ADDIS ABABA UNIVERSITY
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ASSESSMENT OF CHALLENGES IN THE IMPLEMENTATION OF AYSHA-II WIND FARM PROJECT

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Research project as impartial fulfillment of the requirements for the award of the degree of Masters of Project Management

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Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted at any university for a degree.

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Statement of Certification

This is to Certify that the thesis prepared by Ataklti Kahsay, entitled: Assessment of Challenges in the Implementation of Aysha-II Wind Farm Project submitted in partial fulfillment of the requirements for the degree of Degree of Master of Arts Project Management complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

Ethiopia's economy is shifting towards industry by developing cascaded industry parks throughout the county which needs a reliable and uninterruptible supply of electric power. Hence diversifying the energy source of the grid system is highly required which is heavily dependent on hydropower plant i.e. more than 90% of the electricity supply comes from hydropower. Ethiopia has promising wind potential sites. So, the wind technology is an opportunity to address energy mix problem with clean and sustainable energy production. The purpose of this study is to identify the challenges in encountered during the Implementation of Aysha-II Wind Farm Project, to assess their impact and to suggest the possible solutions to overcome the challenges in order to support development of wind power in Ethiopia. Qualitative data analysis was undertaken in the study and interviews were conducted to collect the required data. Three stakeholders which are directly involved in the project implementation were interviewed. The respondents were 25 employees in number including management staffs, professionals and unskilled workers. Additionally, discussion with the contractor's project manager was made to gain more input in understanding the challenges and possible solutions. The findings of this study shows there are challenges that affect the implementation of the Aysha-II wind farm project and has suggested the possible solutions to overcome these challenges. The output of this study can be useful to the EEP (Client), Consultant Ethiopian Electric Power, particularly, to the project implementation office.

Keywords: Aysha, wind farm, challenges

Abbreviations/Acronyms

DEC	Dongfang Electric International Corporation
EC	Ethiopian Calendar
EEA	Ethiopian Energy Authority
EELPA	Ethiopian Electric Light and Power Authority
EEP	Ethiopian Electric Power
EEU	Ethiopian Electric Utility
EPC	Engineering, Procurement and Construction
EXIM	Export Import Bank of China
GW	Giga Watt
GWhr	Giga Watt Hour
ICT	Information and Communication Technology
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
IPP	Interdependent Power Producer
IRENA	International Renewable Energy Agency
Km	Kilometer
Kv	Kilo Volt
$kWh/m^2/day$	Kilowatt-hours per day
LILO	Line –In-Line out
m/s	meter per second
MIE	Mesfin Industrial Engineering
MOF	Ministry of Finance
MOU	Memorandum of Understanding
MoWIE	Ministry of Water, Irrigation and Energy
MW	Mega Watt
O&M	Operation and Maintenance
PPP	Public Private Partnership
RE	Renewable Energy
SSA	Sub-Saharan Africa
USD	United State Dollar
WTG	Wind Turbine Generator

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Contents

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Energy is the main drive for economic growth of a nation and for its sustainable development. Now a days, Ethiopia's economy is shifting towards industry by developing cascaded industry parks throughout the county which needs a reliable and uninterruptible supply of electric power. Hence diversifying the energy source of the grid system is highly required which is heavily dependent on hydropower plant (EEP, 2017).

Installed global wind generating capacity expanded rapidly from only 10 megawatts (MW) in 1980 to 94,124 MW of installed capacity by the end of 2007. At the end of 2007, Europe and North America accounted for 80.5% of global wind power capacity. Overall, developed countries accounted for some 85% of installed wind capacity; upon including China and India, this increased to 98.3% of global installed capacity. Very little electricity is produced from wind in developing countries, and especially in the least developed countries, although wind is used on a small scale to drive mechanical devices such as water pumps (Cornelis and Timilsina, 2009).

IFPRI (2018) stated in their report that wind energy is rapidly emerging as one of the most cost-effective forms of renewable energy with very significant increases in annual installed capacity around the world. Likewise, wind power utilization in Ethiopia is developing from time to time. Up-to-date Ethiopia harvests its electric power about 10% from wind. It is believed that an extensive development of wind energy in Ethiopia can play a crucial role towards resolving electricity supply shortages. The Government of Ethiopia has planned to increase the power generation in the country from 4,180 MW in 2014/15 to 17,000 MW from renewable sources, of which wind energy will have a share of 5,200 MW. A number of government entities such as Ethiopian Electric Power, who face challenges regarding their technical capacities, are responsible for the achievement of these targets (DANIDA, 2016).

Most of the power generation projects in Ethiopia have an experience with challenges and problems that resulted in time and cost overruns, insufficient quality and rise of dispute between the contractor and the client (Tadesse, Zakaria and Zoubeir, 2016).

1.1.1 An overview of Ethiopian Electric Power

The former organization named as Ethiopian Electric light and power Authority (EELPA), which was established in 1956 as authority agency wholly owned by the Ethiopian Government and it was converted to a Corporation in 1997 under the Public Enterprise Act of 1992. Then at this time it is divided in to two companies called Ethiopian Electric Power (EEP) and Ethiopian Electric Utility (EEU).

EEP is state owned electric producer established in 2013 under the Ethiopian Reg. No. 302/2013 to undertake feasibility studies, design and survey of electricity generation, transmission and substation construction and upgrading, handle electricity generation and transmission operational and maintenance activities, lease electricity transmission lines, sell bulk electric power and undertake universal electric access works and facilities by own force or through contracting out to contractors and consultants as required that would enable it to achieve its purpose in accordance with economic and social development policies and priorities of the government (www.eep.gov.et, [Accessed 10 Jun. 2019]). As of 2010 E.C, the organization operates 14 hydro, 3 diesel standbys, 1 geothermal and 3 wind farm power plants with an installed capacity of 3,814.6 MW, 87 MW, 7.5 MW and324 MW respectively and this brought a total of 4,233.1 MW.

1.1.2 An overview of Aysha Wind Farm Project

1.1.2.1 Project location

The proposed project area is located in the Somali regional state, Aysha district; it is located 170 Km Northeast of Dire Dawa city and about 150Km Southwest of Djibouti, 40Km from the border of Somali Land. The GPS location is: North latitude 10^0 29’ ~ 10^0 49’, East longitude 42^0 30’ ~ 42^0 47’ with the elevation of 730 ~ 770 meters above sea level.

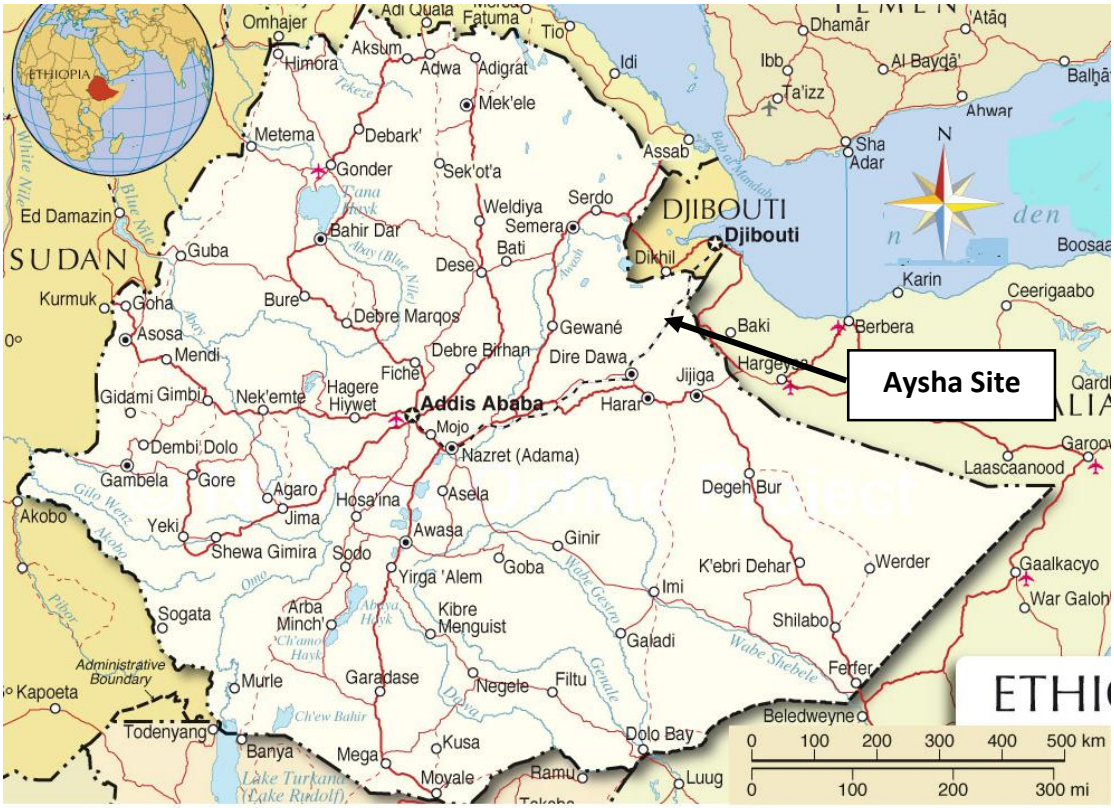


Fig. 1 Project location (Source: Aysha-II wind farm feasibility study)

1.1.2.2 Project description

DEC had discussed with EEP in lining with the wind power generation project and prepared feasibility study report. As per the Feasibility study the annual average wind speed of the site is 8.73m/s at the height of 70m above the ground and annual energy production of the plant is estimated 467.09 GWhr. On this bases, the Ethiopian Electric Power has signed contract agreement with Dongfang Electric International Corporation on 15th January 2016 to construct 120MW wind farm project. the project is designed to construct a wind farm consisting of installation of 48 sets with unity capacity of 2500KW, construction of access roads for operation and maintenance, one 230kV step-up substation connected to the 230kV national grid, provision of training to the O&M team and five years Defect Liability Period.

