind farm). Typically, two different mitigating measures are generally observed by lenders for addressing the problem:

- *“Take or Pay”*

Through this contractual obligation, the off-taker pays a fixed tariff composed by a capacity fee (entirely proportional to the available capacity of the wind farm, so no dispatch is required) and an energy fee, equivalent to the energy delivered. Through the capacity charge, the project developer is able to cover the fixed costs of the wind farm, which extend from debt service to fixed operating costs and an agreed equity return.

- *“Take and Pay”*

With this strategy, the off-taker is forced to take and pay a fixed tariff for all energy delivered from the wind farm. If the energy output of the wind farm cannot be accepted or it is curtailed, then the off-taker has to pay the “deemed” generation.

Foreign exchange

It represents the financial risk that the wind farm investment´s value will change due to changes in currency exchange rates. In the majority of the cases, project developers are determined to shield themselves from currency risks. These hedging measures can include PPA contracts signed in hard currency (USD, EUR) and adjusted periodically according to determined price indexes. Whereas PPA contract prices in hard currencies may shield project developers from local currency fluctuations, on the other side they expose governments to significant foreign exchange risks. On the contrary, PPA can be also established in local currencies and adjusted yearly for domestic price inflation or accordingly to a flat annual rate.

Change in law or in tax

There is a concrete risk that the economic projections and returns for project developers may suddenly change due to modifications in the political scene of a country. Hence, a proper risk mitigation strategy should be implemented, stating which party in the PPA contract will assume the risk of law or tax regime change after the date of contract signature. In order for PPAs to be bankable, several investors require the off-taker to take this risk, possibly supported by the hosting government.

Transmission or interconnection risk

The PPA should clearly indicate which party bears the risk of connecting the facility to the grid and transmitting power to the nearest substation.

Force majeure

In case of an event beyond reasonable control (force majeure), the PPA agreement should also exclude the project developer and the off-taker by their obligations. Risk mitigation procedures and costs associated with force majeure losses are strongly dependent on insurance mechanisms and political risks subject to specific countries/regions.

Force majeure events generally can be divided into natural events and political events. The first ones may include earthquakes, floods, Acts of God and other natural disasters. These events can be considered to some extent as insurable risks; hence the parties will need to look at the availability and cost of insurance, the likelihood of the occurrence of such events and any mitigation measures, which can be undertaken.

Political events instead may include terrorism, riots or civil disturbances, war, strikes, failure of public infrastructure. Typically, the grantor (off-taker or host government) should be willing to bear a certain amount of political force majeure risk, especially those risks which are uninsurable under normal commercial conditions. These risks are generally considered to be beyond the control of the contractor (project developer) (The World Bank, 2017).

Dispute resolution and termination payments

The terms of the PPA should include several steps of dispute resolution mechanism including international commercial arbitration to resolve potential disputes. Moreover, the PPA should clearly indicate termination policies and liabilities for both parties in case that the PPA would be terminated before the natural end of the contract.

Transferability of ownership

Over time, wind projects may be refinanced, thus creating a secondary market which may be represented by an increased participation of long-term financial investors such as insurance companies and pension funds. Proper clauses and mechanisms should be implemented to govern and regulate change of ownership, including possible prior consent of the auctioneer on the transaction. This should be also extended in preserving that changes of ownership won´t affect terms and liabilities of the original bid proposal.

To summarize, governments and public authorities should take into consideration that allocating a high level of risk to project developers and bidders reduces inevitably the amount that lenders will be willing to lend in the project. Consequently this funding gap may be bridged with more higher-priced equity, if at all, increasing the overall project costs and bid tariffs in auctioning tenders.

6.1 Ethiopia

According to (S&P, 2017), “the stable outlook of Ethiopia (B grade in sovereign foreign currency rating) reflects the expectation that economic performance will remain robust and socio-political tensions will not escalate, while current account deficits and related public sector debt will not materially deviate from forecasts over the next 12 months”. In addition “among the 17 sovereigns in Sub-Saharan Africa rated by S&P, 16 have a speculative-grade foreign currency rating, with the only exception of Botswana (A-/Negative/A-2), which has an investment grade foreign currency rating”.

Appropriate risk mitigation and credit enhancement strategies are therefore essential for mobilizing private sector funding and ensuring viability, bankability and profitability of renewable energy projects in frontier markets such as Ethiopia. One of the main challenges for project sponsors and lenders in developing projects in emerging countries is represented by the potential default of utilities, inability to fulfil payment obligations for the entire lifetime of a project (25 years), or by a potential change in the law. This potential scenario can occur due to the fact that end-user tariffs in several African countries are not cost-reflective. In other words, the revenue generated from the sale of electricity to consumers is not higher than the purchase cost of the national utility (off-taker) in procuring the electricity from IPPs. This gap creates financial deficits and requires government subsidies in the short run until electricity tariffs will be fully cost-reflective.

Further, in case of a performance default of utilities in vertically integrated electricity markets, there is also a concrete risk that the procured electricity from IPPs can´t be sold to third parties or it can´t be evacuated from the generation unit due to transmission capacity constraints in the power grid. For all these reasons, project developers and potential lenders will require more security instruments compared to similar projects developed in OECD countries. These security instruments (for risk mitigation or credit enhancement) that IPPs commonly seek are among others the issuance of a sovereign guarantee by the host government, liquidity structures (e.g. escrow account or letters of credit) and guarantee instruments offered by DFIs to backstop the PPA obligations of off-takers.

Sovereign Guarantees

"The main function of a sovereign guarantee is to backstop routine payment risks of state-owned off-takers and satisfy potential termination payments under a PPA contract. A sovereign guarantee is a direct obligation from the host government to the project company and by extension to the lenders. A sovereign guarantee is commonly considered a contingent liability on the host government's balance sheet and should require a detailed assessment of:

- any regulatory hurdles the government may need to overcome to provide such guarantee
- the impact of the guarantee on the sustainability of its overall public debt levels and its impact on various financial covenants the government has undertaken to uphold under its various domestic and international debt obligations
- the policy framework on projects for which such guarantees will be provided, with a view to ensuring fair and equitable treatment of all independent power producers investing in power generation in the host country"

"In some cases, the ability of governments to issue such forms of support is constrained by the government's need to maintain sustainable public debt levels. In these circumstances, governments will sometimes be prepared to issue letters of comfort which are not legally binding, but which give investors and lenders "soft comfort" that the government will not allow the off-taker to go insolvent and that it will step in to assist the off-taker to meet its obligations to its creditors. Nevertheless, these forms of soft comfort are usually not sufficient to enable a project to attract large amounts of foreign investment."(CLDP & ALSF.).

Letters of Credit

"A letter of credit (L/C) is a financial instrument posted and maintained by an off-taker that can be drawn upon by a project company in the event that the off-taker fails to pay a capacity payment, energy payment, deemed energy payment, or a similar payment that is regularly due from the off-taker within a relatively short period after the payment becomes due. The amount available to be drawn under such a letter of credit is usually equal to a few months' worth of projected payments under the PPA. If the off-taker fails to make such PPA payments, then the project company can directly make a demand on this letter of credit. This provides a liquidity buffer enabling the project company to remain solvent with continued operations whilst being able to meet overheads and service its debt, even if the off-taker fails to pay. The off-taker is usually obliged to replenish such a letter of credit by paying the issuing bank under a document called the reimbursement and credit agreement, within the pre-agreed timeline or when the remaining balance is less than the minimum required level after draws are made from time to time.

A letter of credit may be less expensive (or have less opportunity cost) versus using a cash escrow account to cover short-term payment risk. In some cases, by not having the reimbursement obligation covered by a partial risk guarantee, a payment guarantee or a similar DFI product (described below), the letter of credit is a less expensive and less complex solution.

However, in other circumstances, commercial letter of credit issuing banks may be unwilling to take the credit risk of the off-taker as the reimbursing party, or they may only be willing to do so for the first or two IPP projects in a country, or they may only be willing to take such credit risk in return for prohibitively high fees. In such cases, cash collateral from the off-taker may be needed or the host government may agree to take on the obligation to replenish the letter of credit" (CLDP & ALSF, n.a.).

Political Risk Insurance

"Political risk insurance (PRI) offers coverage for political risks associated with government actions which deny or restrict the right of an investor or lender to use or benefit from the project assets and therefore negatively affect the project revenue; or which reduce the value of the project company. These risks include for instance terrorism and acts of violence, war, civil disturbances, expropriation of ownership, restrictions on the convertibility of local currency into foreign exchange and breach of contract by the host government".

"In this context, DFIs (i.e. MIGA) and national export credit agencies (ECAs) represent the strongest public insurers active in developing markets. These insurers typically have mandates to support the policy goals of their sponsoring government or institution, including fostering development or facilitating exports in certain emerging markets. For these reasons, these mandates may also place restrictions on the type of investments that are eligible for coverage. Such restrictions may address environmental issues, eligibility of the investment, or other issues derived from the insurers´ policy objectives" (CLDP & ALSF, n.a.).

