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Status of Ethiopian Geothermal Sector Regulatory Body and Current Development

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ABSTRACT

Ethiopian Energy Authority (EEA), a government regulatory body under the Ministry of Water, Irrigation and Energy (MoWIE), was given full jurisdictions in regulating the geothermal resource licensing and administration activities in accordance to the Geothermal Resource Development Proclamation No. 981/2016. EEA's responsibilities also include reviewing and recommending grid-connected tariffs to the government for approval and approval of off-grid tariffs, auditing energy efficiency programs, labeling energy efficient products and reviewing and approval of Power Purchase Agreements (PPA) and Implementation Agreements (IA).

Geothermal energy in Ethiopia is now a top priority, which the government has given a significant emphasis and committed resources to the sector. As geothermal energy development and use become more prominently recognized in today's renewable energy landscape, the government of Ethiopia has clearly identified as main source of energy next to the hydropower.

Although Ethiopia is well engaged with geothermal resources development, currently conducted exploration work is believed to have studied only a fraction of the ultimate potential. While activities in geothermal exploration started earlier than 1998 with small geothermal power plant, the focus on geothermal activity is relatively new, and as such, the legal and institutional structures, as well as technical capacity building are under development.

The geothermal resource licensing previously was handled by the Ministry of Mines, Petroleum and Natural Gas (MoMPNG) and considered as a mineral before the issuance of the Geothermal Resource Development Proclamation is issued on September 16th, 2016. Consequently, the EEA has established the Geothermal Resource Development License Administration Directorate (GRDLAD) for the issuance and administration of geothermal licenses with the capacity to develop the directives and to manage the licensing process for geothermal resources (indirect and direct use) and administer the existing and new licenses which will be granted in accordance to the Proclamation and regulation and directives issued hereunder. Following the change of government in 1991, a stable political and economic condition has been introduced and issued energy law and this created conducive investment environment. As a result, a significant number of local and foreign investors have shown interests to invest in Ethiopia.

To this effect, the formulation of the energy legal framework including geothermal further amplified the involvement of the IPP's in the geothermal sector. In this regard, the current development of the regulatory body is fascinating.

1. INTRODUCTION

Ethiopia's energy policy framework identifies hydropower development as the backbone of the country's energy sector development. Geothermal, wind and solar along with hydrocarbon fuels and biofuels are also elements of the policy framework, along with energy efficiency and conservation, environmental sustainability and capacity building. The main objectives of Ethiopia's climate resilient and green economy strategy include improving the leaving condition of the people reducing the adverse effects of climate change.

Ethiopia has experienced substantial growth in the past ten to fifteen years and is poised to be leading economy in the sub-Saharan African regions. Ethiopia has developed its five years Growth and Transformation Plan (GTP) from 2010 up to 2015 and GTP II from 2016 up to 2020 to drive economic progress through strengthening the country's agricultural, industrial, and financial sectors to address the Sustainable Development Goals (SDE) and propel Ethiopia from low-income to a middle income country by 2025. Through the second Growth and Transformation Plan (GTP II), the Government of Ethiopia (GoE) seeks to increase installed generation capacity from 2,300 MW as of 2016 to over 17,000 MW by 2020, and of reaching an overall potential capacity of 35,000 MW by 2037. The Government of Ethiopia has determined that private sector investment is critical to achieving these ambitious generation targets although the Independent Power Producers (IPPs) are new to Ethiopia.

To drive progress towards national energy access targets and reduce overdependence on hydropower for electricity generation, the Government of Ethiopia has begun to prioritize the development of other types of renewable energy resources primarily geothermal energy resource. The legal and institutional structures governing geothermal development are now taking shape. The existing legal framework includes the 2013 Energy Proclamation, the 2016 Geothermal Resource Development Proclamation, the 2018 Energy (Amendment) Proclamation, the 2018 Public Private Partnership Proclamation and the 2019 Energy Operations Regulation. The Draft Geothermal Resource Development Regulations is already approved by Ministry of Council and is in the verge of publishing. Once the geothermal regulation is published, the legal framework will play a critical role as they will more fully establish the power and responsibilities of the Licensing Authority.

Regarding the institutional framework, at the moment, Ministry of Water, Irrigation and Energy (MoWIE) plans, coordinates and monitors the overall energy development. Other Ethiopian government institutions involved in the energy development affiliated to MoWIE, including Ethiopian Electric Power (EEP), which is responsible for generation and transmission; Ethiopian Electric Utility (EEU), which is responsible for distribution and sales; and Ethiopian Energy Authority, which is the regulatory body for electric sector and energy efficiency and conservation. Other ministries and agencies involved in geothermal planning and operation include

the Ministry of Mines and Natural Gas (MoMNG), Geological Survey of Ethiopia (GSE), and Energy Bureaus of the National Regional States.