1.1.2.3 Finance source

The finance source for Aysha-II wind farm project is gained from EXIM Bank of China through government to government loan agreement between Ethiopia (Ministry of Finance, MOF) and China. The loan amount is 218,692,386 USD which covers 85% of

the project cost i.e. the foreign portion which shall be paid in USD to the contractor. The remaining 15% will be paid in ETB.

1.2 Problem Statement

Power generation for the electric grid in Ethiopia currently depends almost entirely on hydropower. In 2012, only about 23% of the total population was connected to the national grid. Eighty-three percent of the population resides in rural areas, largely relying on traditional biomass energy sources for cooking and heating (Mondal, Elizabeth, Claudia, Dawit and Mark, 2018). Due to the heavily dependency on the hydro, the government had been forced to ration the electric power supply in the past years when water shortage in the hydro dams occurred, for example the past two months (May to July 2019) there was power cut for five hours every day. Consequently, increasing installation of other complementary renewable energy generation system is mandatory to offset during dry season. Since dry season is the windy season in Ethiopia, in combination with wind power the hydro plants can act as a base load.

IFPRI (2018) verified in their study that Ethiopia has estimated wind potential of 10 GW electric energy potential which can solve its energy crisis and stop relying on fossil fuels. However, only a small portion of the potential is harnessed today. Recently Ethiopia has started to utilize its wind resource for electric power production. Up to date, Ethiopia has integrated three wind farms to the grid with total installed capacity of 324 MW (www.eep.gov.et, [Accessed 10 Jun. 2019]).

Globally, the Africa's installed capacity share is still very limited with estimated total of 1.1 GW and despite of its high wind energy potential, wind-based electricity contributes less than 1% to installed electricity generation capacity on the continent (IEA, 2011). Currently, one wind farm is under construction called Aysha-II wind farm project with installed capacity of 120MW. The contract agreement for the implementation of the Wind Farm Project was signed on 15th of January 2016 to be completed within 18 months from commencement date. The commencement date of the project was on 25th February 2017 but construction of the project is not completed yet. Thus, EEP lost revenue and as public organization it can't fulfill society demand on time.

Implementation of projects in Ethiopia, particularly energy sector are encountered with challenges emerged due to several reasons. The challenges may have impact in cost, time and quality. For example Ashegoda wind farm project was planned to be completed 36 months, but contract signed in 2008 and completed 2013 and Adama-II wind farm (24 months project) contract signed 2012 and completed 2015. No research has been made on challenges of wind farm project implementation in Ethiopia, hence in this study the researcher is highlighting the challenges encountered in the implementation of Aysha-II wind farm project in terms of cost, time and quality. Therefore, the above indicated issues (signals) motivated the researcher to conduct a study on the challenges encountered in the implementation of Aysha-II wind farm project. The study also suggested possible solutions to support the development of wind power implementation. In conclusion, the purpose of this study is to identify the challenges encountered in the implementation 120MW Aysha-II Wind Farm Project and propose possible solutions on how to overcome the challenges encountered during implementation of the project.

1.3 Research Questions

This study attempts to answer the following research questions.

1. What are the challenges encountered in the implementation of Aysha-II Wind Farm Project?
2. What is the impact of the challenges on the project progress?

1.4 Research Objectives

1.4.1 General Objective

The general objective of the study is to assess the challenges and problems encountered during the implementation of Aysha-II wind farm project and give recommendation on how to avoid and resolve the challenges encounters in Aysha-II Wind Farm Project. The assessment had covered the challenges observed during pre-construction and construction time of the project.

1.4.2 Specific objectives

The specific objective of the study includes the followings:

1. To identify the challenges faced in the implementation of Aysha-II wind farm project.

2. To assess the impact of the challenges on the Aysha-II wind farm project.

1.5 Significance of the Study

In general, the findings of this study have a substantial importance for EEP particularly for the work unit involving in the project implementation. The study is expected to present to some extent of the current picture of the 120MW Aysha-II wind farm project. It provides possible recommendations to the organization in effort it would prepare mitigations for implementation of EPC based wind farm projects in order to complete on schedule and within budget. It is also expected that the findings of the research will contribute a lot for the stakeholders such as financer/lender, community, consultant and contractor. Moreover it will serve as a base for those who are interested to conduct further research works regarding the challenges encountered in implementation of projects. It is also clear that it helps to enhance the researcher's knowledge in research practices.

1.6 Scope of the Study

The scope of this study is limited to assess the challenges encountered by the client-EEP during the implementation of Aysha-II wind farm project. It is not possible to cover all challenges faced by the wind farm projects in Ethiopia due to financial and time constraints. Moreover, the study is delimited to the project management aspect and professional tasks, and the challenges faced during daily site activities which are considered as routine are not addressed. The study also focuses on the organization's project management practices in line with the commonly known principles and theories of project management.

1.7 Limitation of the Study

During preparation of this research the project was under intensive works to compensate the time wasted so that the employees did not have plenty time for interview and discussion. This had created a problem to some extent in collecting the data on time through interview from the employees within the time frame set. As a result, the researcher faced time constraint to finalize the report as per schedule.

1.8 Organization of the Study

The study is organized into five chapters. Chapter one provides a brief background to the study, discusses the research problem, scope and limitation, and significant of the study. Chapter two deals with the review of related literatures and will talk about wind energy technology. Chapter three presents research methodology to be adopted in the study. The fourth chapter focuses on the presentation, analysis and interpretation of primary and secondary data. Finally, chapter five contains the summary, conclusions and recommendations.

CHAPTER 2

LITERATURE REVIEW

This chapter contains theoretical review, empirical review and conceptual framework.

2.1 Theoretical review

2.1.1 Introduction

Wind is an inexhaustible and most accepted energy resource, which does not cause any pollution in electricity production (Ucar and Balo, 2009). A wind turbine, or alternatively referred to as a wind energy converter, is a device that converts the wind's kinetic energy into electrical energy with zero carbon emission. Turbines can be built on land or offshore and are grouped into “wind farms” that provide bulk power to the grid (IEA, 2013). The first variable-speed wind turbine tied to the AC electrical grid began to become viable reality in the early mid of 1970’s (NREL, 2001). In 1980, the world’s first wind farm consisting of 20 turbines was built in U.S.A. but filed due to developers overestimate the wind resource. According to the World Bank (2014) the wind energy has shown a remarkable evolution over the past decades (1990–2010), a compound annual growth rate of 25%. Brazil, China, India, and Turkey are among the middle income countries that sustained compound annual growth rates in excess of 60%. In 2012, the global wind power installed capacity reached 300 GW and more than half of it accounted to China and United States. By end of 2018, all wind turbines installed cover close to 6% of the global electricity demand (WWEA, 2019).

Therefore the above statements show that global wind energy utilization had been increasing continuously and today’s wind power technology is matured commercially and many firms are available to provide competitive wind turbines to construct wind farms at the scale of hundreds of MW like other conventional power plants.

2.1.2 Definition of Project Implementation

Project implementation consists of carrying out the activities with the aim of delivering the outputs and monitoring progress compared to the work plan. Monitoring can be defined as control of the project implementation in order to keep the project on track

and achieve the end results of the project. The project manager is responsible for the regular monitoring of the project, but the partner organizations should also contribute actively to the effective monitoring of the project (INTERACT, 2014).

The project execution and implementation activities can include desk-based studies, field studies, active data collection, organizing panel discussions, presentations, end user events, dissemination, gathering and analyzing needs and feedback, providing publications, making research studies more available for public audiences, and utilizing and exploiting relevant data for political decision-makers and/or other end users. In general, specific questions like "Which are the key activities?", "Which organizational capabilities are available?" and "How to engage internal and external stakeholders?" should be addressed (Kirsi, 2017).

2.1.3 Definition of Challenges in project

The 21st century project environment is characterized and driven by increase complexity, uncertainty, and multiple stakeholders competing for the project goals and objectives. The project management practices which are ostensibly influence by the theoretical approaches and models developed by different academics, practitioners and professional institutions are challenged. A significant issue observed from project management in the 21st century is that the nature of project has transform because of the large scale, uncertainty, and huge cost, several stakeholders' involvement in project and increase interests in project benefits (Abdulrahman and Oluwasoye, 2016).

The construction industry faces ongoing challenges. From an external perspective, economic uncertainty, increased competition within the industry and the growing influence of regulatory agencies drive profit margins down. From an internal viewpoint, the increase in the numbers of features in a project's scope, against shorter construction deadlines and restricted budgets raise the complexity of building construction projects. It can be stated that the important challenges that can occur during implementation of project management best practices are role of senior leadership, effectiveness of PMO, human factors, PM training, poor adoption of PM standards, and triple constraints (Sreekumar, 2015).