DFIs Guarantees

Although host governments can provide a sovereign guarantee or arrange other risk mitigation measures, their capability to deliver on IPP commitments may remain in doubt (Eberhard et al., 2016). Guarantees provided by DFIs and MDBs are credit enhancement and political risk mitigation instruments offered by third parties for enhancing the credit quality of a sovereign and for mitigating certain risks, which are not entirely covered in contractual obligations of PPAs. These products offered by DFIs are commonly referred to partial credit guarantees (PCGs), partial risk guarantees (PRGs) and project-based guarantees. They can be categorized into loan guarantees and payment guarantees, as they benefit respectively commercial lenders and project companies.

African Development Bank Guarantees

The African Development Bank (AfDB) offer two different types of guarantees: partial risk guarantees and partial credit guarantees. The first ones insulate "private lenders against well-defined political risks related to the failure of a government or a government-related entity to honour certain specified commitments. Such risks could include political force majeure, currency inconvertibility, regulatory risks (adverse changes in law), and various forms of breach of contract".

"PCGs serve to partially guarantee debt service obligations of low income countries (LICs) and well performing state owned enterprises in LICs. Similarly to the PRG, the PCG allows well performing LICs and state owned enterprises to catalyse more financing at more attractive terms to finance their development needs. Countries are eligible for PCGs only if they are classified as countries with low risk of debt distress (green light countries based on the World Bank / IMF Debt Sustainability Framework traffic light country classification) and deemed to have adequate debt management capacity. However, subject to meeting some defined stringent eligibility criteria, the PCG will also be available to state-owned enterprises in AfDB countries with low to moderate risk of debt distress (green and yellow light countries, respectively, based on the World Bank / IMF Debt Sustainability Framework traffic light country classification)" (African Development Bank, 2017).

World Bank Guarantees

"The WB guarantees are defined by the WBG as policy and project guarantees. Policy guarantees are intended to provide risk mitigation to commercial lenders with respect to debt service payment defaults by government and can only be used by governments to access budgetary support in the context of a specific program of policy and institutional actions" (The World Bank, 2017).

"Project guarantees are applied instead in the context of specific investment projects where governments wish to attract private investment (equity and/or debt). They are designed to provide risk mitigation with respect to key risks which are essential for the viability of the investment. These guarantees may fall under one of the following sub-categories: loan guarantees or payment guarantees. The first ones are intended to provide risk mitigation to commercial lenders with respect to debt service payment defaults caused directly or indirectly by government failure to meet specific payment and/or performance obligations arising from contract, law or regulation. Payment guarantees are intended to provide risk mitigation to private projects or to foreign public entities with respect to payment default on non-loan related obligations by the government".

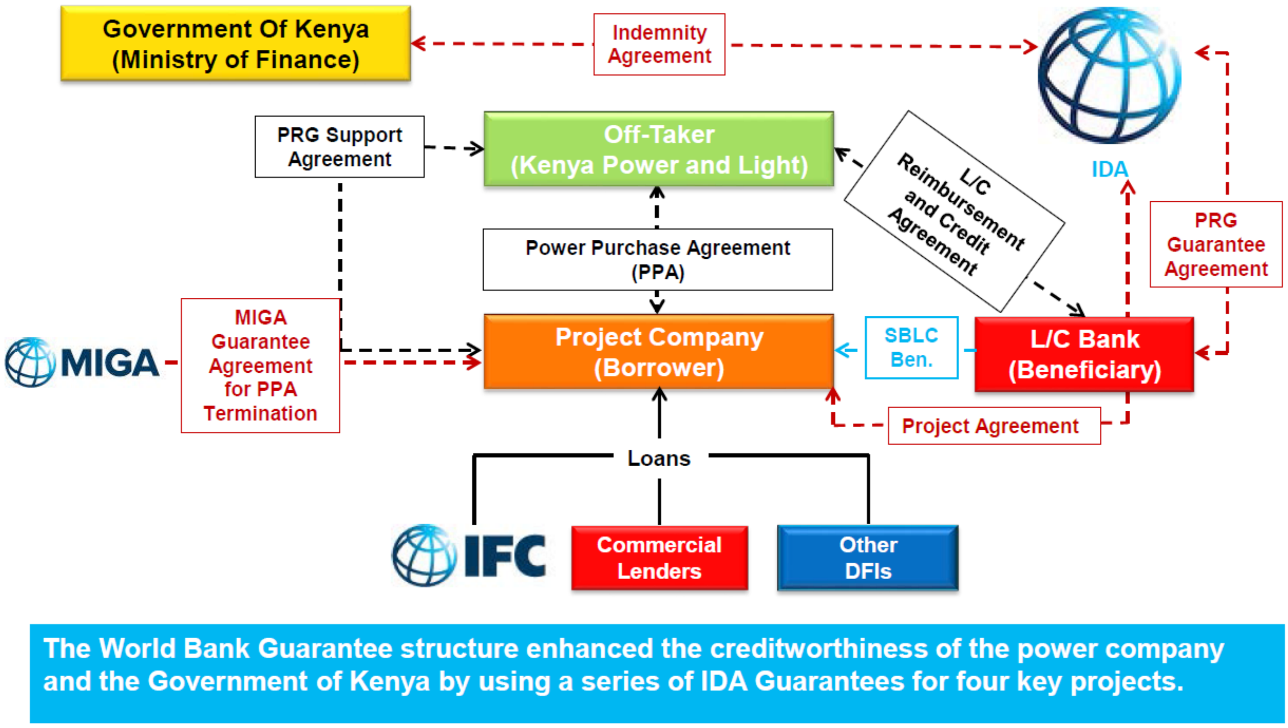


Figure 39: Structure of The World Bank guarantees used in Kenya for 4 IPPs projects (World Bank Group, 2017).

The direct involvement of DFIs such as the World Bank Group in the Ethiopian wind auctioning process is fundamental to catalyse private financial flows by means of guarantees and risk mitigation instruments. These financial products (The World Bank, IFC, MIGA) shelter private debt against a government's (or government-owned entities) failure to meet specific obligations to a private or a public project. Typically, the risks covered are as follows (World Bank, 2016):

- Government (or Government owned entities) payment obligations arising from contract, law or regulation: scheduled monthly payments, termination payments, subsidies, minimum revenue guarantee, debt service, etc.
- Regulatory Risk: change in law, negation or cancellation of license, tariff adjustment
- Currency Risk: convertibility, transferability
- Political Force Majeure: expropriation, war & civil disturbance
- Frustration of arbitration

Governments	Private Investors & Project Developers
Attract private financing for key sectors such as power generation	Reduce probability of default (credit enhancement)
Open access to capital markets and commercial banks	Reduce loss given default (risk mitigation)
Reduce cost of private financing to more affordable levels	Positive impact in capital requirements for commercial banks
Facilitate Public Private Partnerships	Reduce or eliminate key risks associated with transactions in new and untested sectors or business areas
Reduce government risk exposure by passing commercial risk to the private sector	Mitigate risks the private sector cannot control
Improve project sustainability & replicability	Open new markets Improve project bankability, sustainability & replicability

Table 7: Benefits of World Bank Guarantees World Bank, 2016).

Burden and regulatory framework

Concerning major financial issues and credit enhancement, they will retrace the ones from the Ethiopian Metehara solar IPP tender. In details, the GoE is providing a sovereign guarantee in the event that EEP (the off-taker of the solar tender project) won´t be able to comply its payment obligations under the PPA.

Moreover, due to the unknown financial status of EEP, lenders require from the GoE broader guarantees instruments that can cover a routine payment, termination payment and other off-taker obligations under the PPA (Power Africa, 2017). These guarantees have been backstopped by the World Bank Group by partial risk guarantee instruments.

Another critical challenge resides in the restrict use of Offshore FX accounts in Ethiopia. By law, a project company (which is the most established legal vehicle used by project developers) is not allowed to open and operate foreign currency account outside Ethiopia. This provision inhibits as well the ability of the project company to undertake foreign currency exchange and payment transaction (Power Africa, 2017). Hence, special de-risks mechanisms and guarantees need to be mobilized for ensuring financial due diligence.

It is advisable for the Ethiopian auctioning process to follow practices that have been successfully implemented in other African countries and developing countries. In this context, the robust risk mitigation and credit enhancement policies adopted in Zambia for the first solar IPP auction under the Scaling Solar programme (which is part of the World Bank Group solutions) represent a proof of how investor risks can be reduced and competitive tender processes can be consequently established in frontier Sub-Saharan countries.

Special emphasis in this analysis should be given to the discussion if PPA contracts should shield or not project developers from financial risks due to inflation and currency exchange rate. Brazil, Peru and South Africa are examples of countries where full price indexation occurred during IPP auctions. The IPP solar auction in Uganda represents instead a case reference where only the O&M component of the PPA tariff was indexed. In the recent Ethiopian solar auction, the base energy tariff is indexed annually with an escalation rate equal to 2% (Power Africa, 2017). On the contrary, in the Zambian solar auction no indexation was offered to bids. Despite this peculiar feature may induce to believe that the resulting bids in Zambia would have been consistently high (so developers can recover their investment despite the contract's loss of value over time), a low bid price record of 6.02 ¢USD/kWh was achieved (Kruger & Eberhard, 2016).

Concerning instead risks due to currency exchange rate, project developers are keen on signing PPA contracts in hard currencies (USD, EUR), due to the absence of a long-term capital market in several developing countries. Therefore, PPA tariffs are usually denominated in US dollars, such as in Zambia, Uganda, India, Peru, and Morocco. Examples of PPA tariffs signed in local currency are Brazil and South Africa, among others.

