A PROPOSAL FOR COMPETITIVE ELECTRICITY INDUSTRY IN SUDAN: DRAWING UPON INTERNATIONAL ELECTRICITY RESTRUCTURING EXPERIENCES AND TRENDS

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ABSTRACT

Electricity industry was considered a textbook natural monopoly. Accordingly, governments are the best able to manage the large amounts of capital necessary to develop the sector and bear the long time costs recovery. This dogma has been in doubt in early 1990’s and evolution of electricity industry reforms around the world started. The development of an electricity reform strategy based on the market economy that introduces competition is of importance for providing a stable and favorable environment for investments and service quality.

Drawing from international experience, this paper provides a framework and options for electricity industry reform in Sudan. This includes setting policies, strategies and objectives which are in line with the country’s economic reform policies. Considering the particularity of electricity industry, current market situation and existing institutions, a plan for reform steps is proposed to provide an environment for better performance of the sector through gradual implementation of competition. Two main steps are proposed for electricity reform in Sudan. The first is to implement a Single Buyer market model to introduce “competition for the market”, and the second is to introduce a wholesale generation market which is based on Poolco Market Model to introduce “competition in the market”.

Generation wholesale electricity market as expected to be at the proposed time for implementation is simulated to explore how the shape of the industry will be and more importantly how market price will evolve. In this simulation, Optimal Power Flow simulation with respect to generation dispatch has been used to calculate spot market clearing prices at different location in HV electricity of Sudan.

Keywords: Sudan electricity sector, electricity market, electricity reform, single buyer market, wholesale electricity market
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1. INTRODUCTION

Electricity supply industry (ESI) is a set of function bodies that produces, delivers and consumes electricity. Industry structure describes how these bodies are organized and related to each other.

Economically, electricity is viewed as a “product and service” that is delivered to market “consumers” as a commodity for consumption. Accordingly, ESI can be thought to be restructured as a market governed by the behavior of buyers and sellers.[1]

Historically, ESI used to be structured according to electricity flow from production to consumption points where generation plants, transmission and distribution networks are owned by one entity “utility”. Normally, these utilities are public or state owned. These structures are called Vertically Integrated.

In most cases, these utilities serve markets of particular area where no other entity can serve customers. This is called monopolistic, as the monopolist in economic terms is a single seller of good or service.

The strategic nature of the ESI to national economies has long required government intervention and control of investments and regulation of this industry.

In the past decade, with the growing electrical energy demand, the need and the pressure of capacity additions, minimizing costs, supply of energy services at cost reflective price, and to attract private investors to the electricity sector, many countries are initiating new policies aiming to introduce different levels of liberalization in their energy industry with particular emphasis on electricity sector.

Deregulation, restructuring, industry reform, liberalization, re-regulation and sector privatization are various terms used to name the evolving new policies’ implementation and the movement of change in the electricity sector. Ultimately, the main feature of these changes has been identified as two key processes, which are “Privatization” and “Deregulation or restructuring” that can introduce liberalized electricity markets [1,2].

Deregulation in general is the process of transformation from monopolistic to competition through market restructuring, while Privatization, which is the change of ownership from public to private sector, is identified in many countries as a mandate requirement to achieve competition.

Although policy makers have realized that introducing the competition in the electricity industry is inevitable, and countries' strategies have somehow made a provision for that, the details of how to implement efficient competition are not standard or obvious. Accordingly, different implementation paths have been followed based on the various objectives set by policy makers in different countries. The objectives are varying based on size, economical structure and socio-economic standings of each country or state.

By the end of the 1990’s, the movement of electricity industry reform has been widely spread. The change in the industry structure became a global phenomenon, and many developed and developing countries have already started either planning to substantially put a restructuring program in place, or have completed a certain stage of competition. [5]

The deregulation regimes being adopted or proposed share some common principles. These involve a greater reliance on market forces and competition as an ultimate goal. Unbundling the vertically integrated utilities into segments that can be players in a competitive market has been noticed as key and common practice.

In many developing countries the vertically integrated sector was characterized by poor service quality, low labor productivity, high system losses, under investment, lack of service to large portion of population, and subsidized prices that is not covering production cost. It is common in such situations that industrial
customers build their own private generation to avoid frequent system outages.[10]

The pressure to reform arises from policies and economic arguments that deficiencies of natural monopoly can be overcome by introducing competition in the power sector.