2.1.4 General description wind farm system

The construction process of on-shore wind farms can be divided in to five (5) main packages (Zankoul and Khoury, 2014).

i. **Topographical Survey:** conducting a topographical survey to the land where the wind farm will be constructed as per the micro-siting prepared.
ii. **Access road**: to access to the site and mobilize equipment and materials required for construction such as trucks and cranes. After installation is completed the construction access roads will be converted in to permanent gravel roads for operation and maintenance of the wind farm.
iii. **Wind turbine foundation**: consists of steel reinforcement installation, formwork, pouring concrete and curing.
iv. **Electrical Works**: excavating the electrical trenches as well as loading the electrical cables. Crew and excavator are required to do the work.
v. **WTG installation**: is assembly of tower, nacelle and rotor using cranes.

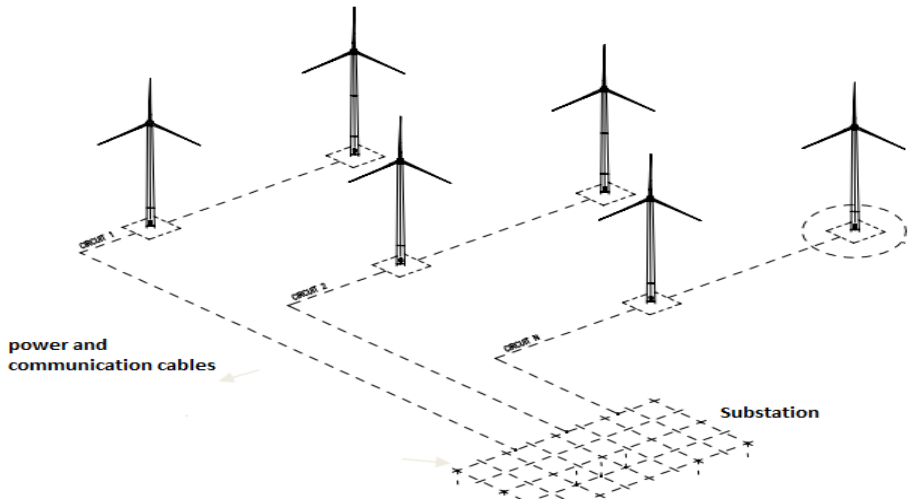


Fig. 1 Layout of typical wind farm (IRENA, 2016)

2.1.5 Wind Power as a Source of Sustainable Energy

In recent years, the environmental effects of energy production have increasingly entered in to the foreground of the sustainable development agenda. Hydrocarbon abundant countries are blamed to become the largest emitters of greenhouse gases, trace metals, and other pollutants due to extensive use of oil, gas, and coal in energy production. Combustion of fossil fuels for heat and power generation is reported to be

among the major reasons for progressing climate change globally (Jianzhong, Albina and Vasilii, 2018).

IZA (2014) identified two main solutions that could be implemented as policy to reduce CO_2 emissions: (1) replacing fossil fuels with renewable energy sources as much as possible and (2) enhancing energy efficiency. Thus, wind turbines can diversify our energy portfolio and reduce our dependence on fossil fuel. Wind energy is homegrown electricity, and can help control spikes in fossil fuel cost (Nathaniel, 2014).

The study made by Kaygusuz about the progress of wind energy and potential of the technology and identified that wind power is the fastest growing energy technology at the turn of the millennium, and will continue to grow for the foreseeable future due to it is abundant, domestic, inexhaustible and clean energy source (2004). MoWIE (2017) stated in their report that the wind energy potential of Ethiopia is estimated to be 10 GW.

Therefore, Ethiopia can expand to use its wind power potential as a source of sustainable energy instead of fossil fuel in order to reduce carbon emission. Moreover, large scale development of wind farms can effectively overcome the deficiency of hydropower plants and as mentioned above by the authors; to reduce the environmental effects due to fossil fuel, to increase access to electricity, to diversify our energy portfolio and to reduce the dependence on foreign fossil fuel.

2.2 Empirical review

2.2.1 Current status of Wind Power in Ethiopia

Alli, Emelly, Yannis and Thouraya (2012) had conducted a research to explore how Africa's wind energy markets have evolved over the years and the results from the study through analysis of 94 projects showed that wind energy markets remained small. An estimated 1.1 billion people (14% of the global population) did not have access to electricity according to Energy Access Outlook 2017. Many more suffer from supply that is of poor quality. IEA (2015) forecasted that if current policies do not change, by 2030 there will still be 1.2 billion people without access to electricity. The number of people without electricity will even rise in Sub-Saharan Africa.

As it is indicted in chapter one, though Ethiopia has abundant wind energy resource potential, it exploits very small portion due to reasons. Up-to-date the country has three wind farms in operation with a total capacity of 324 MW, and a geothermal plant is under construction (www.eep.gov.et, [Accessed 11 Jun. 2019]).

2.2.2 Trends and projections for the near future

As part of the Growth and Transformation Plan, the Ethiopian government has announced plans to increase the country's electricity generation capacity from the current 4,200 MW to 40,000MW by 2035 (Sub-Saharan Africa Power Outlook, 2017). This will be a significant step in realizing the strategic vision of the country being a regional hub for power generation and export to East Africa. Ethiopia recently liberalized the energy sector after ratifying a new Energy Proclamation that allows private investors to construct, generate and sell to EEP in IPP base contract.

There are some indicators on the ground for aggressive power generation expansion. Wind energy is expected to play a key role along with other renewable energy sources such as geothermal and solar energy the share of wind power will increase to 1,200 MW by 2020/21 and about 900 MW are planned to be developed by the private sector through IPP. 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 (MoWIE, 2018).

The majority of this power expansion is intended to be developed by the private sector through IPP tender auctions which includes hydro, solar, wind and geothermal projects.

Sub-Saharan Africa Power Outlook (2016) quantified in their assessment that Ethiopia has significant unutilized renewable energy resources, including an estimated 50,000MW hydropower potential, 10,000MW geothermal resources and 10,000 MW wind. The expected outcomes from the Ethiopian government plans are to increase its power generation by 17,000MW from different renewable source and realize the green economy development of the country.

2.2.3 Project cost and Financing source for Wind Projects in Africa

Project costs are interesting in understanding industry development because they give an indication of both the resource needs per unit of installed capacity, and signal

affordability of wind technologies as well as the level of maturity of the market (African Development Bank, 2015). 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" (Wind Project Development Roadmap, 2018). The table below shows cost breakdown of onshore wind farm project.

Cost share	Percentage (%)
Wind turbine	64 - 68
Grid connection	9 - 14
Construction	4 – 10
Other cost	4 - 10

Table-1: Capital cost breakdown for wind power project (source: IRENA, 2016)

Project costs do not solely depend on installed capacity, but also on the project's location, the requisite off-take infrastructure and general costs of doing business (African Development Bank, 2015).

The electrification in Africa is suffered from a lack of adequate investments, given the scarcity of domestic funds and the higher regional risk perceived by foreign investors (Nicola and Lorenzo, 2018).

Unlike many new construction initiatives in Africa in the last decade which have been funded by the Chinese, a consortium of investors under the auspices of the European Union are financing $690 million project with the African Development Bank as the lead arranger (QUARTZ AFRICA, 2015).

2.2.4 Barriers to wind power development

Blechinger, Katharina and Ortwin (2015) in their research tilted as "Barriers and Solutions to the Development of Renewable Energy Technologies in the Caribbean"

they categorized the barriers for the expansion of renewable energy in to four groups: Technical, Economic, Political and Social constraints.

i. **Technical barriers:-** includes Lack of evidence based assessment of RE potentials, Technical constraints and Lack of technical expertise and experience.
ii. **Economic barriers:-** High initial investments, Financial aspects and Lack of private capital.
iii. **Political barriers:-** Policy, Gap between policy targets and implementation, Lack of incentives or subsidies for RE, Institutional capacity and Lack of regulatory framework and legislation for private investors
iv. **Social barriers:-** Consumer behaviour/awareness, Lack of social norms and awareness, Lack of educational institutions, Cultural, Preference for status quo

Another journal prepared states that the challenges of RE in SSA are: continued employment of fossil fuel subsidies; the presence of monopoly structures in the energy sectors; regulatory and macroeconomic risks in sustainable energy schemes; large capital required to fund sustainable schemes; high transaction costs and negative social impacts (Fortune and Collins, 2014).

Abaka, Iortyer, Ibraheem, Salmanu and Olokede (2017) explained in their study that the persistent energy challenges in Africa have serious negative impacts on the overall performance of the region's social and economic developments. The promotion of renewable energy becomes so difficult because of the high capital investment and repayment of services (tariff). As per their study the barriers are classified as; policy, regulation and institutional; information and technical capacity; and financial.

When it comes to Ethiopia, the following challenges are observed that prevent the wind energy development in the country.

- Production and distribution of electricity are still controlled (monopoly) by the government, EEP and EEU.
- Higher initial investment than fossil fuel generation and hydro.
- Reliability and quality of the grid system doesn't comply with the international standard.
- Low electricity tariff which is not attractive for investors.
- Government's low attention to the wind power development.

- No institutions established for wind energy resource assessment and development
- The regulations didn't allow private wind power developers and domestic capacity limitations.
- No economic institutions established for facilitating PPP (Public Private Partnership) contracts (i.e., power purchase agreements) between the wind power developers and system operators (Cornelis and Govinda, 2009).