2. BACKGROUND

It is evident that commercial energy service has to be regulated and in area where energy resource is not commercially supplied a market infrastructure has to be created to bring such resources to a point where it can lend itself to regulatory measures. Accordingly, to institute business confidence, commercial sustainability, and investment fund, increase service coverage, competent and quality energy services, independent, transparent, impartial energy sector regulator will be required. Sector institutions working in areas that affect the energy sector needs to be closely coordinated with in federal and state levels.

If sustainable economic activities are to be realized, a gradual transition to modern energy systems, which may utilize traditional energy sources, must be achieved. Energy is an economic commodity; therefore, it should be treated like any other commodity using development policy instruments. In particular, it should be subject to the same rational analysis, and closely coordinated with the other policy tools available to the government to meet national development objectives and goals. The need for such coordination has already been articulated in various development policies.

Accordingly, the government has stipulated a vision of developing the Energy sector which is anchored on major directions. These are few as set out in various government development policy and strategy papers. These highlights are presented below.

- Provide efficient, reliable and economical energy supply through the maximum utilization of the country's renewable energy, such as hydro and geothermal power potential;
- Introduce commercial principle in public energy utilities;
- Guarantee commercial energy tariff for regulated energy service providers;
- Build human capacity to sustain necessary knowledge and skill in the study, construction, commissioning and operation of energy projects;
- Restructure public energy utilities to enhance management autonomy, performance excellence and customer care;
- Avail competitive power supply to the economy to enhance the economy’s competitive advantage;
- Affect broader service coverage in urban and rural and deep rural economic settings through appropriate technology financial support;
- Support regional energy trade via inter-connection focusing on export;
- Enhance local material input and engineering service supply;
- Promote the role of the private sector in the energy sector.

These are indeed demanding tasks and requires dynamic management of the multi sector strategic commodity; energy. It is therefore imperative to reexamine the performance of the existing energy policy vis-à-vis developments in all the economic sectors in general and in the energy sector in particular. This should be done in attempting to formulate compatible governance of the energy sector, while taking regulation not the end, but a means to develop the sector. Fundamental questions like where and how energy sector regulation fits, under what policy and policy instruments, institutional responsibility, and coordination across relevant federal and regional institutes directly responsible in the development and regulation of the sector, the role of utility regulation at federal and state level, how and when to develop state level utility regulation. It must be emphasized that the nature of energy itself bring about many players that affects its’ up and down stream business stream. While each relevant regulatory institute exercises its own authority under its jurisdiction should also address the sector wide policy objectives.

3. STRENGTH AND WEAKNESS OF THE ENERGY REGULATORY SECTOR

3.1 Strength

Previous power sector reform efforts have brought about some changes in areas related to establishing the regulatory entity and providing mandates to regulate the sector though there have been short comings when it comes to executing those mandates. Subsequently in an attempt to resolve these and other issues, efforts made to develop and revise the established law and as a result comprehensive legal frame work to regulate the electric sector which includes the geothermal resource that was previously governed by the mining legal framework considered as one of mineral commodity to have its own proclamation and regulation. The energy legal framework also covers energy efficiency and conservation regulatory services to the utilities, the general public and the customers, there is an established competency and trade certification processes to protect customers which has in some degree instituted the need for professionalism in the field, better realization by the utilities of the compliance needs in the business and technical operation, better test and demand is coming in the market for geothermal sector, energy efficiency and conservation, market for energy efficiency & conservation, geothermal competency certification for the professionals and technical services and products is gradually coming in to play. The other strength is with the establishment of geothermal legal framework incompliance with international standard has attracted the foreign investment to the sector.

3.2 Weakness

Despite a number of attempts over the year to update the existing energy policy issued in 1994, still left unrevised most probably due to inadequate connection of the complex issues of the sector with the political structure. This presumably indicates the relatively inadequate capability built in this function to analyze investigate justify policy issues and presenting policy options to win the confidence of the political governance.

As for investment sources, the sector has been dominated by public investment and a blend of concessional and some commercial loans as well. The three cycles of the power sector reform which began in early 90s starting with corporatization, commercialization and decentralization resulted in re-establishment the Utility as public business corporation with management unbundling under vertical integration but liberalized power generation and off-grid supply. A separate regulatory has been established with the promulgation of the electricity law and electricity operation regulation. The electricity pricing methodology has been defined in these instruments and subsequent directives defining commercial tariff for all commercial services. The second round of the reform in 2009 to 2016 actually unbundled power generation and transmission business as one utility and power distribution and sales business as another utility. Further horizontal management unbundling power distribution and sales business along with the political boundaries of the regional states however with greater administrative autonomy is recently implemented. Further automation of the basic functions and sales business is currently in progress. This however has not changed the ownership structure and the incremental liberalization in power generation in the grid. Similarly, off-grid supply business continued to be liberalized as before. As indicted in the PPP law competitive procurement process is further defined and institutionalized.