Whereas PPA contract prices in hard currencies may shield project developers from local currency fluctuations, on the other hand they expose governments to significant foreign exchange risks. This was the case with some PPA signed by the Indonesian authorities back in the 1990th. Hence, hedging schemes and offset procedures need to be carefully implemented both for limiting foreign exchange volatility issues and for ensuring enough availability of foreign currency. One potential off-set procedure for Ethiopia may be represented by the recent exporting power deal commitments (established in USD) towards its neighbouring countries (see Figure 40). They clearly represent a precious resource to create and accumulate foreign currency reserves.

Interconnections:

- Ethiopia – Sudan (up to 250 MW) & Ethiopia - Djibouti (up to 90 MW) has a practical Interconnection
- Ethiopia – Kenya 500 KV D.C. under construction (up to 2000 MW) ; PPA signed
- Exports Egypt via Sudan, exports Sudan and Egypt grouped (the feasibility study, design, tender document completed PPA negotiation with Sudan started in April 2017)
- 1200 MW (Sudan) and 2000 MW (Egypt) scheme, 3,200MW assumed exports, Eastern Nile trade program study
- Exports to Tanzania under power purchase agreement negotiation
- Rwanda, Burundi, South Sudan and Yemen, Memorandum of Understanding to supply 2000 MW signed

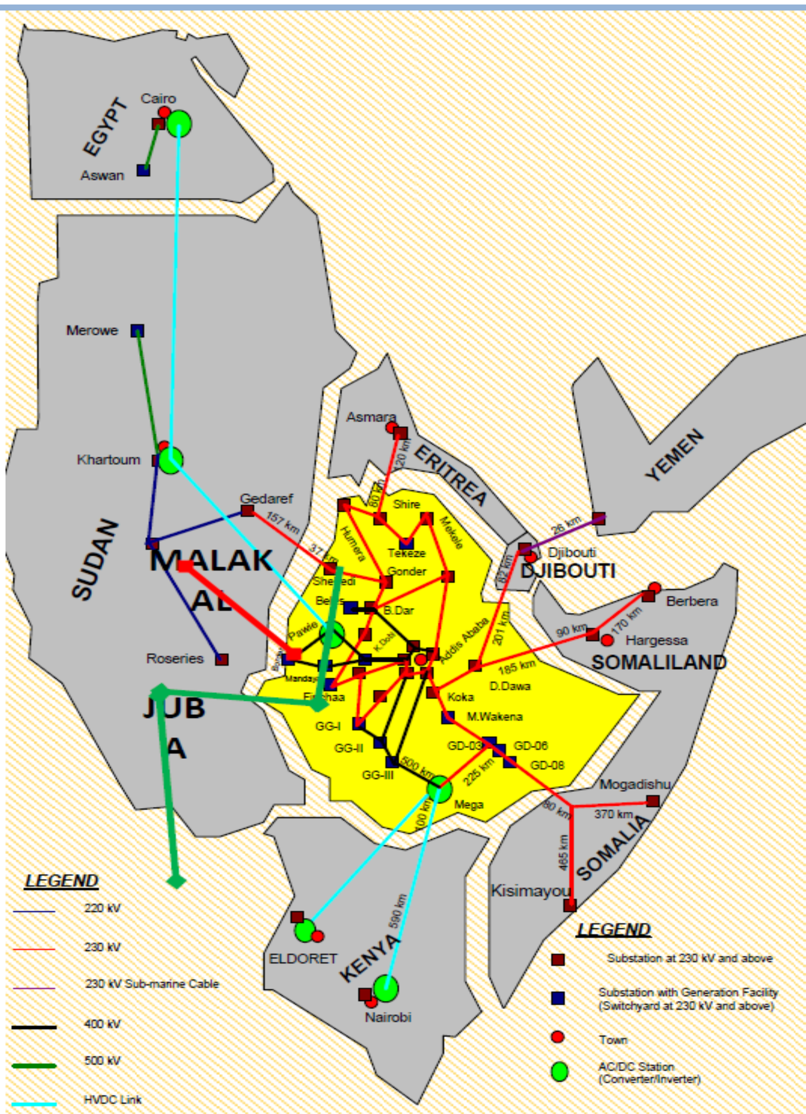


Figure 40: Overview of existing and planned export interconnections between Ethiopia and neighbouring countries (Lemma, 2017).

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
Off-taker obligation	There may be a concrete risk the off-taker may be financial and or technical unable to temporarily dispatch the wind farm	Proper de-risking mechanisms and guarantees of dispatch should protect project developers in the PPA agreement. On the technical side, a robust wind integration strategy has to be in place or developed (if absent) to avoid or limit wind power curtailments	*Medium risk* Counterpart risks mechanisms should be addressed by the GoE, which also need to be backstopped by partial risk guarantees instruments by the World Bank. *Medium risk* also due to technical reasons (weakness of the grid). Outcome 2.2 should mitigate this specific risk part
Currency risks	Changes in local currency exchange rates may affect the PPA price and undermine the wind farm investment´s value	Project developers need to shield themselves from currency risks by means of hedging measures or using hard currencies for PPA prices	*Medium-high risk* The PPA payments can be made in BIRR and then converted to USD currency under special compensation from GoE. The limited reserve capacity of foreign currency need to be backstopped by partial risk guarantee instruments
Foreign exchange Account	The use of onshore and offshore FX accounts may be restricted or in some circumstances inhibited	Special dispensation and consent on IPP transaction requirements should be implemented by governments	*Medium-high risk* MOFEC through NBE will facilitate IPPs to have a series of FX accounts at any eligible offshore bank. These accounts however will be opened by Ethiopian Commercial bank to be approved by NBE. The accounts will be managed by a trustee fund agreement to be entered between the IPP, NBE, the commercial bank and the foreign bank. The money will be held on trust for the IPP by the commercial bank of Ethiopia. These accounts are used to hold the funding, insurance premium, debt service. The IPP is also

			allowed to open a local FX account at the Ethiopian commercial bank to mirror the offshore accounts
PPA termination before natural end	Premature contract termination may leave the project developer and the project with no access to the market	Based on the reason of the pre-mature termination of the contract, adequate guarantees mechanisms should be ensured (liquidity facilities, termination payments)	*Low-risk* since the involvement of the World Bank Group should ensure proper guarantees schemes, including liquidity facilities and termination payments

7. Procurement Process and Construction

When the final investment decision on the project is matured and financial consent is achieved, the wind farm project enters in the two last stages of its development: construction and operations. The financial closure of the project and the construction stage are strongly dependent on the negotiated procurement contracts for the different construction elements. Construction elements include all wind turbines parts, including their transport and assemblage as well as civil and electrical works, which are often grouped together and referred to the category "balance of plant".

Figure 41 and Figure 42 provide a cost breakdown analysis of onshore wind projects in established RE markets and in emerging RE markets, such as South Africa. Wind turbine costs in developed RE markets represent about 64 to 84% of capital costs (capex) for onshore wind farms. Instead, the sum of BOP costs, which include grid connection costs, construction works (civil works plus foundation works) and other costs, ranges from 17 to 34%.

Comparison of capital cost breakdown for typical onshore and offshore wind power systems

Cost share of:	Onshore (%)	Offshore (%)
Wind turbine	64-84	30-50
Grid connection	9-14	15-30
Construction	4-10	15-25
Other capital	4-10	8-30

Figure 41: Comparison of capital cost breakdown for wind power systems in established RE markets (IRENA, 2016)

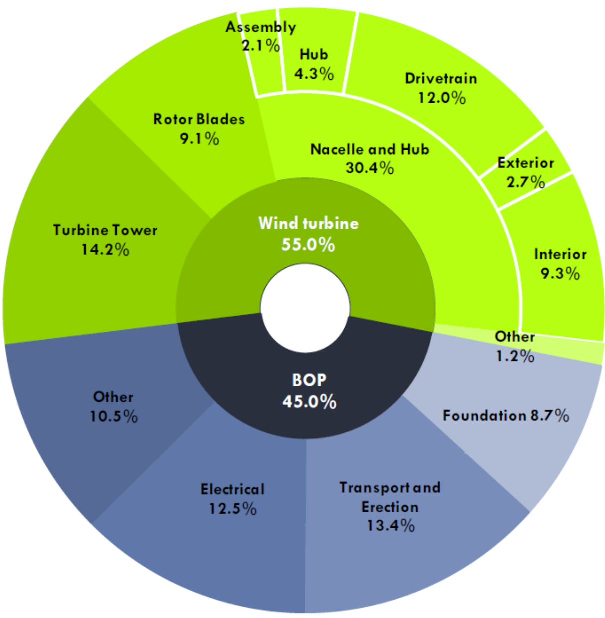


Figure 42: Cost breakdown of onshore wind projects in South Africa during REIPPP bid window 3 (Department of Trade and Industry, 2015).

In relatively new RE markets instead (i.e. South Africa), the division of capital costs between the two main categories (wind turbines and BOP) is less pronounced with BOP costs that represent up to 45% of the overall capital costs. This difference is traced back to the development status of the South African wind energy market. Within the BOP category, the expenses on transport and erection represent the biggest single cost item followed by electrical/grid connection costs.