Beside of the aforementioned barriers, World Bank (2009) in their research identified that grid connected wind farms can also suffer from other barriers such as migratory bird paths, aviation issue, lack of availability of transmission line and competition for land use with agricultural, recreational or for other use.

The other barrier in development of renewable energy in Ethiopia is related to the government's policies. In general they are supportive for RE, however, proper instruments are not used for their effective implementation (Ethio-Resource Group, 2012).

2.2.5 Potential policy instruments to support wind energy development

As stated above, Ethiopian government established a number of policies to increase the generation mix in the country. The key instruments to support wind energy development are feed-in-tariffs, investment tax credits, direct subsidies, favorable financing, renewable energy portfolio standards and public investment (Cornelis and Timilsina, 2009). Based on specific needs and circumstances, individual governments can tailor policies to support wind power deployment. In many cases, a combination of policies will be most effective in addressing country-specific objectives and challenges.

2.2.5.1 Renewable Electricity Standards

A renewable electricity standard (RES) sets a requirement for a region, utility, or country to purchase a specific amount of electricity from renewable sources. Government shall set targets of developing electricity generation portfolio.

As of 2013, 25 national and 54 subnational governments had adopted RES or similar policies. Even in the absence of wind-specific targets, RESs have significantly supported wind development in several countries and jurisdictions, as wind power is

often the least-cost renewable energy option (National Renewable Energy Laboratory, 2015). RES includes:

- Establishing long-term RES targets that increase over time to support sustained wind growth
- Defining the standard to support wind generation
- Enacting subnational RESs to support diverse wind resources and development needs
- Supporting a broader enabling policy environment

2.2.5.2 Feed-in Tariffs

Feed-in Tariffs (FITs) provide a per kilowatt-hour payment for renewable electricity that is "fed" into the grid. FITs are designed to increase deployment of renewable energy technologies by offering a long-term purchase agreement for electricity generation at a specified price, thereby providing market certainty for developers. As of 2013, 51 countries had adopted wind FITs, making them one of the most widely used policies to support wind investment (IREN21, 2014).

Wind FIT payment levels can be differentiated to support wind development under various conditions. The FIT payment can be differentiated in relation to resource quality which allows the payment to be appropriately aligned with generation costs at specific sites, in relation to project size which supports distributed projects and help to avoid inflated developer payments for large projects, in relation to location which includes can help support development of less accessible wind resources and bonus payments and premiums for developers that implement advanced technologies that support grid integration.

2.2.5.3 Interconnection Standards

Grid-connected distributed wind turbines are often most attractive in areas with high electricity costs, significant wind resources, flexible permitting and zoning, and ease of interconnection to the utility grid (WWEA, 2014). Interconnection policies ensure all renewable electricity projects can connect to the grid if they meet certain technical requirements to ensure safety. Effective interconnection policies also provide simplified procedures and forms for small systems so as not to place a proportionately high administrative burden on small wind system installers and owners.

2.2.5.4 Wind Investment and Production Tax Credits

One of the policy mechanism to support wind energy development is tax incentives. There are two most widely adopted renewable energy tax incentives which have been enacted in 37 countries (REN21, 2014).

a) **Investment tax credit (ITC)**: it is basically a tax related to incentive that allows individual/ entities to deduct a certain percentage of specific investment related costs from their tax liability apart from usual allowances for depreciation. In wind projects, it reduces the wind project owner's tax liability based on the capital investment in the project.
b) **Production tax credit (PTC)**: provides a credit to companies producing wind energy on a per-kilowatt-hour basis. To support equitable and efficient outcomes, wind tax incentives are normally tied to the incremental costs associated with wind power production. Generally, higher tax credit rates may be more likely to drive wind deployment, but will result, of course, in some loss of government tax revenue and can lead to less-experienced wind developers entering the market.

2.3 Empirical findings

The researcher could not find researches specifically focus on the assessment of challenges encountered during wind project implementation in Ethiopia. But there are a number of studies conducted by different researchers concerning challenges on renewable energy development in Africa. In general the authors have pointed out that hydropower has been the longest-standing and largest green energy source used in Africa's electricity supply industry, but the last two decades have seen the rise of solar and wind. They also mentioned that the wind energy development has faced many challenges categorized in to three: policy, technical and economic.

To mention few similar studies: "Scaling –Up Renewable Energy Program Ethiopia Investment Plan" (Tewelde, 2012), "Energy security, uncertainty, and energy resource use option in Ethiopia" (Dawit, 2015) and "Hybrid Solar – Wind – Diesel Systems Case Study in North Ethiopia" (Mulu, 2013). There are also studies made in Africa on challenges of wind energy development. To mention few: "The empirical reality & sustainable management failures of renewable energy projects in Sub-Saharan Africa"

(Eugene, Peter, Peter and JosVan, 2017), "Development of Wind Energy in Africa" (Alli et al., 2012) and "Prospect and Challenges of Renewable Energy Resources Exploration, Exploitation and Development in Africa" (Abaka et al., 2017). The other study with respect to international perspective is made by Victoria, Kathrin, Lea, María, and Johann titled as "Wind of Challenges: Implementation factors regarding wind energy development, an international perspective" (2014).

Dr. Tewelde from the Ministry of Water and Energy; has mentioned that wind farms are essential for Ethiopia generation mix in order to avert possible shortfalls during unfavorable dry periods in the hydro generations due to their complementing advantage. The future generation composition of the power system of the country also is also indicated in the study and by 2030, the 99.43% will be generated from renewable energy resources by 2030. Regarding the challenges, he said the possible challenges include low implementation capacity and economic situation of the country that affect the implementation plan. The proposed mitigation mechanism includes strengthening the implementation of the civil service reform program, increasing foreign exchange earnings by expanding export capacity and assuring sustainable and rapid overall economic growth (2012).

Abaka et al. (2017) focused on the challenges that hindering the development of renewable energy resources in Africa. They stated the major barriers are political conflicts and conventional challenges which includes technical, technological, economic, and institutional weaknesses.

Eugene in his case study for the Sub-Saharan countries, has stated that different challenges emerged at different stages of the project management process during implementation of public RE projects in SSA. These major challenges include in the execution of public RE projects are incompetence of project managers, lack of clear designation of responsibilities and unsustainable management. They proposed solutions such as transparency, shared responsibility and ownership (clearly defined to which degree stakeholders have authorized ownership). The data were gathered via survey, interviews and physical inspection of the projects (2017).

Dawit also emphasize that Ethiopia's energy sector faces critical challenges to meeting steadily increasing demand which is heavily dependent on hydro. He also added that

development of alternative energy resources is low. Comparing to the other RE resources solar and wind have lower plant factors of 30% and 40% respectively (2015).

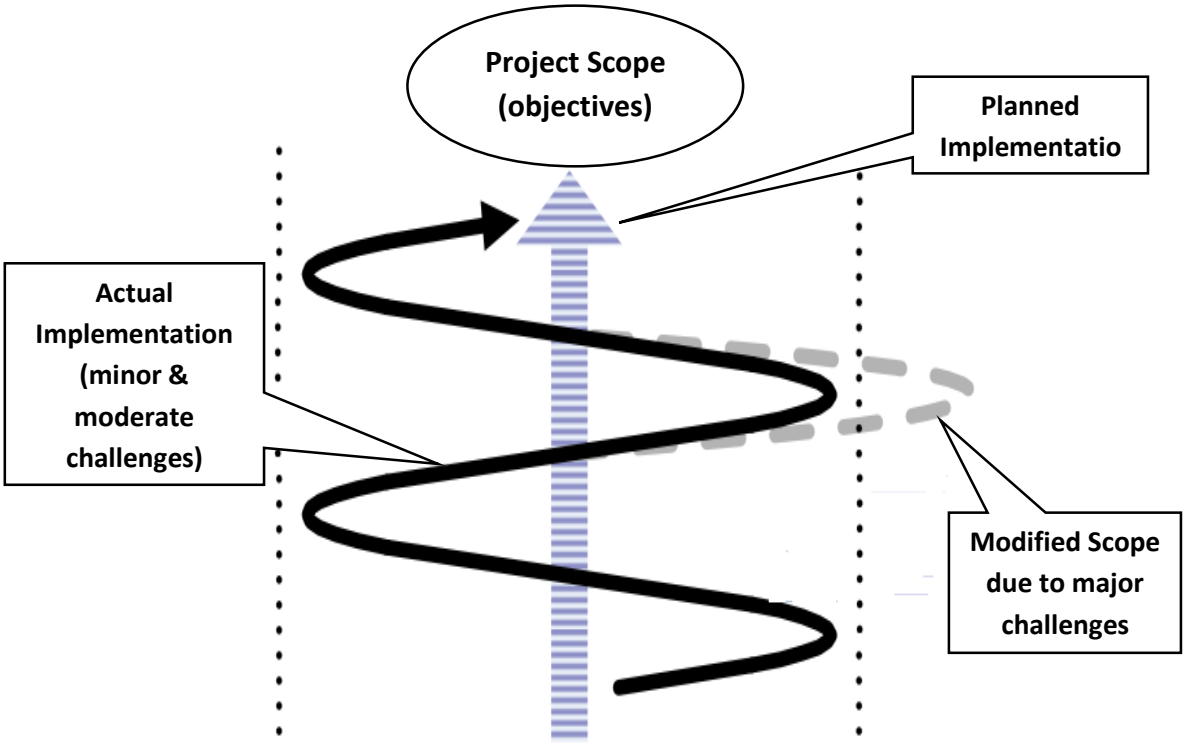
Victoria et al. (2014) have stated in her study that political and market phenomena, siting issues (limited land availability), the green vs. green dilemma (involves the incoherent relationship between policies promoting renewable energies with policies protection species and their environments, becoming a major point of concern during siting and operations of wind energy) and social acceptance are challenges present in wind energy planning and policy.