While these measures were introduced in anticipation of Foreign Direct Investment in the sector under a single buyer model, however over the years much has not been achieved. The policy preference to commercially develop renewable energy technologies which bear typical characteristics that may not easily lend itself to a type of commercial financing has played its own part on top of other issues related to overall macro-economic performance. The definition of the single buyer model itself which is the vertically integrated utility (before unbundling of Generation and Transmission assets) as an off taker and now after unbundling the generation and transmission company, which has provided little incentives for the off taker to buy from the private generator.

4. ENERGY REGULATORY BODY-ETHIOPIAN ENERGY AUTHORITY (EEA)

Although Ethiopia is endowed with abundant renewable energy resources and has a potential to generate over 60,000 megawatts (MW) of electric power from hydroelectric, wind, solar and geothermal resources, currently it is only has approximately 4,300 MW of installed generation capacity from different energy resource to serve a population of over 104 million people. The current GTP has a target to increase generation capacity to over 17,000 MW by 2020, with an overall potential of 35,000 MW by 2037, which would help sustain Ethiopia's continued economic growth.

Source of Energy	Existing Capacity (MW)	(%)	Target Capacity for 2020 (MW)	Target Capacity for 2030 (MW)	Ongoing Projects (MW)	
					Under Construction	Under Preparation
Hydropower	3,810	88.94	13,817	20,200	8,804	2,280
Geothermal	**7**	**0.16**	**577**	**3,500**	**70**	**1,000 (PPA & IA signed)**
Solar	0	0	300	3,000		100 (auctioned) 450 (EOI)
Wind	324	7.56	1,224	2,500	120	Multiple Project Preparation
Nuclear	0	0	0	2,000		
Waste to Energy	25	0.58	0	300		
Other Sources	118	2.75	1,290	1,580	170	
Total	**4284**		**17,208**	**33,080**	**9,164**	**3,830**

Table 1: Existing Capacity and Future Direction of Energy Mix

The EEA, as a regulatory body has the authority to review and recommend grid-connected tariffs to the government for approval and has the authority to approve off-grid tariffs. With the goal of moving towards a carbon neutral economy and create more sustainable energy future, the GoE has prioritized energy efficiency as a policy goal. The EEA is mandated through the 2013 Energy Proclamation to design, implement and oversee energy efficiency programs throughout the nation. It is also responsible for providing licenses, auditing energy efficiency programs and labeling energy efficient products. Other essential functions include the review and approval of Power Purchase Agreements (PPAs) and Implementation Agreements (IAs). In this respect, the Authority has major challenges like setting and reforming of tariffs to allow for full-cost recovery, high power using industries and households usage of backdated technology which lead to inefficient energy use and high losses of energy and delivery of more power to the majority of the population living off-grid. The majority of the problem is accountable to the capacity of the qualified personnel and production of skills and training of the human resources in the energy sector due to lack of a fully equipped and comfortable training center.

In addition to above mentioned responsibilities and mandates, the Ethiopia Energy Authority is mandated the licensing and administration of the geothermal resources by the new Geothermal Resource Development Proclamation 981/2016. The development of geothermal resources requires a group of highly skilled specialists from a number of disciplines of science and engineering. Because of its diversity, geothermal energy has not been taught as a common subject at universities. The training of geothermal specialists has mainly taken place on-the-job within companies and institutions like in our case from Ethiopian Geological Survey, Ministry of Mines and Natural Gas and companies who are working in mineral exploration and development. The Authority is trying to capacitate with competent staffs, by restoring the high turnover rates of professional staffs which significantly limiting the ability

of the Authority to build and maintain a sustainable institution and execute its expected responsibilities by establishing regular training opportunities for staff and/or structured mentoring for newer staff. The activities conducted by the Authority in accordance to the existing legal framework are presents as follows.

4.1 Licensing & Economic Regulation and Certification

As per the Ethiopia Energy Proclamation No. 810/2013 and the Investment Proclamation No. 769, the EEA is responsible for issuing and renewing licenses (generation, transmission and distribution) in accordance with the proclamation, supervising the operations of licensees and collecting fees for the issuance and renewal of licensees. The Authority has to appropriately review all studies and documentation submitted by the licensee and approve accordingly on time. Compliance and monitoring work have been conducted on the licenses and the licensees are subject to reporting every year once a project is completed. There is capacity, ability and availability limits of staffs to effectively monitor licensees. The Authority also has full mandate to review and approve off-grid tariffs and is responsible for developing the guidelines associated with licensing for IPPs. Different types Electrical construction and consultancy services, inspection services, energy auditing, energy efficiency laboratory testing and others have to be carried out by competent persons in order to ensure public safety and supply reliability. Therefore, EEA issues certification of professionals and business entities at all level and nationwide is a mandatory requirement.