Typically, agile and bankable wind projects are established through engineering-procurement-and-construction (EPC) contracting procedures. One of the major advantages of EPC mechanisms (both for primary and secondary contractors) is the ability to centralize and regulate liabilities through a single point of contact (EPC contractor). This is also the reason why among lenders and investors, EPC contracts are the most preferred contract procedure for achieving bankability for wind farm projects.

In some cases, EPC contracts for wind farm projects may envisage the use of two separate procurement contracts. One contract will cover the turbines supply and the other one the balance of plant. The key points of EPC contracts are:

- A single point of responsibility
- A fixed contract price
- A fixed completion date
- Completion and performance guarantees and liquidated damages
- Caps on liabilities and liquidated damages
- Insurance and Force Majeure

7.1 Ethiopia

Typically engineering-procurement-and-construction (EPC) contracting procedures are the most established ones along IPP tendering auctions. For example, 49 EPC contractors have been involved in the 64 projects during the first three rounds of REIPPP programme in South Africa and in the majority of the cases, as primary or second contractors (Eberhard et al., 2014). Furthermore, for a reliable and safe operation of wind farms, it should be mandatory that the procured equipment of wind IPP auctions comply with international standards. The International Electrotechnical Commission (IEC) standards, which have the reference number 61400 and are entitled “Wind Turbine Generator Systems”, have been adopted by several countries around the world and are used as the foundation for the development of national standards.

Burden and regulatory framework

It should be mentioned that the burden of using wind infrastructure equipment, which complies with international standards does not represent a bond in procuring the equipment locally. The strict criteria of the REIPPP programme in terms of local content requirements and internationally certified equipment are a proof of this possible synergy in the procurement strategy.

However, as stated by (Eberhard & Naude, 2016), the price of plant equipment is primarily driven by market conditions (global and local), market dynamics and the life stage of the technology rather than the design of the procurement process (Sager, 2014). Furthermore, local tax laws also affect this cost category, particularly in terms of VAT and import duties on imported equipment. In general a more enabling environment for RE investments will assist to reduce EPC costs, such as tax incentives or at least clear tax treatment, as well as local infrastructure upgrades (Eberhard & Naude, 2016). As shown in Figure 43, EPC costs in the South African wind auctions accounted for three-quarters of the investment costs, on average. Although EPC costs always constitute the bulk of capital costs, this large value can be also related due to the strict local content requirements imposed in the South African auctions.

ONSHORE WIND (Average cost per MW in R'000)	BW 1	BW 2	BW 3	BW 4[44]	Average % of Total Cost
EPC Costs	16,123	17,047	15,915	18,045	75%
Interest during Construction	1,265	1,610	1,220	1,190	6%
Development Costs*	1,073	1,599	795	546	4%
Success fees paid to Sponsors/ Developers*	455	624	537	720	3%
Debt Service Reserve Account*	944	733	884	89	3%
Contingencies*	899	769	585	248	3%
Other borrowing costs (arranging & facility fees)*	635	449	318	257	2%
VAT Working Capital	168	242	284	265	1%
DOE Development Fee*	179	236	213	190	1%
Working Capital	133	312	207	99	1%
Other Costs	85	53	111	55	0%
Other construction costs	69	79	186	135	1%
Professional Fees*	39	187	16	29	0%
Maintenance Reserve Account*	65	-	70	31	0%
Total	**22,132**	**23,941**	**21,339**	**21,897**	**100%**

Figure 43: Breakdown of upfront costs based on REIPPP (Eberhard & Naude, 2016).

In tender procedures, local content requirements (LCRs) are usually considered as part of economic development (ED) criteria and expressed as a percentage of the total project cost sourced locally through both equipment and services.

By the broad outline of definition, LCRs in the REIPPP programme have been affected by several changes during the bid windows, as indicated in Figure 44. The changes introduced in BW3 had the effect of making firms move away from simply sourcing local materials, for elements like support structures, toward the establishment of local manufacturing capacity for high-value components such as wind towers.

The crucial argument for bidders and investors was and still is whether or not the South African government-driven demand for renewable energy can be sustained long enough, and at high enough levels (and high enough prices) to make commercially feasible the establishment of manufacturing capacity (Eberhard et al., 2014).

BW	Changes per BW	Exclusions from Definition
1	N/A	Finance charges, Land, Mobilisation fees of Operator.
2	Total costs up to COD, limited to spending on South Africans and South African products. More disclosures, such as details of components and activities to achieve local content commitment, were required. Certain components were identified as priorities but no point adjustment was given for these during this round.	Same as BW 1 with additional exclusions of imported goods and services.
3	All raw/ unworked steel and aluminium used in local manufacture of components, regardless of source, deemed local. More detailed disclosures than BW 2 such as types of goods and services that form local content as well as suppliers and providers of these. Bidders also had to disclose costs between 'key components' and 'balance of plant'.	Same as BW 2, with transmission and distribution connections costs of the private company also excluded.
4	No major changes.	Same as BW 3.

Figure 44: Key Differences in permitted local content requirements (Eberhard & Naude, 2016).

Uncertainties about the pipeline of new RE and wind projects, and the security of potential investments represent a significant barrier for attracting investors and developing local players within the wind value chain. Experiences from several countries highlighted a set of common key success factors for the development of local RE components manufacturing. In details they are (EIB & IRENA, 2015):

- Substantial political support aiming at creating a long-term stable market
- Competitive local players in the global market
- Strong industry innovation potential and skilled workforce
- Investment capacity and strong financing infrastructures

For governments like Ethiopia newly exposed to the wind industry, it is crucial to establish a predictable and stable pipeline of wind projects and a clear vision on the long-term RE policy framework. This implies also that governments should properly clarify the objective of tendering procedures and consider a trade-off principle between developing a local industry and achieving lower prices. Generally, auctions with minimal or no local content requirements can encourage foreign players to enter the market. This means renewables may grow more rapidly and in some instances at lower prices than might otherwise be the case. On the contrary, the country may forgo with the strategy of domestic development which brings benefits such as employment, local value, skills and know-how (IRENA, 2017).

It is advisable that before introducing LCRs in tendering auctions, the GoE should conduct in-depth studies on the potentiality and ability of local Ethiopian businesses and industries along the wind value chain to provide components and services. In the design of local content rates, the GoE should investigate potential limits in the availability of skilled local suppliers and/or production facilities as well as in the quality of components and the qualification of the local workforce. Depending on the status of these crucial factors, the GoE should gradually and carefully phase in local content shares (EIB & IRENA, 2015). The local content portion of the latest wind EPC bid in Ethiopia can be considered as reference for setting minimum LCR requirements for the upcoming IPP wind tenders.

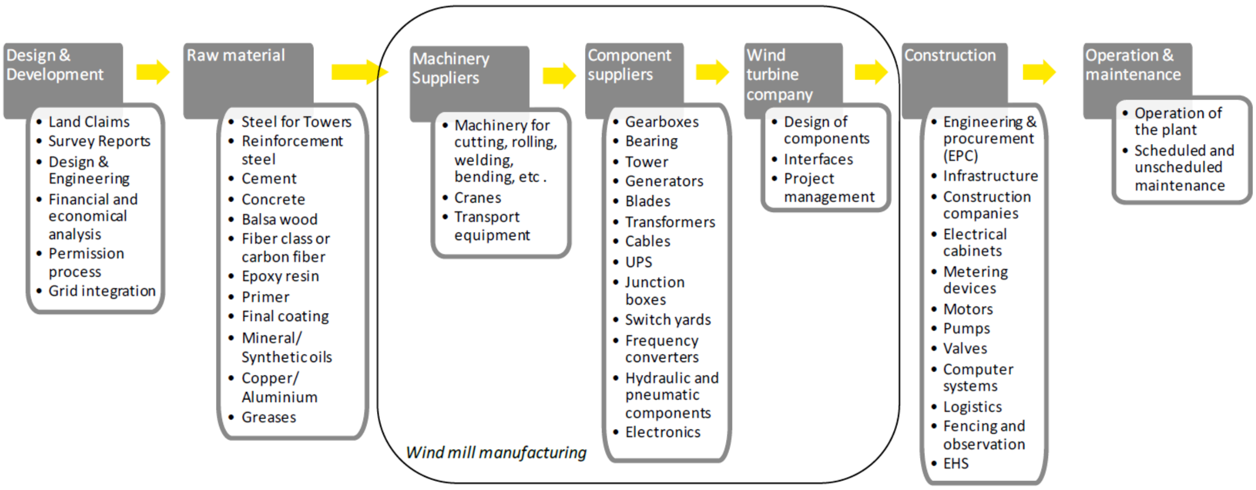


Figure 45: Onshore wind value chain (EIB & IRENA, 2015).

Typically, an effective entry point for implementing LCR is represented by sourcing locally services associated with the BOP, construction and operational & maintenance phase of the wind farm (foundations, roads, civil works, electrical works, etc.).

Concerning the manufacturing process, the most important components for wind turbines are represented by blades, rotors, towers, nacelles, generators and electronic components. Potentially, manufacturing large components close to their destination market could sensibly reduce logistics and transportation costs. However, the production localisation of these components in new markets is often limited due to the high quality standards and specialized manufacturing processes required for these items.