National Renewable Energy Laboratory (2015) verified in their report that wind power is playing a significant role in meeting global electricity demand while also supporting local economic development, mitigation of carbon emissions, and reduction of water use from the power sector. Global wind power capacity has expanded, on average, 21% annually since 2008, with at least 85 countries having implemented commercial wind operations by 2013. As notable examples, in 2014, wind power provided 28% of electricity in Denmark, 28.5% in Iowa, United States, and 21% in Spain.

2.4 Conceptual framework

The project application is the baseline for project implementation that contains project objectives, a description of the activities for achieving them, and measurable output and result indicators to show they have been achieved. However, no matter how good the original plan is, it is not expected the project to be implemented exactly as planned (INTERACT, 2014).

In this study the challenges in the implementation of Aysha-II wind farm project will be identified with respect to technical, economic, political and social factors and impact of these challenges on the project's cost, schedule and scope will be seen. The impacts will be measured by looking the variance seen between what is set and what actually is. The benefits of the project are looked based on the project objectives against actually obtained.



Source: INTERACT - Project Management Handbook, 2014

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

This chapter presents the research design, population and sampling size, data sources and their collection tools, sampling techniques, data collection procedures and methods of data analysis.

3.1 Research Approach

The research approach in this study is predominantly qualitative which makes use of primary and secondary data to answer the research questions and achieve the study objectives. The study analyzed the assessment of the challenges in the implementation of Aysha-II wind farm project.

Observation notes, interview transcripts, literary texts, minutes of meetings, historical records, memos and recollections, documentary films, are all typical examples of qualitative data. Some are recorded very close to the events or phenomena, whilst others may be remote and highly edited interpretations, so assessments of the reliability must be made. Also qualitative data rely on human interpretation and evaluation and cannot be dispassionately measured in a standard way (Nicholas, 2011).

The purpose of the qualitative research is to make sense of and recognize patterns among words in order to build up a meaningful picture without compromising its richness and dimensionality. This approach can contribute significantly in health services provision, policy setting and administration (Lawrence, 2015).

It is believed that the research method used to conduct this study is very effective and answers the research questions properly.

3.2 Research design

This study was mainly exploratory focusing on the challenges in the implementation of Aysha-II wind farm project. Exploratory research is used to investigate a problem which is not clearly defined. It is conducted to have a better understanding of the existing problem by means of open-end questions (qualitative). Exploratory type is low cost and interactive in which the information can be gathered either directly from

the subject (like survey and interview) or from previous publishes (like case studies, magazine, books, etc). In this study interviews were conducted with the employees of EEP which includes managers, RE, site team and with selected people living in Aysha town.

3.3 Population and Sampling

The target population for the study were EEP employees, consultant and local community approximately 25 people who directly involve in the project and who have better knowledge about challenges encountered in the project implementation. It consisted of managers at head office, professionals who were working at home offices and site. The participants had been selected based on their knowledge on RE and the project, and represent different stakeholders. Thus, representative people of Aysha town were included who work in the project. The researcher also discuss with the contractor's project manager to have wider observation about the project.

Title/ Position	No.	Remark
Head of Generation Construction office	1	
Manager of Aysha Wind Farm Project	1	
Resident Engineer	1	
Design Review Engineers	4	Consists of generation design engineers: electrical engineers = 2, civil =1 and mechanical = 1
Contract Administration Team	2	Consists of senior engineers: electrical engineers = 1 and mechanical = 1
Construction Supervision Team	6	Consists of generation construction engineers: electrical engineers = 2, civil = 2 and mechanical = 2
Aysha community representatives who work at the project site	10	10 contract workers at the site
Total	**25**	

Table-2. List of interviewees

3.4 Data Collection

There are two major types of data that have dominated the field of research methods: namely Primary and Secondary data. Primary data are information collected by a

researcher specifically for a research assignment because no one has compiled and published the information in a forum accessible to the public. The methods for primary data involve interview techniques through direct contact, phone and e-mail. Secondary data are when a researcher uses data collected by a party for some other purpose in the past time, then these become secondary data for the current users.

The data for this study were collected mainly by interviewing with Head of Generation Construction office, Project Manager, Resident Engineer, project supervision team, contract administration team and local community of Aysha town. Secondary data sources also referred to achieve the research objective. These include study of previous related literatures, books both printed and in electronic formats, academic articles, reports, documents and journals, review of selective archival records of Aysha-II wind farm project such as contract document, project progress reports.

The researcher was unable to record the audio of the interviews conducted with the interviewees, thus the data were collected by taking short notes during the interview and memorizing and writing them in detail during the study writing. The researcher traveled to Aysha site to have interviews with the site team and local community.

3.5 Data Analysis

As mentioned in the research approach section, this research study used qualitative methods to analyze the data collected in order to understand the challenges in the implementation of Aysha-II wind farm project.

Qualitative content analysis is the method used to analyze the data. The object of (qualitative) content analysis can be all sort of recorded communication (transcription of interviews, discourses, protocols of observations, video tapes, documents…). The main part of the analysis is qualitative. It can be supplemented by quantitative analysis (Mayring, 2003). The researcher had also formulated a clear research question and described the theoretical background. The research question was made to be explorative. Moreover, the researcher had included EVA (Earned Value Analysis) to analyze the collected data.

The interviews were conducted with Head of Generation Construction office, Project Manager, Resident Engineer, project supervision team, contract administration team

and local community of Aysha town. The interviews were made in Amharic language and transcribed in to English. Furthermore, the author did not generate completely new theory but to rely on existing literature.

3.6 Scale Reliability and Validity

In qualitative research, efforts have to be made to enhance reliability in a broader sense. Validity is one of the strengths of qualitative research and is based on determining whether the findings are accurate from the standpoint of the researcher, the participant, or the readers of an account (Creswell, 2014). During proposal preparation and approval process, the interview questionnaires were reviewed and modified as per the advisor's comments.

Except the people from Aysha town, the interviewees are responsible personnel involving directly in the execution of Aysha-II wind farm project and in EEP head office who know the project very well. In addition, the interviewees who work in the project have checked the structured questionnaires and their suggestion/comments were considered. Moreover, the researcher had conducted site visits and documents of the project have been provided to the researcher.

3.7 Ethical issues

Ethical considerations can be specified as one of the most important parts of a research. Thus researcher has an ethical responsibility to do his/her study honestly and with integrity. In doing this research, participants will be given appropriate information about the purpose and intended uses of the research, and after receiving informed consent from participants the interview will be conducted. They will be also made aware of their right to refuse participation whenever and for whatever reason they wish. The identity of individuals participated in the research will be protected at all times through confidentiality i.e. names will not be mentioned in the study. Moreover, the researcher assured that the data obtained from the interviewees will be used only for this study. The researcher will not modify and change findings to meet his and/or participants' needs. Therefore, the researcher believed that the study was not raising any ethical anxiety.

CHAPTER 4

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

This chapter presents analysis, presentation and interpretation of primary and secondary data.

4.1 Challenges in the Implementation of Aysha-II Wind Farm Project

The author of this research project conducted four separate interviews with concerned stakeholders who involve in the Aysha-II wind farm project to have a concrete view of the challenges faced during implementation of the project. The interview questions were designed taking in to consideration the objective of this research project and the research questions which need to be answered at the end of the study. In order to make a suggestion that will be concrete and elaborate on the challenges in Aysha-II wind farm project. All the interview questioners were conducted by face to face interviews with the head of generation construction office, project manager, resident engineer, contract administration team and construction supervision team.

The answers gathered from the interviewees are categorized in to three and presented below.

4.1.1 Challenges observed during pre-construction time

As per the project manager - the annual energy production issue of the wind farm can be considered as the major challenge that affects the project largely. During the review of DEC's detailed micro-sitting report the client noticed that the annual energy production is less than the agreed amount by 27.25 GWhr which should be 436 GWhr. The contractor argued that the error was occurred due quality of the wind data provided by the client and proposed to upgrade the WTG capacity to 2.5 MW as one option in order to attain the agreed annual energy production without project cost variation. Consequently the quantity of WTGs decreased from 80 to 48. This issue also affected the loan agreement which required consent from EEP, MoF and EXIM bank; and took significant time.

The head of generation construction office stated that the challenge occurred in the implementation of Aysha-II wind farm project is financial constraint. EEP couldn't pay

the advance payment to DEC as per the schedule. The commencement date of the project would be effective after advance payment is paid to the contractor and this situation extends the starting of the project. He added “as general with respect to the renewable energy policy”, EEP faced a problem of consistent and effective implementation of regulations. Also, the generation and distribution of electricity are still controlled (monopoly) by the government. The other challenge to the wind energy expansion is, it needs higher initial investment than the hydro.