4.2 Tariff Review and PPA and IA Approval

The EEA has full legal authority over tariff setting. The Authority review and recommend grid connected tariffs to the Ministry of Water, Irrigation and Energy (MoWIE) and to approve off-grid tariffs. Without the EEA's full authority to approve grid connected tariffs, electricity tariffs are subject to non-commercial issues that affect its ability to generate sufficient revenue to maintain commercially viable utilities. As stated in the Energy Proclamation, the tariff should be reviewed annually and revised every four years. Upon the submission of the utility's rate filing, there is a 120-day review process before the EEA accepts and makes a recommendation to the MoWIE. Prior to the utility tariff filing, utilities engage with the EEA for clarifying questions. Tariff review is conducted by senior management and staffs. The Authority also has final approval over PPAs and IAs.

4.3 Energy Efficiency (EE) and Conservation

In accordance with the Energy Proclamation, the EEA is responsible for developing a national Energy Efficiency (EE) strategy and program, promoting energy efficiency and conservation, developing an energy audit code, a labeling code, a grid code and other technical codes. They are also responsible for overseeing the Energy Efficiency Fund (EEF) and approving EE Fund trust agent and loans from the Fund. The concept of energy efficiency is new within Ethiopia and requires significant sensitization of essential energy stakeholders such as the Ministry, utilities and public. The Ethiopia Energy Proclamation outlines several EE goals; however, the legal regulatory frameworks lag. The EEA plays an active role in EE programs, prioritizing energy efficiency expansion through domestic and industrial customers as opposed to traditional utility driven energy efficiency programs. Successful utility driven EE efforts have included a 2012 lighting initiative to change out incandescent lamps for CFLs in which utilities were able to save 100MW.

4.4 Energy Audit Works

The EEA are currently conducting energy efficiency audits for energy intensive industries such as cement and iron melting. Initially, companies were apprehensive about energy efficiency audits, but upon realization of the energy savings potential they have requested audits in the future. The EEA is working with companies to encourage them to establish energy departments that monitor and analyze energy usage patterns and evaluate mechanisms to improve efficiencies. Commercialization will require a thorough market analysis and increased awareness on the value of energy efficiency to ensure that energy efficiency auditing is viewed as a valuable service to customers

4.4 Standards and Labeling

The EEA is working to develop standards for energy intensive appliances such as electric injera mitades, stoves, washing machines, rice cooker and other electric materials that are responsible for creating the majority of the peak demand. We are also working in labeling of these materials and monitoring non-conforming imports. For this and other purposes, the Authority started strengthening of its capacity in establishment of energy efficiency testing laboratory. Procurement of tools and working facilities are started with other projects to strengthening electrical workshops for assessment and certification of professionals and equipment.

4.4 Geothermal Resource Development Licensing and Administration

The Ethiopian Geothermal Resource Development Proclamation No 981/2016 was issued giving the EEA the sole responsibility of issuing and administrating geothermal exploration, operational and other licenses which was previously governed by Mining Operation Proclamation No. 678/2010 under the Ministry of Mines and Natural Gas. In addition, the EEA is responsible for designating geothermal resource areas and issuing certificates of professional competency for geothermal consultancy services and technical work in the sector. To support this new mandate the EEA has recently established a Geothermal Resource Development Licensing and Administration Directorate within the authority.

The development of geothermal resources requires a group of highly skilled specialists from a number of disciplines of science and engineering. Because of its diversity, it is hard to get geothermal experts from the market. The one's who is specialized in the geothermal fields are already occupied by private companies and hard to compete with them and bring to the regulatory body. Due to these reasons, we are trying to hire professionals who were working in the mineral and other related sectors and give training on-the-job and/or try to find training opportunity in the likes of Africa Geothermal Center of Excellence (AGCE), JICA and UNU. As geothermal resource regulatory body, we have lack of scientists and engineers specialized in Geothermal Project Management, geological exploration, borehole geology, geophysical exploration, borehole geophysics, reservoir engineering, chemistry of thermal fluids, environmental science, geothermal utilization, drilling technology, certification of professionals and business entities and Geothermal Cadastral Management System to manage and effectively implement its objectives.

Although activities in geothermal exploration started earlier than 1998 with small geothermal power plants, the focus on geothermal activity is relatively new, and as such, the legal and institutional structures, as well as technical capacity building are under development. The large geothermal potential the country is endowed with and with a view to expediting the development of this resource targeting for base load supply not only to the national market but equally for the regional market as well. Licensing process and corresponding organizational structure is being implemented however human capacity development is largely required to effectively execute this responsibility. The new directorate formed by EEA has to have a capacity to develop the directives and to manage the licensing process for geothermal resources (indirect and direct use) and administer the existing and new licenses which will be granted in accordance to the Proclamation and Regulation.