The most important and first step to start restructuring is to set a clear goals and constraints for selection of country's model. There are common elements of all restructuring models. These elements are basically existence of regulatory authority that controls monopoly activities, market structure for competitive activities, and clear enforceable property rights.

Reform of Electricity industry in the Sudan started in year 2000 with a provisional decree of forming “electricity act 2000”. The act restructures electricity industry by breaking the monopoly of NEC (National Electricity Corporation; ie NEC), in the fields of generation and distribution. The act allows new players to participate through licenses granted by the Federal Minister upon recommendation of the new regulatory authority formed under the act.

A new law for NEC was approved in 2001 to accommodate the requirements of the Electricity Act. The law allows NEC to purchase electricity from producers and participate and cooperate with the states to form companies outside the national grid.

2. Evolution of Electricity Deregulation and Reform Models

For decades, electricity industry has been treated as natural monopoly and structured as regulated vertical integrated utilities. This has been the choice of policy makers to avoid social welfare prices deviations. There are some exceptions in some countries where franchise competition is introduced within monopoly structure to achieve marginal cost prices. Recently, in mid 80’s, an important change of power generation technology was experienced, where combined cycle technology (CCGT) brought efficient small plants into service with considerably low investment cost. The average production cost ($/KWH) of small size CCGT then was reduced to the same level of large plants average cost. This caused the economics of scale in power generation to vanish. New players with efficient, low investment cost power plants have been attracted. These players are either independent power produces or large industries who build the plant for their own purpose and participate in selling and buying residual energy and reserve capacity.

In 1983 Joskow and Schmalensee [3] provided an imagination of competitive markets for electricity” wholesale and retail “by separating these businesses from the “wires” businesses of transmission and distribution. They foresaw that scale economics in generation that justify utility monopolies is passing.

Hogan 1993 [5] proposed a basic work model for introduction of competition in electricity industry. The model identified the “wholesale generation competition” and “retail competition” as two major areas in the electricity industry that form a competitive market, while transmission and distribution remain a natural monopoly segments.

Being considered as an ultimate target for full competition, Hogan’s basic model accommodates both wholesale and retail competition. [5, 8] He has also introduced an intermediate model that accommodates the wholesale generation competition only, as a transition model to full competition.

Many references identified four market models that comprise increasing levels of competition in electricity industry where any marketplace can fit into one of them. The models are [4,6,7,9]:

1. Monopolistic model “vertically oriented utilities”
2. Purchasing Agent Model or Single Buyer Model “first level of competition Model”
3. Wholesale Competition Model “Second level of competition Model”
4. Retail Competition Model “full competition Model” “fig. (1)”

The driving force and reasons for shifting the regulated monopoly and vertically integrated structures to competitive structures govern the selection and timing of implementation of transitional and target models.

![Retail Competition Model](image)

**Figure 1: Retail Competition Model**

3. LESSONS FROM OTHER DEVELOPING COUNTRIES EXPERIENCES.

Power sector reform in developing and less developed countries typically starts with initial stage of converting state owned utilities into corporations that work on commercial basis. In the second stage, this process is followed by unbundling and then introduction of competition- when the country size allows private sector participation.

Most reforms in developing countries are not completed to full competition model. For example, no African country has completed the transition to a fully unbundled, competitive, or private electricity sector. [13] Very Few countries have successfully unbundled their utilities – Uganda for example has unbundled its utility, some have introduced bidding competitive independent power producers (IPPs) or concession “competition for the market”, but no country has competitive market where different actors are competing “in the market”.

There is difficulty to reform state owned enterprises “SOE” because SOE budget has soft constraints and is actually financed by the state. The central role of the state extends to political control over the enterprise including control of key appointments. Such situations actually affects the majority of reform steps in developing countries. Some compromised options are implemented by introducing elements of corporate efficiency without addressing all the interlocking elements of the SOE system. One of these solutions is creating opportunities for IPPs to generate electricity alongside the existing state owned utilities. In fact this represents a partial reform with hybrid market that combines elements of market activity with large state dominated sectors.[11]

Many reforms started with and were mainly centered on privatization drawing from UK experience. By contrast, the experience of Norway and New Zealand - which is in an advanced stage of electricity market liberalization – shows that privatization is not a pre-requisition for reform [14].