According to the resident engineer - the contract of Aysha-II wind farm project was awarded through Memorandum of Understanding (MOU) between the Ethiopian and China governments. There was no tender process, DEC was awarded the contract without competing with other international firms through bid. As a result, there was no alternative contractor to replace.

4.1.2 Challenges observed during construction time

The construction supervision team - the main challenge occurred during WTG installation works was wind speed. Wind turbine installation is challenging work in condition of high and variable wind speed due to need to lift heavy loads to high location. This problem was because of shifting of the initial project activities schedule, installation schedule. The nacelle, tower and generator are hoisted when the wind speed is less than 10m/s. There was another natural obstacle in the civil works i.e. due to high temperature most of the time concrete pouring of the WTG foundation was done at nighttime.

As per the project manager - land compensation issue (right of way issue) was the other difficulty in the implementation of the project. When the contractor started site works after receiving right of way from the client, some people started to build dwells at the site and the contractor was forced to stop site work.

The design review team has mentioned that the submission of the design documents by DEC for approval were not sequential as per schedule. Both supervision and contract administration teams explained that there was also delay of cement supply from the factory due to projects’ priority by government. The contract was made with National Cement Factory. On the other hand, marine transportation of materials and equipment delay was occurred. By law DEC should use Ethiopian Shipping Line to transport the

equipment from abroad but unable to get on time as per its schedule. And custom clearance bureaucracy delayed to deliver to the site.

As per the construction supervision team - the contractor was unwilling to take corrective actions as per the site instruction provided by the client.

The contract administration team explained that the other challenges was settling the "liquidated damage" issue requested by EEP as compensation payment for delay of completion time of the project.

4.1.3 Challenges related with capability and strategy

The resident engineer explained that in general, Ethiopia has no experienced experts in wind power, since it is introduced to Ethiopia in short time. Comparing to the international consulting firms, it is expected that the consulting team would face a lot of burden and challenges during provision of consultancy service. But it would be minimized/avoided by offering adequate training to the team when planning to involve in such task. So, delay of duty delivery on schedule was observed which is considered as a challenge for project implementation. Lack of availability of experienced and capable local subcontractors in the market is also another challenge. The contractor couldn't get local subcontractor which has adequate experience in wind farm construction. The supervision team also stated that poor quality of civil works occurred and DEC replaced by another local company twice through client's consent.

As per the head of generation construction office – government regulation had been also a bottleneck in the expansion wind farms in the country which didn't allow private involvement in the energy sector.

4.2 The impact of the challenges on the project progress

The project manager said "main impacts of the challenges" in the project completion are delay and over cost. The cost raise is emerged due to the client's employees were paid salaries and allowances without the contractor performing tangible works on the ground. He also mentioned that the delay of completion time of the project is caused mainly due to revision of design of the wind farm i.e. change of WTG and installation

delay due to high wind speed. Consequently, EEP has lost revenue which would be collected from selling the electricity generated by the plant.

On the other hand, as per the annual energy calculation prepared by DEC which guaranteed, the client has "gained a benefits" due to change of the wind turbine from 1.5 MW to 2.5 MW. The benefits include additional 30 GWhr energy, the supplied WTG is latest in which the spares will be available in the market, and less number of WTG requires less land and less cost of O&M.

4.3 Possible solution taken by the client to overcome the challenges of Aysha-II Wind Project

The major actions taken by the client are presented below as per the interviews made with the Project manager and resident engineer.

Guaranteeing the required annual energy production of the wind farm through negotiations can be considered as the main achievement gained by the action of the client. EEP had also taken immediate action regarding the land compensation issue by conducting meeting with public and resolve the conflict permanently. Although the contractor refused for the project cost reduction requested by client as a reason for the decreased quantity of WTGs (80 to 48); finally DEC agreed to provide one 500 tone crawler crane, to double the spare part quantity and to upgrade the lifting device inside the WTG. Moreover, the client was able to get training for four professionals at the head quarter of the contractor-china without additional cost.

As per the manager - strong warning letter was issued to the contractor to bring him to the right track. The contractor was told to improve site activities with respect quality & time and to work intensively to compensate the time wasted. The client also closely follow up the status of the project. The project manager also added that the client had handled the contractor's time extension request wisely and ends with win-win solution, without terminating the contract.

The resident engineer explained that site activities are being closely followed and meetings held every week to evaluate the performance of the contractor, the contractor is obliged to submit weekly schedule regarding his activities and notifications are provided 3 hours ahead of execution.

4.4 EEP's plans to facilitate the Wind Power Development in Ethiopia

The head of generation construction office explained that EEP is the only organization responsible for bulk electric power generating in the country, hence the key mechanism to encourage the wind power development in Ethiopia would be establishing regulatory framework that permit the private to involve in the business. Now, the Government of Ethiopia has reviewed the energy sector policy in relation to the participation of Independent Power Producers (IPPs) and recently the Parliament ratified the comprehensive Public-Private Partnership (PPP) Proclamation. Likewise, 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.

The EEP's plans to facilitate the wind energy in Ethiopia are summarized as follows.

- ✓ To overcome such challenges EEP will strictly apply the procurement procedures and contractor shall be selected through bid completion process. No more projects will be implemented through MOU.
- ✓ Wind data collecting campaign is already ongoing to prepare wind resource map to have valid wind data for further study.
- ✓ Ethiopian Electric Power (EEP) is working in collaboration with Ethiopian Ministry of Water, Irrigation and Energy (MoWIE), the Ministry of Finance (MoF), the Ethiopian Energy Authority (EEA), the World Bank Group (WBG) and the Danish Energy Agency (DEA) to develop/construct wind farms by the private sector through IPP modality. The first wind tenders will be auctioned for a number of projects with a total capacity of 500 MW.
- ✓ In the future projects, EEP has planned to conduct close stakeholder consultation with the community about projects during site selection and feasibility study and create a platform for participation in the projects.
- ✓ EEP processing to establish IPP-framework for wind power projects.
- ✓ EEP has planned to diversify the generation source which is dominated by hydro, such as geothermal, wind and solar. That is integrated energy source diversification strategy.
- ✓ To establish improved R&D center for conducting research and studies

4.5 Benefit of the Aysha-II Wind Farm Project

According to the explanation during the interviews with the project manager and resident engineer as well as secondary data. The benefits that can gained from the project implementation are presented below.

The basic benefit of the implementation of the Aysha-II wind farm project is the national energy production will be increased and the economy will improve as well. At the same time the energy source of the grid system of the country will be more diversified which is heavily dependent water. The benefits that will be gained from the implementation of the project are explained as follows.

Avoided Emissions: The country will have environmental benefits such as benefits gained through avoidance of carbon gas emissions though installation of the wind farm. Moreover, the generating organization can be beneficial by selling carbon offsets through CDM (Clean Development Mechanism).

Job opportunity: Hundreds of people are employed in the construction activities, particularly the labors and guards recruited from the surrounding communities. So, they are getting additional income. Moreover, the project has civil works such as road and foundation construction which is being done with local resources like cement, gravel and sand, construction machineries; and the works are subcontracted to local contractors. The transportation companies (ESL and inland transporters) are also benefited from the project implementation, transporting equipment to the site.

In addition to the job opportunities, technology transfer and local manufacturing capability will be enhanced. The contractor has signed a contract agreement with MIE (Mesfin Industrial Engineering) to manufacture jointly the tower sections of eight WTGs in Ethiopia for Aysha wind farm. Beyond the financial benefit to the company, this will promote developers to invest in the country.

Avoided Fuel Cost: If we compare the wind farm project with alternative thermal power plant, it will incur high cost of importing fossil fuels. Thermal station would be feasible, if Ethiopia have developed fossil fuel resources.

Energy Savings from Co-generation: The project has benefit of energy savings in terms of water storage through co-generation of wind and hydro power plant. This is approach is valid for countries like Ethiopia which have high portion of hydro power and seasonal storage potentials. The benefit can be calculated by converting the wind energy production to equivalent of water saved in a reservoir of a comparable hydropower plant. Hence, the stored water to be used at a time when wind is low. Theoretically 467 GWhr could be applied to calculate the savings in water.

4.6 Social impact of the project

As per the interview with the local people, there is no visible impact observed yet. They expect that after completion of the project, the educated youngsters will have permanent job. The environmental and social issue of the project are considered as negligible and the site is characterized by:

- Hardly any vegetation
- Less population, mainly engaged in animal husbandry
- Protected sites and archaeological regions are out of the area
- There are no permanent settlements
- No migratory birds
- No habitat at the site which is arid land.

However, the project stakeholders (project office, contractor and local administration and health offices) are working on the control of spread of STD during construction period. The contractor is providing random health education including free condoms to the site workers. One nurse is available at the site.

Before closing the project, the contractor will construct infrastructure like school, potable water and clinic to the local community.

In addition to the above presentation, analysis and interpretation, the matrix format is presented below.