5. VALUES AND BARRIERS OF GEOTHERMAL ENERGY IN ETHIOPIA

5.1 Values of Geothermal Energy

Because of the population and economic growth of the country, the demand for electricity is expected to rise. The population of Ethiopia at the moment is believed to be about 104 million and expected increase to more than 120 million by 2025. Per capita gross domestic product must increase from USD 380 to USD 1000 in order for Ethiopia to reach middle-income status by 2025, as set forth in the current Growth and Transformation Plan (GTP), and increasing Ethiopians' access to modern electricity services is a key pillar in driving economic growth. The country's power supply must increase correspondingly, and the power system expansion plan projects generation capacity has to increase dramatically from the current 4,300 MW installed generation to achieve the development goal.

The country has to diversify its power generation sources to protect against climate change and drought to compensate the power interruption which is happening now due to seasonal hydro power variation. At the moment, more than 95% of the country's electric power is generated from hydroelectric plants. This exposed the country to interruption and shortage of power due to periodic drought and shortage of water in the dam. To counter this potential threat and ensure long term energy security, the Ethiopian government to consider other energy sources like solar, wind and especially geothermal power indigenous energy which is pure domestic energy that contributes to the energy independence through stable power supply. Geothermal energy can produce electricity in stable manner without any seasonal or daily fluctuation. The plant factor of geothermal power generation has been proven as high as 80% operation performance.

The other value of geothermal power is its environmental aspect. The geothermal power plant has no combustion process and hence will not produce any air pollutants like sulfur oxide, nitrogen oxide and dust. Ethiopia is committed to renewable energy and reducing its vulnerability to climate change. As part of its long-term commitment to carbon-neutral growth, Ethiopia has made clear its prioritization of domestic renewable energy resources. The current GTP focuses on increasing the availability of modern energy services, and the 2011 Climate Resilient Green Economy (CRGE) Strategy sets a target of increasing renewable power generation five-fold within five years as one of four key pillars supporting its green economy strategy. In addition to safeguarding sustainable economic growth, the CRGE Strategy also commits to adaptation measures to reduce the potential impacts of climate change on Ethiopia's economic growth and security. Considering the shortage of modern energy supplies in the country and the climate change issue due to greenhouse emissions, there is a need to develop geothermal energy in Ethiopia in order to help substitute imported fossil fuel, provide a major backup to an uncertain hydropower supply, serve the arid and semi-arid areas of the country where hydropower is unavailable and contribute to the UNFCCC effort to reduce global warming.

5.2 Barriers of Geothermal Energy

Geothermal energy is attractive because of the reliability, all day domestic availability, and relatively low CO_2 emissions. However, the future contribution of deep geothermal energy is subject to major uncertainty due to unproven nature of the resource before investing heavily. Preliminary geothermal resource study has to answer questions like how much this resource can be exploited, how much the economic cost is, what are the environmental and community risks and the public willing to bear, and what the benefit of geothermal resource is, and what the regulatory and institutional framework setups are. If we have proper answers for these issues, the geothermal project risks will be minimized.

Since Ethiopia is believed to have huge potential of geothermal resource, massive amount of energy could be generated from this geothermal resource, which could supply for both local consumption and export. Geothermal projects are designed to be within time, budget, planned specification and legal and regulatory provisions while meeting the project objectives. The geothermal development is exposed to various risks of varying degrees throughout all its phases and stages of development. However, the two most important constraints are the burden of large upfront investment and large resource development risk. Regarding the need for large upfront finance, the government is considering various options that could help develop the resource while reviewing the overall energy policy of the country. One option which is considered is to invite private investors to participate in the sector. Another option, as was the case with the development of hydroelectric power, would be to seek loans and grants from international financial institutions and develop by public entity establishing a proper government institution.

The other barrier which distinguished a geothermal project from other power projects is a resource development risk. Every geothermal field is unique and can have different characteristics and or different development challenges. Even within the same sections, some wells may have different chemistry, well output, temperature, pressure, enthalpy and drilling challenges. Some of the resource risk can be classified on existence, resource size, suitability, and utilization challenges. These resource risks are not only confined in the exploration and appraisal development stage but persist throughout the entire economic life of the project on varying scales. To minimize these risks, Ethiopia has given great emphasis and trying to establish a conducive geothermal legal framework and intensives and institutional arranges.

6. GEOTHERMAL RESOURCE DEVELOPMENT LICENSE AND ADMINSTRATION DIRETORATE (GRDLAD)

The Geothermal Resource Development License and Administration Directorate was established at the end of 2017 under the Ethiopian Energy Authority in accordance to the Proclamation No 981/2016 to regulate the geothermal operations of the Licensees and to ensure the conservation and development of the resources for the social and economic benefit and growth of the country and

to be utilized including electric generation. The vision of the directorate is to see the geothermal potential of the country contribute to the economic growth by creating conducive investment environment so that making use of geothermal resource for generating electricity by giving significant focus on development of its vast geothermal renewable energy sources to create a sustainable, green economy and contribute in establishing Ethiopia as a leading energy exporter and East Africa regional renewable energy hub.