**IPP experience**

In countries with domestic resources like China and Thailand, the initial interest of foreign IPP’s has been reserved in favour of state controlled generating companies that are formed by state controlled corporations. Many other countries’ reforms are aimed to increase private investment and avoiding going to full liberalization; examples of these countries are Philippines, Poland and to some extent Brazil.

In India after the electricity act of 2003 that converted the single buyer model into multi buyer system, the interest in foreign IPP investors is still there; while there is increasing
support to some capable local actors of private investment.

Some countries are continuing with single buyer model without further reform plans, examples of these countries are Mexico, Kenya, Egypt, Turkey and most of the Arabian Gulf Countries (GCC countries). [12]

The experience of IPPs in the Arabian Gulf Countries has been successful from contractual point of view. The driving force for the slow reform process was not to attract investors, but it was mainly to achieve efficiency or follow government reform policy. The strong macroeconomics of GCC countries where subsidy can be withstood, contributed to this success. Meanwhile, success in Thailand caused by the government made the IPP program financially sustainable by allowing its power purchase costs to be recovered [12]

In many other countries, governments need private investors and thus offer attractive terms for IPP’s. Once operational, and the government has already secured what it needs (infrastructure); the original bargain has become obsolete and lead to wide array of adjustments to the original contractual arrangements. The adjustments varies from outright cancellations, to official renegotiations and to various other types of pressure [12]

Risk management in long term Investment in power sector has always been viewed as “obsolescing bargain”, where the negotiation leverage gradually shifts from IPP’s to government as IPP’s operating investments increases. Based on this theory, risk allocation of the agreements are identified by making government or utilities bear considerable part of the project risks

4. SUDAN ELECTRICITY INDUSTRY REFORM

The Sudan power industry is characterized by a sole electricity utility which is responsible for generation, transmission, and distribution of electricity. Power system in the Sudan consists of the National transmission grid and some small isolated networks.

Current structure of the electricity industry in the Sudan is still a vertically integrated single utility structure. Despite the promulgation of the electricity act 2001 which dictates different conclusions, the electricity industry in the Sudan remains structurally unchanged and practically pursuing monopoly under vertically integrated utility.

Attempts of electricity industry reform were made as part of wider government privatization program. The focus was on providing a legal framework to facilitate private sector and foreign investor’s participation in the electricity sector. Practically, because of the complicated nature of the electricity industry and its high investment requirements, the legislation alone could not attract investors or effectively change the existing industry structure and practice.

The privatization program listed NEC as one of government’s corporations that is targeted for privatization. In contrast, the Electricity Act dealt with NEC and its existing powers as it is, and allowed for newcomers with Ministry licenses.

The current structure of electricity industry in Sudan is a compromise made to adopt government economic reform and privatization program while retaining political governance of the sector. There were no proper considerations to power-sector characteristics, institutional characteristic or country context. Although it is important for reform to be in-line with government macroeconomic reform and privatization initiatives, the reform should be embarked to achieve objectives of its own. To ensure successful reform, it is vital to start with clear policy and Power Sector Strategic objectives derived from a careful study of the sector. The strategic objective shall be included in a reform plan that lays down a set of targets, framework and implementation plan for the reform. This shall include:
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Identify Major Issues in the Power Sector
- Set Key Objectives for reform
- Provide Guidelines and Vision for future Sector Structure
- Provide Guidelines for Legislative and Regulatory Reforms
- Identify the directives for the accepted models for Private Sector participation for the generation and distribution businesses

In order to propose a practical model for reform of electricity supply industry in Sudan, it is essential to start with a proposal for sector policy. The proposal for sector policy has been made based on the major issues of the sector in addition to the objectives of government economic reform and the privatization program:

- Electricity shall be produced and delivered to all classes of consumers in a reliable; efficient and fair manner at reasonable price.
- Improve the quality and quantity of energy supply through gradual application of appropriate sector reforms
- Promote efficient utilization of energy resources.
- Satisfy internal demand of electricity then maximize power export opportunities to the neighboring countries.
- Increase access to affordable electricity
- Promote private sector participation in the development of electricity industry.

Details of the reform policy, objectives and strategies are provided in Table (1) below.