Key information group	Question 1: Challenges encountered	Question 2: Impact of the challenges	Question 3: Benefit of the project
Head of Generation Construction office	➢ EEP financial constraint ➢ Inconsistent and ineffective implementation of regulations ➢ Energy production & selling are still seized by government ➢ High initial investment		
Project manager of Aysha wind farm project	➢ Land compensation issue ➢ Delay of consent from MoF and EXIM bank on the design change	➢ Revenue loss ➢ Contract agreement ➢ Additional 30 GWhr energy ➢ The supplied WTG decreased from 80 to 48, so less land consumed and less O&M cost.	➢ Avoided Emissions ➢ Increasing energy generation capacity of the country and generation mix ➢ Economic development

Resident Engineer	➢ Contract award process not through tender competition ➢ Annual energy production of the plant issue ➢ Wind data accuracy problem	➢ Project completion delay and over cost	➢ Income and technology transfer to the local contractors ➢ Energy Savings from Co-generation, Avoided Fuel Cost ➢ Construction of infrastructure like school, potable water and clinic to the local community
Design review team	➢ Submission of design document		
Project Contract Administration team	➢ Marine transportation of materials and equipment delay was occurred ➢ Liquidated damage issue requested by EEP		
Construction Supervision team	➢ High wind speed and temperature at the site avert the site work ➢ Cement supply delay ➢ Unwilling to take corrective as client's recommendation		
Local people	➢ No major impact observed due to presence of the project		➢ Additional income generation through job opportunity

Table-3: Matrix analysis

As per the discussion with the professionals at the site, the challenges are classified as major and moderate. A total of 15 challenges (5 technical, 5 economic, 3 political and 1 social) are identified. “Financial constraint of the Client”, “site condition: high wind and temperature”, “Wind data accuracy problem”, “transportation and supply delays” are as the most significant challenges. The others are considered as moderate.

The impacts occurred in the project are identified and can be grouped in to two: positive impact due to the design change and negative impact caused by the other challenges mentioned above. The positive impact includes “additional 30 GWhr energy” and quantity of WTG decreases “less land consumed and less O&M cost”. Moreover, seven benefits are identified.

4.7 Analysis of the Aysha-II wind farm project performance using Earned Value Analysis (EVA)

Construction industries are facing challenges day by day. Among all these challenges it is very crucial to improve the performance of a project with respect to Schedule and Cost. Earned Value Analysis is an important tool in analyzing the performance of any construction project. It measures the project progress and helps in identifying the critical activities thereby bringing the project on schedule (Sandhya and Ganapathy, 2015).

Taking in to account that the contract type of the project is EPC/ turnkey with fixed project cost, there will not be cost variation in the contract agreement. However, the client will face over budget due to additional expense to its employees as the completion time is extended. Thus, this analysis is concerned with the activities executed by the contractor at the site and services like provision of O&M training, technical support during warranty period, supply of tools and spare parts and factory test witness are not included in the project activities.

a) Considerations of the analysis

The project was expected to be completed by August 2019. However, during conducting this study the following works have been performed by the contractor.

- Only set of 8 WTG equipment out of 48 were arrived on site.

- Preliminary civil works were completed.
- Foundation of 27 WTGs were completed.
- Substation civil work were completed.
- Construction of permanent camp not started yet.
- The other works were under progress.

Using the formulas SV= EV – PV and SPI = EV/PV, the performance indicators are calculated with respect to the site work activities as follows.

Major Activities	Planned Value (PV)	Earned Value (EV)	SV	SPI
Equipment supply from Workshop to Djibouti port(including insurance)	192,182,420	40,745,809	-151,436,611	0.21
Inland transportation from Djibouti port to project site	9,870,500	2,545,083	-7,325,417	0.26
WTG equipment installation	12,779,500	1,597,437	-11,182,062	0.13
Preliminary site works and civil work at substation	7,144,415	7,144,415	0.00	1.00
WTG & transformer foundation	20,978,349	11,800,321	-9,178,028	0.56
Facilities supplied to Employer, including permanent camp	1,290,600	924,560	-366,040	0.72

Table-4: Earned Value Analysis

Remark: all costs are in USD. (Source: contract document and project progress report of Aysha wind farm project)

b) Analysis

Schedule Variance (SV) = EV – PV; Negative means behind schedule, Positive means ahead of schedule and zero means on schedule. **Schedule Performance Index (SPI) = EV / PV**; less than 1 means behind schedule, greater than 1 means ahead of schedule and 1 means on schedule.

Therefore, the schedule analysis of the Aysha-II wind farm project (table-4) shows that except the preliminary civil works on schedule, the other progressing activities are behind schedule with a value of negative SV and value of SPI less than 1. The SPI result show the activities are progressing below 100% of what was originally planned. For example: the WTG equipment installation is at 13% of what was originally planned. In overall, we can conclude that the project is behind schedule and time extension request by the contractor is expected to be applied.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of the findings

This research project is set out to assess the challenges encountered in the implementation of Aysha-II wind farm project. Wind farms are being considered as a viable option of providing electricity. The following benefits can be obtained from wind farm projects:

- Wind farms do not cause any pollution during electricity production.
- They create job opportunity to citizens, local contractors, raw material suppliers,
- It plays a big role in addressing energy mix problem.
- In some countries like Ethiopia the project provides additional benefits like school, potable water and clinic to the local community.
- The project will play an important role in increasing the power generating capacity of the country and meeting generation mix policy of the government.

The challenges in the implementation of Aysha-II wind farm project and their impacts are summarized as follows:

- From archival reports and interviews, major challenges faced in the implementation of Aysha-II wind farm project are financial constraint of the Client, high wind and temperature, wind data accuracy problem, transportation and supply delays. These challenges have major impact on the project cost and schedule.

- The client doesn't have technically trained professionals on wind power technology to be able to properly supervise the contractor's site works.

- Sub-contractor's insufficient experience, financial problem, shortage of hard currency, client's delay of advance payment to the contractor and contractor's problems in assigning its site staff.

- Site works have been delayed due to high wind speed, high temperature and problem of delivering equipment on time to the site.

- Absence of accurate or complete wind data has hindered the process of selection of the appropriate wind turbine type and cause error estimation in annual energy production of the wind farm.

- The restricted regulatory of Ethiopian Shipping Line on transportation (on sea, ESL) affects the on time arrival of equipment and materials for the project.

- As per the EMV (Earned Value Management) analysis, the project is behind the schedule and cost overrun which was expected to start generation of 120 MW electric power by August 2019.

- The wind farm's design was changed due to annual energy issue i.e. 1.5MW replaced by 2.5 MW. Consequently, quantity of WTG decreased from 80 to 48.

5.2 Conclusion

The following are the conclusions drawn from the findings of the study:

- The main challenges have been identified in response to the objective of the research. As per the discussion and interviews 15 challenges are identified and categorized in to technical, financial, social and political challenges. As per their weight of impact the challenges like financial constraint of the Client, site condition barrier (high wind and temperature), and Wind data accuracy problem, transportation and supply delays are as the most significant challenges. The others are considered as moderate impact.

- As per the interviews made and documents referred, the impacts of the challenges on the project progress are resulted in overschedule, cost overrun and income loss.

- From the secondary data and interview question it is clear that there is schedule delay in which the completion of the project was expected in August 2019. However, up to date only 27 WTG foundations, erection of 6 WTGs are completed and electromechanical installation at the substation is ongoing.

- With regard to the benefits of the project: the project will insure the economy development of the country by increasing generating capacity by 120 MW.

- Although the project is delayed due to design change, EEP has obtained additional 30 GWhr energy without cost variation as per the contractor's proposal.

- Due to the challenges the project couldn't completed yet and second time extension is expected to be applied which will be counted starting end of August 2019. Consequently, EEP lost revenue.

5.3 Recommendations

Based on the research findings, recommendations are forwarded below to the client in effort it would help to mitigate challenges encountered in the Aysha-II wind farm project and for the future wind farm projects as well.

- ✓ The project implementation office should identify all the challenges and prioritize them according to their impact then organize corrective actions on time. This will enable to avoid further delay of the project.

- ✓ There has to be provision of continuous capacity building training for EEP's professionals to overcome technical incapability challenge occurred in Aysha-II wind farm project and in order to establish competent consultant team for future projects.

- ✓ Regarding the contract award, it should be mandatory that the procurement process comply with international technical standards and EEP's procurement guideline. Also, national standards for wind turbine generator systems shall be developed by adopting the international standards.

- ✓ The issue of project delay should be discussed with the contractor and addressed at most urgency and defected works shall be identified and corrected without cost variation.

- ✓ There has to be wind speed forecast technology to schedule WTG erection works accordingly.

- ✓ The economic benefit of the Aysha community should be reserved after completion of the project through involvement in the O&M works.

Additionally, awareness on the wind farm has to be created so that the community will develop ownership spirits and the plant will be save.

- ✓ It is highly recommended that Ethiopian Electric Power to enhance project finances for the future and should make available the data needed to assess the size of local wind resources.

- ✓ In order to minimize such huge delay, the factors like technical, financial, social and political should be assessed adequately during appraisal of wind farms.

- ✓ The project office/EEP should also consider the experiences of other projects such as Ashegoda and Adama wind farms "what challenges were faced?" and "how they were handled?, i.e. corrective actions taken ".

5.4 Suggestions for Further Research

This study directly focused on the assessment of challenges encountered in the implementation of Aysha-II wind farm project. Therefore, this study can be improved further to assess the impact of challenges faced in the construction of other wind farm projects in Ethiopia which are characterized with more complicated challenges. Future researches can be also conducted on the IPP/PPP wind projects as the government has decided to amend its regulation and allow the private investors to take part in the power generation market in order to achieve the country's aggressive power demand.