In this respect, the GRDLAD encourage and facilitate both private sector and government institutions to undertake high quality geothermal exploration and development in order to bring about a meaningful and sizable impact to the economic growth of Ethiopia through efficient, effective geothermal resource promotion, licensing & administration and develop the large geothermal potential of the country and expediting the resource for base load supply not only to the national market but equally for the regional market as well.

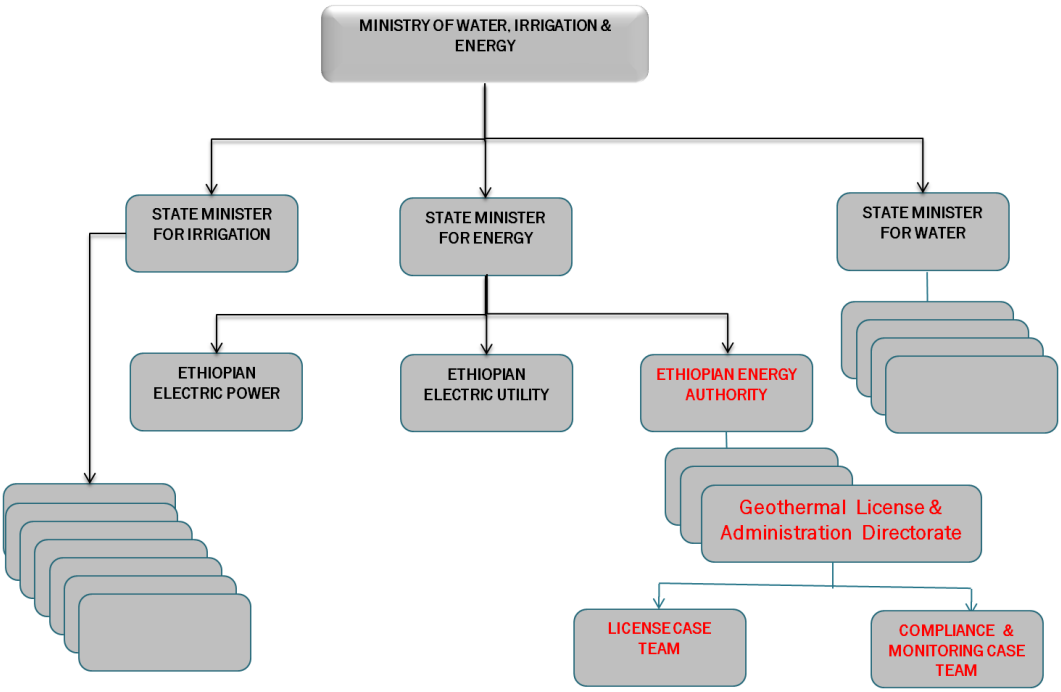

Figure 1: Organizational Structure

6.1 License and Administration Case Team

License Case Team issues Grade I geothermal operation licenses namely Reconnaissance, Exploration and Geothermal Well-field Development and Use License and Grade II geothermal resources license to prominent investors that fulfill the requirements in accordance with Geothermal Laws. Prepare promotional materials in the geothermal potential of Ethiopia and conduct promotional activities to introduce the geothermal resources of the country. Issues certificate of professional competency for geothermal consultancy service, technical works like geophysical survey and drilling activities. This team also designates an area as a known geothermal resource area by public notice.

6.2 Compliance and Monitoring Case Team

Compliance and monitoring case team follows up and administers reconnaissance, exploration and well-field development and use licenses which are issued by the Directorate. It also facilitates mineral samples exports, verifies and provides supports for importing vehicles and machineries from custom duties and tax free, work permit and visa requests in accordance with the Geothermal Laws. It also approves or issues the permits as appropriate to drilling plans and programs, well design plans, and drilling permit applications.

6.3 Geothermal Opportunities in Ethiopia

The government's Energy Policy is an integral part of its overall development policy. It aims to facilitate the development of energy resources for economical supply to consumers. It seeks to achieve the accelerated development of all available energy resources and the promotion of private investment in the production and supply of energy including geothermal resource. Ethiopia has an area of 1.14million km^2 made up of a broad plateau and lowlands along its periphery. The highlands rise up to 4600m altitude while the most depressed lowlands reach 120m below sea level. The Ethiopian sector of the Great East African Rift bisects the plateau from the northeast to the southwest of the country. The Rift in Ethiopia has created a conducive environment for the existence of geothermal resources and covers an area of about 150,000 km^2.