Concerning the manufacturing process of towers, existing local steel manufacturing companies may represent a precious entry point for establishing a local production. The process can be executed through minor changes in the existing production processes and/or through an initial acquisition of licensing technology from specialized foreign companies (EIB & IRENA, 2015). However, as stated before, the most important condition for localising the production of towers is represented by a stable wind project pipeline. For instance, the delays incurred by Eskom in finalising the power purchase agreements in the last bid window, have induced a dramatic standstill since the end of 2016 of the two South African tower factories.

The localisation of critical components like blades, generators and gearboxes, it is extremely complex. In details, at least a critical bulk of 1000 MW per annum is required for safeguarding the sustainability of the investment for these specific production facilities. Moreover, for ensuring an effective “know-how” plan, it is advisable that local industries will form joint ventures with international experienced specialists. In addition, for satisfying the extremely high-quality standards of these critical components, extensive qualification and training processes are necessary for the new sub-suppliers. The training phase can take from 3 months to up 15 months for the most critical parts (EIB & IRENA, 2015).

On this subject, Figure 46 provides an extensive analysis of the local content elements and shares during the bid window 3 of the South African REIPPP. BOP components accounted for the largest part of the local procurement spend associated with wind projects. In details, services like foundation and civil works were fully localised, while approximately 17% of the expenses in electrical and grid connection were outsourced outside South Africa for procuring special components (oil transformers, etc.) (Department of Trade and Industry, 2015). On the manufacturing side, no component was fully localised, but towers alone represented 24% of the local procurement spend.

Category	Key Component	Average local content % per component	Local content R'million/MW	Local content breakdown	
Wind Turbine	Tower	79.9%	R 1.9	24.2%	25.2%
	Blades	-	R 0.0	-	
	Hub	1.4%	R 0.0	0.1%	
	Nacelle- Drive Train	2.2%	R 0.0	0.6%	
	Nacelle- Exterior Fittings	-	R 0.0	-	
	Nacelle- Interior Fittings	0.4%	R 0.0	0.1%	
	Other	7.9%	R 0.0	0.2%	
Balance of Plant	Foundation	100.0%	R 1.5	18.6%	74.8%
	Transport and Erection	57.2%	R 1.3	16.4%	
	Electrical	82.5%	R 1.7	22.0%	
	Other	79.7%	R 1.4	17.9%	
TOTAL		46.6%	R7.9	100.0%	

Figure 46: Local content breakdown per component during REIPPP bid window 3 of wind projects (Department of Trade and Industry, 2015).

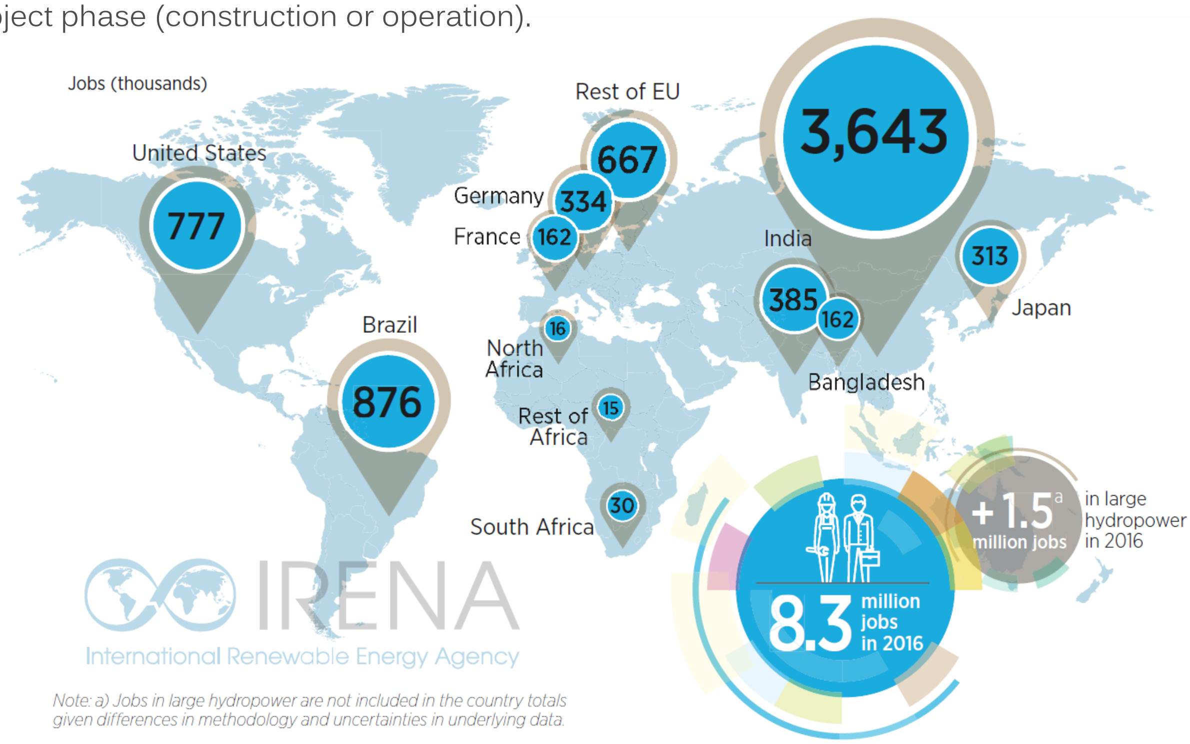
Furthermore, the implementation of strict local content requirements in auctions has been also questioned recently, since it may represent a strong barrier to market entrance and as such, it may be in conflict with the World Trade Organization (WTO) rules (GIZ, 2013). To alleviate this general concern and potential risk, “softer” LCR may be introduced in tender auctions, using, for instance, LCRs only as a weighted parameter in the winner selection process rather than as a hard constraint (IRENA & CEM, 2015). Another viable solution may be represented by splitting the auction demand into LCR and non-LCR tenders. This latter strategy, for instance, was implemented in India during its 2014 solar auction. The auction results showed that the levelized cost of electricity generated by plants complying with LCR was approximately 15% higher than the ones with non-LCR compliance (IRENA & CEM, 2015). Table 8 aims to further clarify how different LCR requirements have implemented during renewable energy auctions in different countries.

Another fundamental priority of governments contracting RE projects is the creation of local employment. According to latest IRENA´s publication (IRENA, 2017), the renewable energy sector employed worldwide 9.8 million people, directly and indirectly, in 2016. Since 2012, the jobs in the solar and the wind sector have experienced the most consistent increase (more than doubling), while employment in large hydropower and solar heating and cooling has declined (Figure 47). Focusing on the African continent, within the total number of 61000 jobs created, half of them are localised in South Africa and one-fourth in North Africa (mostly localised in Algeria and Egypt).

South Africa	Increasing minimum local content requirements in bid rounds 1, 2 and 3 (from 25 to 40%)
Morocco	Local content is no exclusion criterion, but the Moroccan Agency for Solar Energy (MASEN) asks for min. 30% from bidders. Industrial integration is also a selection criterion under the Integrated Wind Energy Programme of ONE (Office National de l´Electricité)
Ethiopia	In the 1st IPP solar auction, bidders are required to fulfill 15% of the total project value in local content
Saudi Arabia	The proposed auction design strongly favours local involvement in the production and the construction of projects as the levels of local content and local labor play an important role in the winner selection process
Brazil	Local content is not required from the auctioneer, but from the Brazilian National Bank of Development (BNDES) to access subsidized loans
China	LCR was implemented in the first auctions for fostering renewable energy, but as the country´s wind equipment industry flourished, these constraints were no longer necessary

Table 8: International comparison on local content requirements (GIZ, 2013), (IRENA & CEM, 2015), (Power Africa, 2017).

The breakdown analysis of the South African REIPPP´s outcomes in terms of jobs creation is presented in Figure 48. Globally, the jobs created within the solar and wind sector account for 84% of the total number of jobs among all the renewable energy technologies. Another peculiar result of the breakdown analysis is to identify how the jobs opportunities are created within the different segments of the wind value chain. It can be noted that the ratio between local construction jobs and operations jobs for onshore wind projects from bid window 3 is more than 1:3. The methodology for counting the jobs is based on the lifecycle of the specific project phase (construction or operation).



10 Primary data are collected through correspondence with government entities and industry representatives. Secondary data are referenced from a review of a wide range of national, regional and global studies.