Other areas of renewable energy projects such as solar, hydro and geothermal should be studied as these could help the Government to expand generation mix and to achieve energy generation targets in a sustainable way.

References

Abaka, J., Iortyer, H., Ibraheem, B., Salmanu, H. and Olokede, O. (2017). Prospect and Challenges of Renewable Energy Resources Exploration, Exploitation and Development in Africa. International Journal of Engineering Research and Development, [online], Available at: www.ijerd.com [Accessed 23 Jun. 2019].

Abdulrahman, B. and Oluwasoye, P. (2016). Project Management Practice: Redefining Theoretical Challenges in the 21st Century. Journal of Economics and Sustainable Development, [online] Volume 7, p. 8. Available at: www.iiste.org [Accessed 14 Aug. 2019].

Alli, D., Emelly, M., Yannis, A. and Thouraya, T. (2012). Development of Wind Energy in Africa. Tunis: African Development Bank.

Blechinger, P., Katharina, R. and Ortwin, R. (2015). Barriers and Solutions to the Development of Renewable Energy Technologies in the Caribbean. Switzerland: Springer International Publishing.

Cornelis, G. and Timilsina, G. (2009). Wind Power Development Economics and Policies. Washington, DC: World Bank.

Creswell, J. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. 4th ed. London: SAGE Publications Ltd.

DANIDA (2016). Accelerating Wind Power Generation in Ethiopia. Addis Ababa: Royal Danish Embassy, p.49.

Dawit, D. (2015). Energy security, uncertainty, and energy resource use option in Ethiopia, [online] Available at: http://hdl.handle.net/10419/121259

Dereje, D. (2013). Ethiopia's Renewable Energy Power Potential and Development Opportunities. Addis Ababa: Ministry of Water and Energy.

Ethiopian Electric Power, (2016). Co/33.20/68/08 - EPC/t Contract agreement for construction of Aysha-II wind farm project. Addis Ababa: EEP, pp.145.

Ethiopian Electric Power, (2017). Assela wind farm feasibility study project. Addis Ababa: EEP, pp.192.

Ethiopian Electric Power, (2017). Co/33.20/97/10-Contract amendment No.-1 of Aysha-II wind farm project. Addis Ababa: EEP, pp.98.

Ethiopian Electric Power, (2018). Annual Report 2017/18. Addis Ababa: EEP, pp.23.

Ethiopian Electric Power, (2019). Aysha wind farm progress report May 2019. Addis Ababa: EEP, pp.17.

Eugene, C., Peter, B., Peter, C. and JosVan, H. (2017). Failures and generic recommendations towards the sustainable management of renewable energy projects in Sub-Saharan Africa. Netherlands: Elsevier Ltd

Fortune, G. and Collins, C. (2014). Problems of Sustainable Energy in sub-Saharan Africa and Possible Solutions. Mediterranean Journal of Social Sciences, 5(6), pp. 454-459.

German Association of Consulting Engineers-IZA, (2019). Renewable Energy. [online] Available at: https://www.vbi.de/english/ [Accessed 11 Jun. 2019].

IFPRI, (2018). Ethiopia Strategy Support program. [online] Available at: https://essp.ifpri.info/ [Accessed 8 Jun. 2019].

INTERACT, (2014). Project Management Handbook. European Regional Development Fund (ERDF)

IREN21, (2014). With Developing World's Policy Support, Global Renewable Energy. [online] Available at: http://www.ren21.net/gsr [Accessed 11 Jun. 2019].

IRENA, (2016). Wind Power Technology Brief. [online] Available at: http://www.iea-etsap.org/Energy_Technologies/Energy_Supply.asp [Accessed 11 Jun. 2019].

Jianzhong, X., Albina, A. and Vasilii, E. (2018). Renewable Energy and Sustainable Development in a Resource-Abundant Country: Challenges of Wind Power Generation in Kazakhstan. Journal of Energy Development, [online], p.21. Available at: www.mdpi.com/journal/sustainability [accessed 29 June. 2019].

Kaygusuz, K. (2004). Wind Energy: Progress and Potential. Turkey: Karadeniz Technical University.

Kirsi, H. (2017). Project Management Handbook. [pdf] Finland: Laurea. Available at: https://www.researchgate.net/publication/320101542 [Accessed 25 Jul. 2019].

Mayring, P. (2014). Qualitative content analysis: theoretical foundation, basic procedures and software solution. [online] Available at: URN: http://nbn-resolving.de/urn:nbn:de:0168-ssoar-395173 [Accessed 25 Jul. 2019].

Ministry of Water and Energy, (2012). Scaling - Up Renewable Energy Program Ethiopia Investment Plan. Addis Ababa: Ministry of Water and Energy.

Mondal, A., Elizabeth, B., Claudia, R., Dawit, M. and Mark, R. (2018). Ethiopian energy status and demand scenarios: Prospects to improve energy efficiency and mitigate GHG emissions. Journal of International Food Policy Research Institute, [online], Available at: www.elsevier.com/locate/energy [Accessed 13 Jul. 2019].

Mulu, B. (2013). Hybrid Solar – Wind – Diesel Systems for Rural Application in North Ethiopia: Case Study for Three Rural Villages using HOMER Simulation, [online] Available at: https://www.researchgate.net/publication/280521443 [Accessed 25 Jul. 2019].

Nathaniel, W. (2014). How wind turbines are not generating green energy: An economic review of the Ontario Green Energy and Green Economy Act. Journal of RE, volume (2), pp. 3-8.

Nicholas, W. (2011). Research methods. USA and Canada: Routledge, pp.143-160.

Nicola, B. and Lorenzo, C. (2018). Financing Energy Access in Sub-Saharan Africa. Italy: Istituto Affari Internazionali.

NREL, (2001). Policies to support wind power deployment. U.S.A: U.S. Department of Energy and the Australian Government Office of Industry and Science.

NREL, (2015). Policies to support wind power deployment. U.S.A: U.S. Department of Energy and the Australian Government Office of Industry and Science.

Sandhya, S. and Ganapathy, R. (2015). Analysis of Project Performance Using Earned Value Analysis. Journal of Science, Engineering and Technology Research, [online] Available at: https://www.researchgate.net/publication/313180605 [Accessed 16 Sep. 2019].

Sreekumar, A. (2015). Best Practices and Implementation Challenges in Effective Project Management. Journal of Economics and Sustainable Development, [online] Available at: https://www.researchgate.net/publication/276059340 [Accessed 12 Aug. 2019].

Tadesse, A., Zakaria, D. and Zoubeir, L. (2016). Assessment on Performance and Challenges of Ethiopian Construction Industry. Journal of Architecture and Civil Engineering, [online] Available at: www.questjournals.org [Accessed 8 Jun. 2019].

Tewelde, B. (2012). Scaling –Up Renewable Energy Program Ethiopia Investment Plan. Addis Ababa: Ministry of Water and Energy.

Victoria, G., Kathrin, W., Lea, B., María, E. and Johann, K. (2014). Wind of Challenges: Implementation factors regarding wind energy development, an international perspective. AIMS Energy, 2(4), pp. 485-504.

Zankoul, E. and Khoury, H. (2014). Simulation of On-Shore Wind Farm Construction Process in Lebanon. Lebanon: Emile Zankoul, Pp.4-5.

ANNEXES

I. INTERVIEW QUESTIONS

A. Interview Questions to the Head of Generation Construction office about EEP and wind projects

1. Can you give us a brief description of your organization, EEP?
2. What is the history wind farm in Ethiopia?
3. What is the wind potential of Ethiopia?
4. What is your organization's plan to increase wind farm construction in the country, Ethiopia?
5. Finance resource for wind farm projects?
6. What are challenges faced in the implementation of the Government's strategy in renewable energy?

B. Interview Questions to the Project manager of Aysha-II Wind Farm and to the Resident Engineer (consultant): EEP-Engineering Office

1. Can you give us brief description of the EEP-Engineering office?
2. Can you explain briefly the Aysha-II Wind Farm Project (feasibility study and construction phase)?
3. How was the procurement process of the Aysha-II Wind Farm project?
4. What is the benefit of implementation of the project?
5. The finance resource for Aysha-II Wind Farm Project?
6. What are the main challenges encountered in the implementation of Aysha-II wind farm project?
7. What corrective actions taken by the client/consultant?
8. What is the effect of the challenges in the project progress?
9. How is the involvement of local companies in the project?
10. Is there mechanism established for technology and knowledge transfer to the local people form the contractor?

C. Interview Questions to the project supervision team and contract administration team

1. The main challenges occurred in the implementation of the project?

2. As per your observation, what are the contractual challenges faced?
3. How is the site work performance of the contractor?
4. How you handle disputes with the contractor, if any?

D. Interview Questions to local community, Aysha town

1. What impact did you observe due to the implementation of Aysha-II wind farm project?
2. What is your reaction to the implementation of Aysha-II wind farm project?
3. Any suggestion about the project?

II. CONTRACTUAL DATA OF AYSHA-II WIND FARM PROJECT

Scope:	EPC-project
Client:	EEP
Consultant:	EEP-Engineering office
Contractor:	DEC
Financer/lender	EXIM Bank of China
Contract number:	CO/33.20/68/08
Contract Signing Date:	15th January 2016
Contract Commencement Date:	25th February 2017
Contract Price Contract:	257,285,160 USD
Completion time:	18 months