Ethiopia started long-term geothermal exploration in 1969. About 120 localities within the rift system are believed to have independent heating and circulation systems. From these localities about two dozen are judged to have potential for high enthalpy resource development, including for electricity generation. Exploration work peaked during the early to mid-1980s when exploration drilling was carried out at the Aluto-Langano geothermal field. Eight deep exploratory wells were drilled to a maximum depth of 2.5 km and temperature up to 350°C, of which lead to a new era of resource utilization started and installation of 7.2 MWe net capacity pilot power plant in 1998.

6.4 Current Development

Geothermal is the next optimum energy resource to develop after hydropower. In order to achieve the countries GTP plan in geothermal development both the public and the private sector participation is envisaged. Bilateral and Multilateral Cooperation are very essential to meet the ambitious geothermal development targets and the private sector would be the main player in Geothermal Exploration and Development. As IPP's are new in Ethiopia, there are only five companies who have eight licenses as shown in Table 2 and their location in Figure 2. At the moment there are only two companies who signed the Power Purchase Agreement (PPA) and Implementation Agreement (IA) and in the verge of ratification which are Tulu Moye Geothermal Operation Plc and Corbetti Geothermal Plc. The others are in the process of PPA negotiation and as well surface exploration activity.

Table 2: Existing Capacity and Future Direction of Energy Mix.

No	Company Name	Locality	Issue Date	Original Area/km^2	Remark
1	Reykjavik Geothermal Consulting Co.	Abaya	Dec. 11, 2009	513.94	Active
2	Corbetti Geothermal Plc	Corbetti	Dec. 11, 2009	735.8276	PPA & IA Signed
3	Cluff Geothermal Limited	Fentale	July 15, 2015	1,255.696	Active-PPA Negotiation
4	OrPower Twelve Inc	Boku	April 20 , 2015	342.697	Active-PPA Negotiation
5	OrPower Twelve Inc	Shashemene	April 20 , 2015	1,005.726	Active-PPA Negotiation
6	OrPower Twelve Inc	Duguno	April 20 , 2015	1249.506	Active-PPA Negotiation
7	OrPower Twelve Inc	Dofan	April 20 , 2015	1,255.65	Active-PPA Negotiation
8	Tulu Moye Geothermal Operation Plc	Tulu Moye	August 29 2018	588.3726	PPA & IA Signed