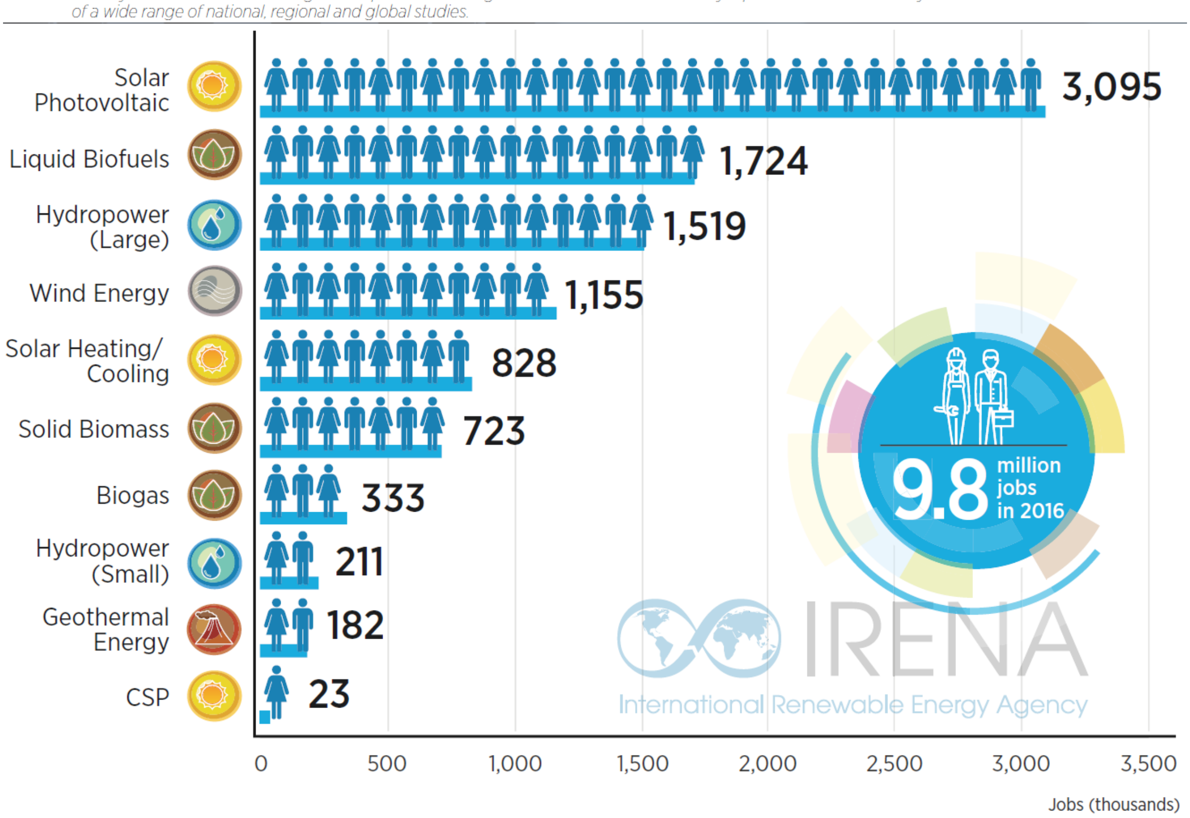


Figure 47: Renewable energy employment by countries and technologies (IRENA, 2017).

Technology	BW 1	BW 2	BW 3	BW 3.5	BW 4	Total per technology
Onshore Wind						
Local construction jobs	1 810	1 787	2 612	N/A	5 146	11 355
Local operations jobs	2 461	2 238	8 506		18 836	32 041
Solar PV						
Local construction jobs	2 381	2 270	2 119	N/A	6 585	13 355
Local operations jobs	6 117	3 809	7 513		16 352	33 791
CSP						
Local construction jobs	1 883	1 164	3 082	2 271	No bids	8 400
Local operations jobs	1 382	1 180	1 730	2 920		7 212

Figure 48: Jobs for local citizens in the South African REIPPP programme (where 1 job = 1 person-years) (Eberhard & Naude, 2016).

This result is also in line with the outcomes of the recent IRENA publication (IRENA, 2017), which for clarity of comparison have been also included in this report (see Figure 49).

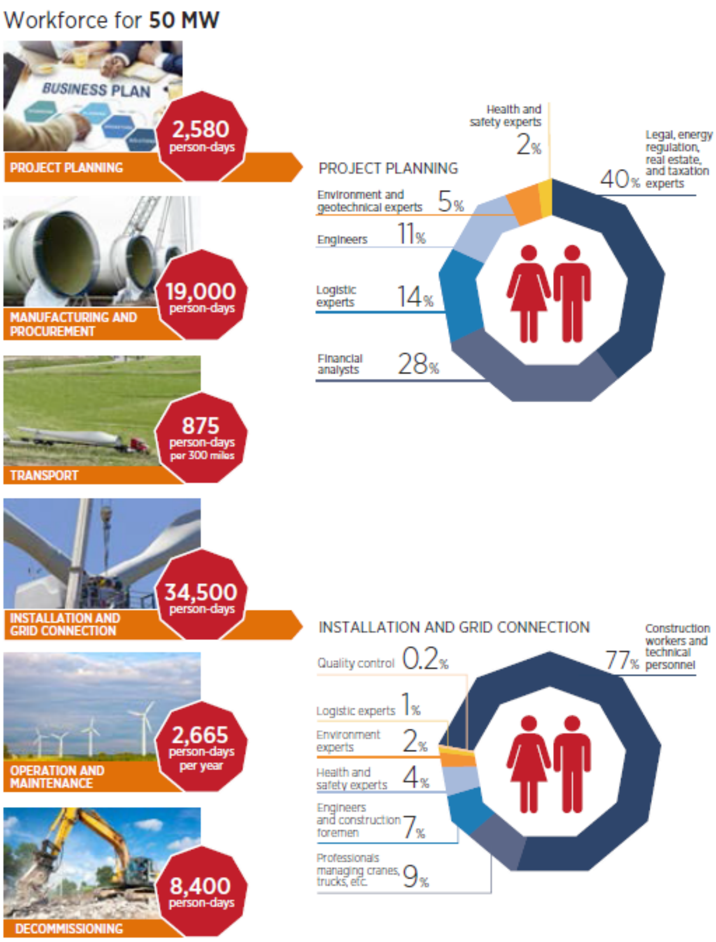


Figure 49: Workforce requirements along the wind value chain (IRENA, 2017).

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
Procured equipment	The procured equipment may be not specifically suitable for the project purpose, system integration or location and may not be ready at commercial and system safety level	The procured equipment should comply with robust international standards (i.e. IEC 61400)	*Medium risk* The tender requirements should shield the auctioneer from low-quality or prototyping equipment threatening system stability and performance
Economic development criteria	If not properly designed, local content requirements in auctions (which are part of economic development criteria) may rise bid tariffs and/or discourage proper competition	Local content requirements (LCRs) must be accompanied by government policies that aim to facilitate financing of domestic RE industry, sufficient scale and foster a strong domestic supply chain and a skilled workforce	Low-medium risk LCRs in IPP wind auctions will begradually phased in. In according to the progresses and readiness of theEthiopian manufacturing capacity and supply chain, LCRs will progressively increase in consecutive bidding windows
Fixed contract price	The risk of cost overruns and the benefit of any cost savings are to the EPC contractor´s account	The contractor should have a limited ability to claim additional money, which is limited to circumstances where the project developer has delayed the contractor or has ordered variations to the works	*Medium-high risk*. Since high risks lead to high contract prices, the choice of competitive EPC companies is crucial

Fixed completion date	EPC contracts include a guaranteed completion date that is either a fixed date or a fixed period after the commencement of the EPC contract	Relevant delay liquidated damages will compensate the project developer for loss and damage suffered as a result of late completion of the wind farm	*Low risk* for the initial auctions, mostly represented by the EPC companies chosen *Medium risk*represented by the ambitious and short-term RE auction plan (2017-2020) of the GoE, which may lead to collateral delays and slow down the project pipeline
Performance guarantees	Since the revenue stream for the project developer depends on the wind farm, it is crucial that the wind farm performs as required in terms of output and reliability	EPC contracts should include performance liquidated damages payable by the contractor if it fails to meet predefined performance guarantees	Risk depends on the choice of the EPC profile
Caps on liability	Most EPC contractors may cap their liability at a percentage of the contract price	Project developers may favor the selection of EPC contractors that do not cap their liabilities. In other terms, this means preferring contractors with an overall liability cap of 100% of the contract price	The risk should entirely compensated through the choice of EPC companies offering 100% liability cap
Grid access	Usually, the PPA will not become effective until commissioning is completed	EPC contracts should clearly define the obligations of the project developer in providing grid access. Investors should discourage situations where the obligation of the project developer to provide grid access is uncertain	*Medium-high risk* It has been a common problem for South Africa, Brazil and Turkey among others

8. Operation & Maintenance

The operation and maintenance process of a wind farm is the latest stage of the development of wind projects. The process is usually regulated through long-term agreements between the turbine manufacturer, the project developer and the wind farm operator.

Developing the most appropriate O&M model is critical and varies from project to project. Typically, when project developers purchase wind turbines from a manufacturer, the contract includes a full O&M service agreement, which ensures a specific level of performance for a certain period (5-10 years). When the period is expired, the project developer may choose to renovate its agreement with the wind turbine manufacturer, or deciding to internally conduct all the maintenance activities. Through a hybrid approach instead, the project developer performs and takes care exclusively of certain tasks, outsourcing and subcontracting other commitments to experienced technical companies, usually referred as independent service providers (ISPs).

Operation & maintenance costs typically account for 20% to 25% of the total LCOE of current wind power systems (EWEA, 2009). The costs usually include both fixed and variable elements. Fixed O&M costs typically are represented by insurance, administration, fixed grid access fees and service contracts for scheduled maintenance. Variable O&M costs instead include scheduled and unscheduled maintenance not covered by fixed contracts, as well as replacement parts and materials, and other labour costs.

Component	USD/MW/year	% of total O&M cost
Wind turbine maintenance	20,100 – 24,500	47.6% -49.3%
Electrical installation maintenance	1,100 – 1,300	2.6%
Insurances	7,500 – 9,800	18.9% -18.4%
Land rental	4,000 – 6,000	11.7% -9.8%
Management &administration	8,100 – 9,900	19.2% -19.9%
Total	**40,800 – 51,500**	**100%**

Table 9: Breakdown analysis of O&M costs for onshore wind farms (IRENA, 2016).

Moreover, due to the volatility of wind energy, the power output of wind farms is highly depending on wind speeds. This fact has also a direct impact on reliability and security of supply into power systems, especially for countries with a high penetration of RE sources. Hence, over the past years stricter grid codes have transformed wind farms from passive power generation units to active generation units with grid support characteristics. Nowadays, wind farms are connected to TSO dispatch centres through advanced communication networks (SCADA systems) in order to regularly share information about active and reactive power generation statutes (Vankata & Wu, 2016).

In most of the EU's member states where wind power has a share above 2% in the annual generation, wind power generators are already balancing responsible in financial or legal terms. In these countries, wind power producers generally have the same balancing rules as conventional generation units (EWEA, 2015). Hence, relaying on accurate and iterative forecasts is paramount for wind farm operators as well as for TSOs, which have to constantly ensure low overall system operation costs.

The process of forecasting wind power generation is usually divided into different time scales, depending on the intended application. From few seconds (10s) up to a few minutes (10 min), forecasts are generally used for active control of wind turbines. This category of forecasts is usually referred to as "short-term" forecast. For the following 48–72 hours, forecasts are needed for the power system management and/or energy trading, by means of unit commitments and economic dispatches (medium-term dispatches). For longer time scales instead (up to 5–7 days ahead), forecasts are deployed for planning the maintenance of power systems.

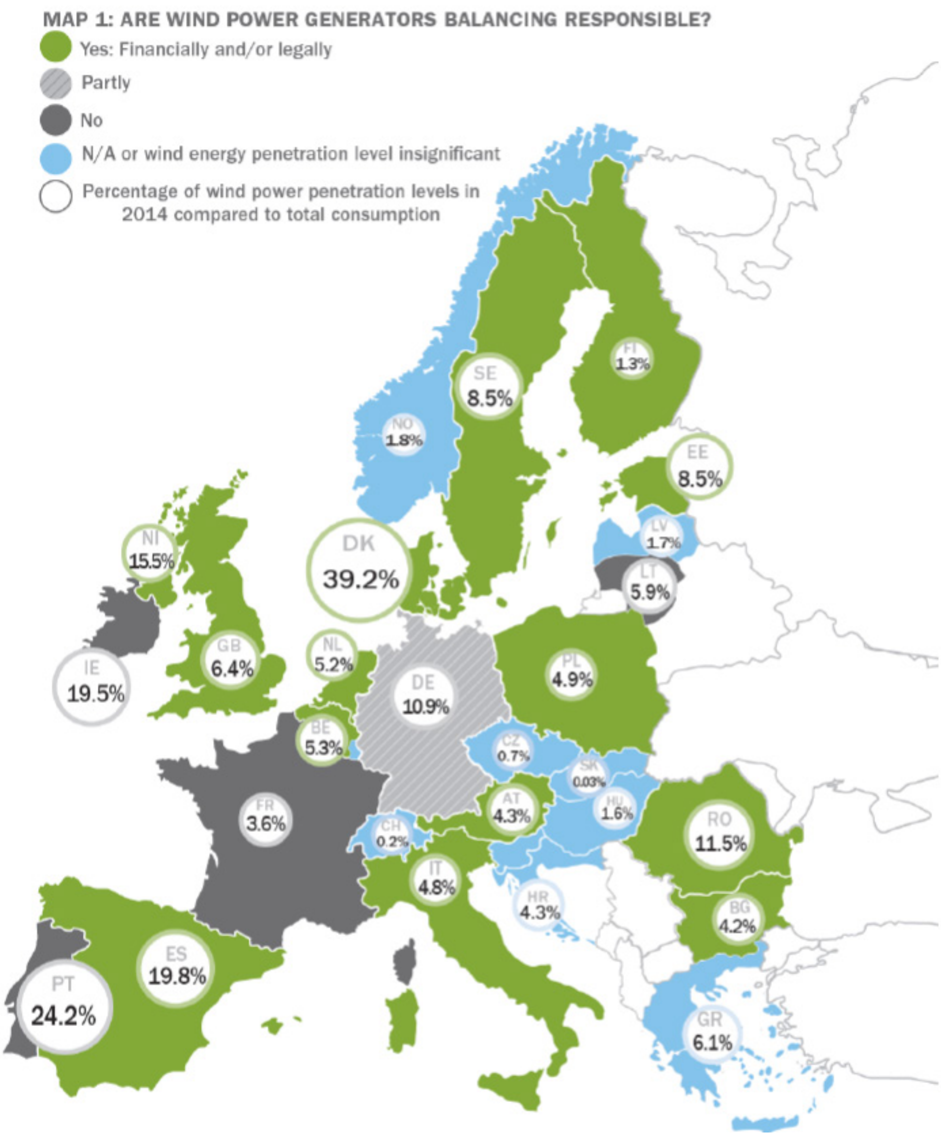


Figure 50: Are wind generators balancing responsible? (EWEA, 2015).

Since the maintenance of wind farms may be particularly costly in several cases, an optimal maintenance strategy is crucial.

Operational planning in Denmark

A key element in a secure and economically efficient system operation with large shares of variable renewable energy sources is represented by operational planning based on the best available schedules and forecasts at different times. This section provides a brief description of the procedures and tools implemented by the Danish TSO (Energinet) in system operation. The relevant operational planning starts 28 days before operation – designated as "D-28", and the following figure illustrates the main activities from D-28 to real-time operation (DEA et al., 2017).

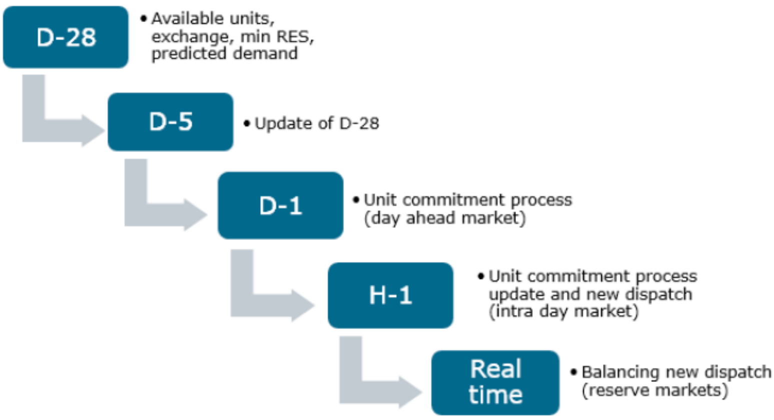


Figure 51: Main operational planning activities from D-28 to real-time operation (DEA et al., 2017).

The operational planning process is initiated at D-28 with a first estimate for the available generation units, expected exchange on interconnectors, minimum generation from renewable energy sources and demand. This estimate is updated on D-5. The main result on D-1 is the unit commitment and dispatch resulting from the day-ahead market, and one hour before operation (H-1), the unit commitment and dispatch is updated according to the result of the intraday market, which closes at this time. During real-time operation, the system operator ensures the physical balance of the entire system via manual reserves in the balancing market and finally via automatic reserves (DEA et al., 2017).

The fundamental idea of these procedures is to plan ahead and base the planning on the best available data at any time. The target is to minimise the remaining imbalances to be handled with expensive automatic reserves by using cheaper manual reserves for anticipative balancing. To support these operational planning procedures some tailor-made IT-tools have been implemented in the control centre at Energinet. An important system is the so-called operational planning system illustrated in Figure 52. The operational planning system is used for collecting all continuously updated schedules and forecasts for generation, import/export and demand calculating the resulting predicted imbalance for the coming hours. The operator uses this system to evaluate the predicted imbalance and decide on activation of manual reserves for up and down regulation to close as much of the gap as possible before the operating hour (DEA et al., 2017).