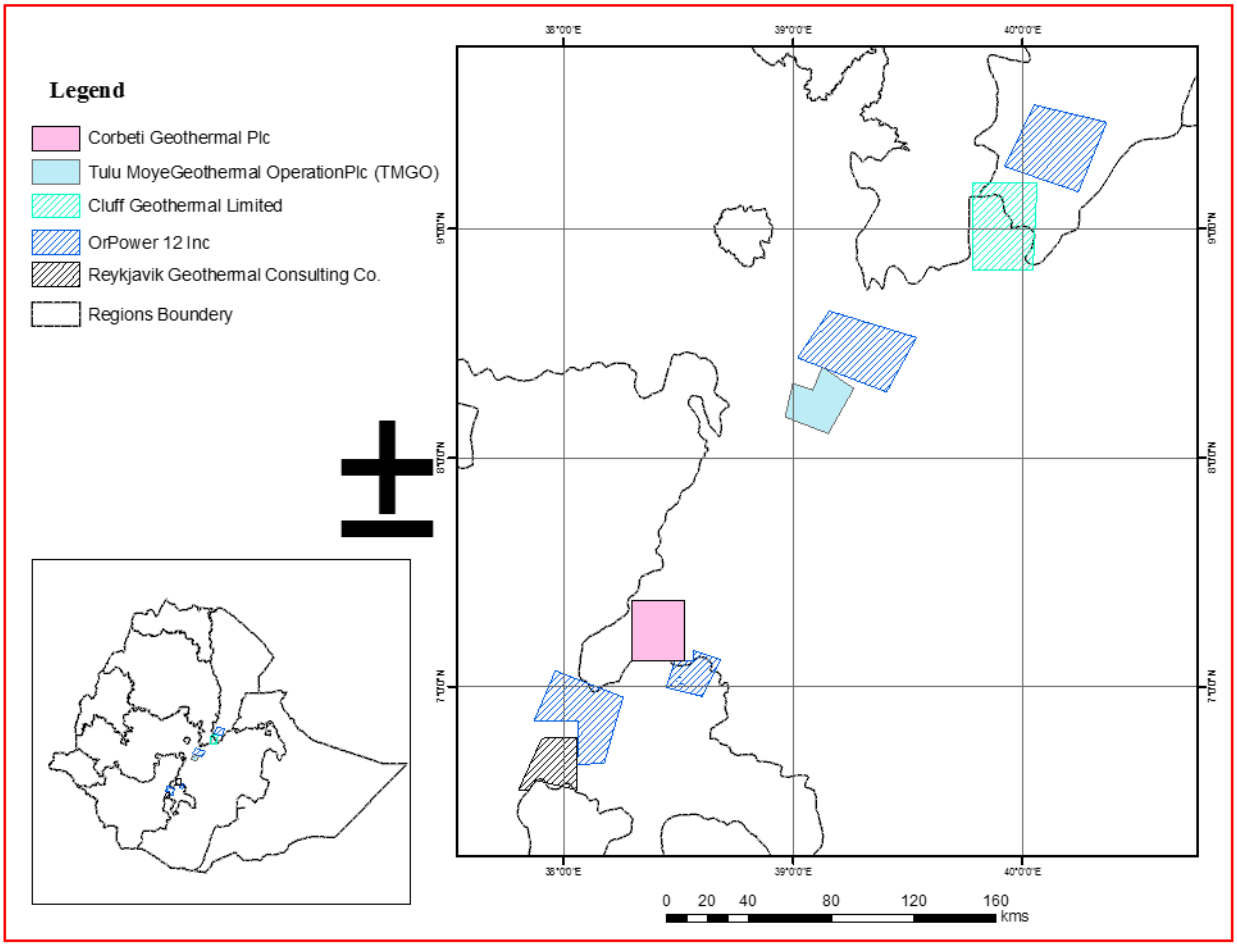

Figure 2: Location of Active Geothermal License Areas.

It is summarized the current activities conducted by public and private companies as follows:

- Public -Aluto Langano Expansion, Tendaho, Alalobed, Dubti, Ayrobera and Boseti
    - World Bank-GoE Geothermal Sector Development Project
        - Production drilling and 70MW plant at Aluto Expansion
        - Test drilling and 25 MW plant 1st phase at Allalobeda
    - AFD-GoE Shallow & deep Resource Development drilling at Tendaho
        - 12 MW Shallow resource and 2 test wells (deep resource)
    - Ethio -JICA Test well drilling Projects
        - Exploration and testing at Ayrobera and Boseti

- Private Companies
    - Corbetti Geothermal Plc (Corbetti Block)
        - Exploration and development of 500 MW
        - Signed PPA & IA waiting to be approved by EEA & HoPR, Preparation to commence drilling
    - Tulu Moye Geothermal Operation PlC (ulu Moye Block)
        - Exploration and development of 500 MW
        - Signed PPA & IA waiting to be approved by EEA &HoPR, Preparation to commence drilling
    - Reykjavik Geothermal Consulting Co.(Abaya Block)
        - Exploration and development of 500 MW
        - Signed PPA & IA waiting to be approved by EEA &HoPR Preparation to commence drilling
    - Cluff Geothermal (1 block) & OrPower 12 Inc. (4 blocks)
        - Started PPA negotiation & under Exploration

7. SUMMERY OF THE ETHIOPIAN GEOTHERMAL PROCLAMATION

The new Geothermal Resource Development Proclamation No. 981/2016 was issued in September 2016. The draft Geothermal Regulations is approved and the process of publishing. The highlights of the Proclamations are as follow:

- invite private investment in geothermal operations;
- classify geothermal resource into Grade I that is a resource capable to generate electric power and to provide services such as direct heating and combined heat and power and Grade II that is a resource used for the purposes such as direct heating, agriculture and industrial applications, recreational bathing and medical purposes;
- provide reconnaissance license not more than 24 months, non-exclusive and non-renewable, up to 2,000 km^2;
- provide exclusive exploration license with two renewals of 1 year each in no more than five years, up to 200 km^2 and a licensee shall not hold more than licenses at time;
- provide exclusive well-field development and use license for 25 and when expires the government may continue to develop the resource as it finds feasible, up to 50 km^2;
- require adequate health, safety and environmental protection;
- provide exemption from customs duties and taxes on equipment, machinery, vehicles and spare parts imports as necessary for geothermal operations.

8. CONCLUSION

It is the strategy that the country produces mixed electricity from hydropower, wind, solar, geothermal and biomass resources to promote energy efficiency and to reduce the role of hydrocarbon fuels in transport and industry. Based on the provisions of the energy and geothermal legal framework, the Ethiopian Energy Authority started to develop some of its mandates to encourage and facilitate both private sector and government institutions. By encouraging these mandates will help to undertake high quality geothermal exploration and development in order to bring about a meaningful and sizable impact to the economic growth of the country through efficient effective geothermal resource promotion, licensing & administration and develop the large geothermal potential of the country and expediting the resource for base load supply not only to the national market but equally for the regional market as well. But legal and regulatory framework addressing geothermal development needs skill, international experience and capacity building. The regulatory body is now trying to build the complicated set of rules to address the issues to properly manage the sector.

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