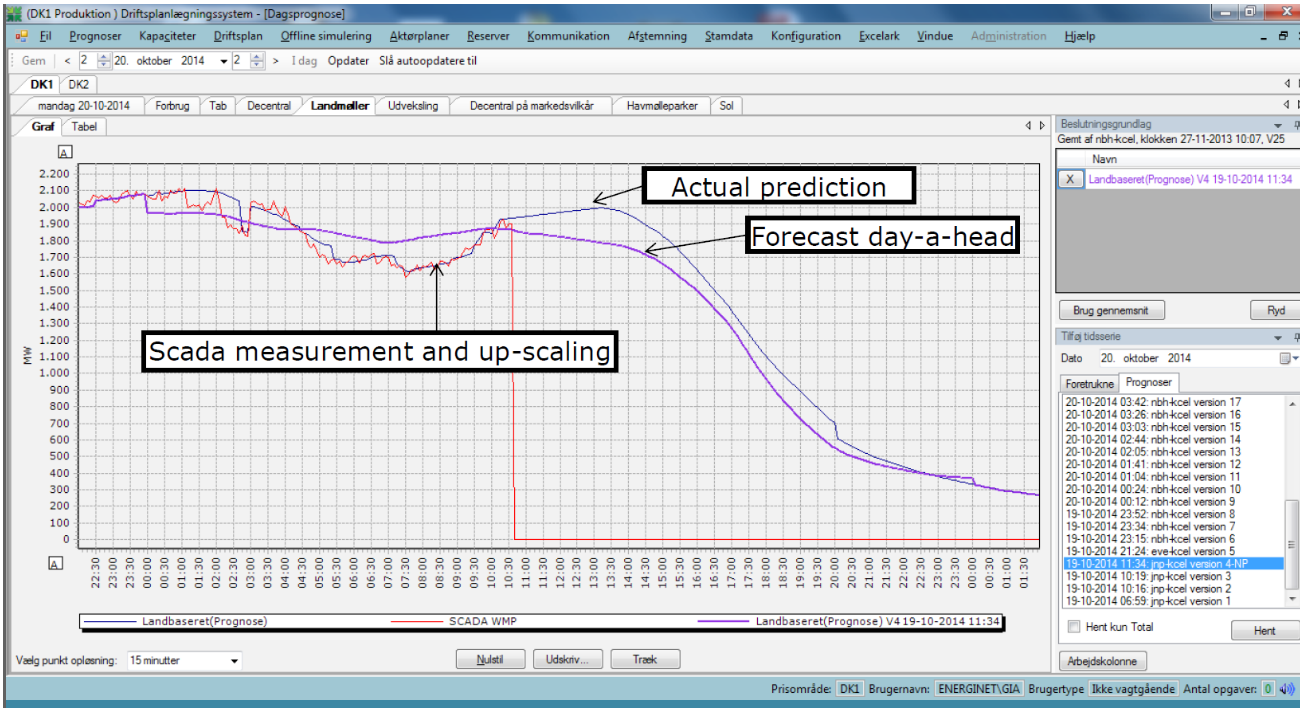


Figure 52: Overview of the operational planning system used by the Danish TSO (Energinet, 2016).

8.1 Ethiopia

Today, wind power capacity accounts for just 324 MW of Ethiopia's total capacity of 4,180 MW at the end of 2015, with the vast majority coming from hydropower. The three wind farms are called respectively Ashegoda, Adama I and Adama II. The first one was contracted in 2008 when EEP signed an EPC contract with Vergnet of France to develop a 120 MW wind farm. Through a tender invitation, HydroChina and CGCOC signed in 2009 an EPC contract with EEP to develop a 51 MW wind farm at Adama (Adama I), which also represents the first operational wind farm in Ethiopia (2012). After its inauguration, EEP signed another EPC contract with HydroChina to add an additional 153 MW of capacity (Adama II). This additional capacity came online in 2015 (SAIS China-Africa Research Initiative, 2016).

Furthermore, the GoE has already identified three sites for wind farm development: Aysha Wind Farm (300 MW), Adama III (150 MW), and Debre Berhan Wind Farm (100 MW). These new committed investments are part of the Growth & Transformation Plan II (GTP2, 20015-2020), where Ethiopia plans to increase its power generation capacity of 17,000 MW from different renewable sources, including up to 1,200 MW of wind power capacity. Of this wind power expansion, around 900 MW are planned to be developed by the private sector through IPP wind auctions.

	Ashegoda Wind Farm	Adama Wind Farm I	Adama Wind Farm II
Feasibility	2006	2009	2009
Contract Signing	2008	2009	2012
Capacity (MW)	120 MW	51 MW	153 MW
Total Project Cost	US$289 million	US$117 million	US$345 million
Financiers	BNP Paribas; AFD; Ethiopian Govt.	China Eximbank; Ethiopian Govt.	China Eximbank; Ethiopian Govt.
Commencement	2009	2011	2012
Inauguration	2013	2012	2015

Figure 53: Information on the operational wind farms in Ethiopia (SAIS China-Africa Research Initiative, 2016).

Figure 54: Operational and under development wind farms in Ethiopia. Source: Ethiopian Electric Power.

Burden and regulatory framework

The frontier status of the Ethiopian wind energy market and more in general of the liberalized electricity market is backed up by a dispatch generation strategy which relies exclusively on a centralized function, where power generators are dispatched by the TSO, EEP. Furthermore, compared to other European markets for instance, Ethiopia is a less mature market where for instance the penetration of wind and other variable renewables (excluding hydro) is less significant and where neither some of the physical, operational or regulatory preconditions are already in place. This lag includes (EWEA, 2015):

- Existence of a functioning intraday and balancing market
- Balancing market arrangements providing for the participation of wind power generators, as e.g. short bidding periods
- Market mechanisms that properly value the provision of ancillary or grid support services for all market participants including wind power
- A satisfactory level of market transparency and proper market monitoring
- Sophisticated forecast methods in place in the power system

- The necessary transmission infrastructure

Hence, a capacity building programme on wind power integration is fundamental for implementing a well-functioning market with high penetration of RES. In this perspective, the vast experience of Energinet (Danish TSO) can play a crucial role in strengthening the capacity of EEP to effectively integrate the growing power generation from diversified sources and manage power supply and demand effectively through a least-cost planning strategy.

To conclude, it should be mentioned again that the operation & maintenance of wind farms represents an invaluable source for potentially boosting local employment possibilities and labor force skills within the Ethiopian country. Recent international experience from several auctions, showed that job creation has been one the major economic development outcomes. Citing the REIPPP programme, the two figures below show in details how the job creation criterion has been deeply implemented and which encouraging results have been achieved. In details, the majority of jobs created are associated with wind and solar projects. Focusing on wind technology, jobs created during the operation of wind farms represent ca. 74% of the total jobs created by wind projects.

Description	Threshold	Target
RSA Based employees who are citizens	50%	80%
RSA Based employees who are Black people	30%	50%
Skilled employees who are Black people	18%	30%
RSA based employees who are citizens and from local communities	12%	20%
RSA based citizens employees per MW of Contracted capacity	N/A	N/A

Figure 55: Elements of the job creation criterion for the REIPPP programme (Eberhard & Naude, 2016).

Technology	Jobs during Construction			Jobs during Operations			Total Jobs		
	SA Citizens	Black Citizens	Local Comm-unities	SA Citizens	Black Citizens	Local Comm-unities	SA Citizens	Black Citizens	Local Comm-unities
Onshore Wind	11,355	9,165	4,827	32,041	24,751	16,384	43,396	33,916	21,210
Solar PV	13,356	9,742	6,022	33,790	27,874	22,823	47,146	37,616	28,844
CSP	8,400	5,370	2,223	7,212	4,920	3,276	15,612	10,290	5,499
Biomass	245	183	106	2,187	2,000	1,710	2,432	2,183	1,816
Biogas	-	-	-	-	-	-	-	-	-
Landfill Gas	6	6	2	240	180	60	246	186	62
Small Hydro	439	280	150	174	93	109	613	373	259
Total	33,799	24,746	13,328	75,644	59,818	44,362	109,444	84,564	57,690

Figure 56: Job creation outcomes for the REIPPP programme (where 1 job = 1 job year) (Eberhard & Naude, 2016).

Barriers and action options for development

Fact	Impact	Appropriate Action	Relevance for Ethiopia
O&M contracting model	Developing the most appropriate O&M model is crucial, including the assignment of liabilities and tasks	The right contracting model should be based for instance on the project size, type of companies involved and competence of project developer	Risks may arise from the profile of the auction winner and the readiness level of the Ethiopian RE labor market, supply chain and tax system
Wind farm availability	Low percentage values of availability may have a huge impact on the energy yield of the wind farm and on system planning	Wind farm unavailability and underperformance should be limited both on PPA contracts (off-taker´s side) and by means of advanced wind farm operational strategies (project developer´s side). Respectively, off-takers should require detailed forecasts and set up penalties due wind farm underperformance and unavailability. Project developers should use advanced tools for limiting it (root causes analysis, failure prioritization, condition monitoring, preventive maintenance and logistic of components)	*Low-Medium risk* The auctioneer should require detailed forecasts and implement penalties due to wind farm underperformance. The competences and proven commercial experience of the wind farm operator is crucial to attenuate underperformance and unavailability
Electricity market status	The liberalization of the electricity market should be seen as a long and sophisticated process rather than a single event	It requires on-going government commitment to resolve challenges when vested interests and cross-subsidies are unwound	*Medium-high risk* The liberalization process of the Ethiopian electricity market is at its early stage. Generation & transmission are currently bundle by EEP and grid infrastructure is under development. A regulating and balancing market is still absent and the dispatch and scheduling capability does not rely on advanced forecasts.Outcome 2.2 of the AWPGE programme and the committed development

			plans of the EAPP may sensibly mitigate or erase these capacity problems
Economic development criteria	A capacity building programme on renewable energy should be extended to socioeconomic empowerment	Economic development criteria which relate to community development, local community ownership and job creation should be always promoted in auctions.	*Medium risk* Models of local ownership shall be facilitated within the auction design. Community share-ownership instead may be unfeasible to implement in the short-term due to lack of adequate economic resources for local communities. Requirements on community development and job creation are therefore of paramount importance to promote sustainable socioeconomic empowerment

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