5. GUIDELINES AND VISION FOR FUTURE SECTOR STRUCTURE

It is suggested that privatization should not be the driving force for electricity reform. Experiences from Norway, Australia, New Zealand and many other countries confirm that industry structure, market design, and effective regulatory frameworks are the main drives for sector efficiency and successful reforms. Accordingly, the cornerstone in achieving efficiency and the objectives of the industry is to change the current structure to achieve the strategic objectives of sector reform to improve efficiency through better investment decisions, better use of existing plants, better management and better choices for customers;

**Proposed Industry Structure**

Due to the relative small size of the Sudan power market reform process needs to consider restructuring main issues, namely cost of competitive market, reliability, metering requirements and market power. Reform process should be embarked slowly after proper preparation.

At first stage, possible suitable models will be centered on Single Buyer Model with a setup that allows for long term transition to proper competition in the market if appropriate. However, under Single Buyer Model competition “for the market” can improve efficiency through competitive bidding for new generation facilities. It is important to keep in mind that market design should be simple and applicable to Sudan environment and avoid complications that arise from compromises of different interest groups “lesson from California”.

A gradual implementation plan for Sudan is recommended. The key step in the new structure is to have the vertically integrated utility (NEC) unbundled to various business entities based on its ability to be competitive or to remain a natural monopoly with proper regulation. The step shall be combined with creation of necessary institutions for policy and regulatory functions which are required to ensure successful implementation of the proposed market model and structure.

Experience from developing countries reveals that depending on availability of the supporting infrastructure of sector and country condition, 8–15 years is recommended for planning full
implementation of the restructuring process. [15].

For Sudan electricity industry shall be performed gradually in stages in what follows.

5.1 Single Buyer Model (Stage 1)

Generally, the business functions in the electricity business system can be summarized as follows:

- Generation (can be competitive)
- Power procurement
- Economic dispatch
- Technical (real time) dispatch
- Transmission
- Distribution
- Sales and service (can be competitive)

Restructuring involves separating some of these functions and combining them to new entities. Some of the entities can be competitive and others need to be regulated. The proposed structure combines these functions and applies competition and regulation to the relevant functions as follows:

**Sector Functions**

**Regulation**
- Policy making

**Generation**
- Construct plants
- Operate and maintain plants

**Power Procurement (single buyer)**
- Negotiate terms with generators and sales and service companies over the medium and long term
- Purchase fuel (this function is assigned to the Single Buyer as it normally bears fuel risk in PPA’s and to allow inclusion of fuel efficiency incentive/penalty terms in the PPA’s. However, this function can be assigned to the generation function)
- Assess need for new capacity given demand forecast
- Run bidding process to select new plants/power purchase contracts
- System operation and control: (this function can be assigned to transmission company)
- Supervise implementation of power purchase agreements and Economic Dispatch
- Determine merit order of plants based on rules for payments and contract structures
- Plan merit order dispatch of generators given existing capacity and constraints due to technical dispatch
- Co-ordinate maintenance of generators and transmission (long-term)
- Technical (real time) Dispatch
- Control reserve capacity
- Conduct technical dispatch to balance short-term demand and supply given existing capacity
- Co-ordinate maintenance of generators and transmission (real time)

**Transmission**
- Plan transmission capacity additions
- Construct transmission system
- Operate and maintain transmission system
- Plan maintenance of transmission system

**Distribution**
- Plan distribution capacity additions
- Construct distribution system
- Operate and maintain distribution system
- Plan maintenance of distribution system

**Sales and Service (Retail marketing)**
- Design end-user tariffs
- Read meters
- Conduct billing and collection
- Provide customer service
- Forecast demand

According to the nature of each electricity business function, the proposed private participation in the sector is summarized in table (2) below:

Based on the main function of the electricity sector, the proposed reform model considers functional separation with the following structure:

- Unbundling of NEC according to electricity business function.
- Create a state owned Electricity authority (Sudan Electricity Authority SEA) to take the role of sector policy making and retain ownership of state assets.
- Establish generation companies owned by SEA; the companies shall be licensed and subject to price review by the Regulatory Authority. The companies shall own NEC generation assets and the number of the generation companies can be decided according to feasibility of separation between hydro and thermal generation.
- Form a transmission company owned by SEA and licensed by the Regulatory Authority. The company acquires and operates all transmission assets in Sudan. As exercising natural monopoly, Transmission Company shall be owned by SEA and controlled by the Regulatory Authority through regular price reviews.
- Establish a single buyer and seller company (Sudan Electricity Company SEC) licensed and cost controlled by the Regulatory Authority. The Company shall be owned by SEA Authority to acquire the necessary guarantees needed for power purchase agreements to attract private participation in generation business.
- Allow for private generation participation through acquiring license from the Regulatory Authority. Due to the discussed hurdles of attracting private investment particularly foreign investors, at first stage, private investment entry can be through limited partnership with SEA through project financed company (IPP) (Fig.(2)). Considering the finance difficulties in Sudan in general and power sector in particular, limited partnership is a suitable setup where SEA holds more that 50 per cent of the equity of the IPP project company and acts as a general partner. Foreign and local investors can form joint ventures in a limited partnership in the project IPP Company. For each individual IPP project, SEA equity can be in a form of a joint stock company. In addition to the investment of the joint venture, the limited partnership shall be aimed to benefit from the technological and management skills of the foreign investors. The IPP project company shall sell electricity to Sudan Electricity Company only by signing a long term Power Purchase Agreement (PPA). This agreement is vital for IPP Project Company in getting the financial closure.
- Establish distribution companies owned by SEA and licensed and controlled by the Regulatory Authority. The companies shall own NEC distribution assets. The number of the distribution companies can be decided according to a feasibility study taking into account number of customers, geographical location and size of the distribution assets. The distribution companies shall be subject to price control by the Regulatory Authority.
- Allow for private participation in distribution business through acquiring license from the Regulatory Authority and be subject to its price reviews. One possible form of private participation in new distribution facilities would be through concession award with a performance incentive schemes.
- Separation of distribution business and sales and customer service functions can also
provide an opportunity to private sector participation and achieve efficient customer oriented retailing services.

A schematic diagram for the proposed stage one industry structure is shown in Figures (3) and (4) below.

5.2 Generation Wholesale Market Model (Stage 2)

The change of industry structure to a wholesale generation competition is a critical step as it involves conceptual change in risk allocation among different business entities. In order to undertake the change to wholesale generation competition market, particular consideration needs to be made to generation business that requires scarce investment resources, which can hardly be attracted in Sudan under single buyer model. The change of risk allocation needed for competition in the market may be a barrier to attract new investment under Sudan context. In addition, the existing generators which hold a life of the plant PPA will be severely affected by accepting the risk of competition for dispatch.

Payments

The decision to move towards wholesale market needs to be taken after conducting all necessary due-diligence. This is needed to ensure readiness to have healthy competition in the market for electricity production. The key and important issue is the market design.

Two fundamental principals have to be considered while designing a competitive wholesale market for electricity generation. First, is to have competitive and efficient energy trading; second is to be able to have reliable operation of the grid. To achieve a competitive and efficient market, a robust energy market structure has to be created. The structure shall ensure both long term and short term health and efficiency. Reliable operation of the grid can be achieved through an efficient scheduling process that is able to conduct security constrained economic dispatch (SCED).

It is proposed as a first implementation of wholesale market in Sudan to go for design that is based on mandatory pool with multi-seller single buyer arrangement. In this case, system operation and market operation can then be assigned to the single buyer company to act as Poolco and system operator to ensure both market efficiency.
and system reliability. This structure and market design helps in implementing competition in the market while avoiding the complication of market structures that have multi-buyers and multi-sellers. If found appropriate after implementing single buyer model, the proposed structure for Sudan is shown in Figure (5).

The design of the Poolco market shall not only be made to keep price in-line with the cost, but also should provide appropriate incentives for new investments.

In the suggested market design, all generators will receive system marginal prices which are the price on the marginal (high price) unit. Additionally, generation plants will receive prices which are higher than their variable cost to cover their fixed cost “implicit capacity payment”. In this case, base load plant, which normally has high fixed cost, will receive considerably high margin for fixed cost recovery.

Figure 5: Wholesale Market Proposal for Sudan

3. GENERATION WHOLESALE MARKET SIMULATION

The simulation of the proposed wholesale market for Sudan electricity under Poolco model has been conducted for operating hours representing different operating conditions.

![Figure 5: Wholesale Market Proposal for Sudan](image)

Simulation results reveal that that location and technology of thermal generation has considerable impact on market price. At different operating conditions, market clearing price varies between 35$/MWh (marginal cost of high efficiency thermal plant) and 123 $/MWh (marginal cost of high fuel price thermal plant). This variation in marginal cost is attributed to the cost of fuel supply to plant location, type of fuel, plant efficiency, and generation technology of the plant.

The Locational Marginal Price is the cost of supplying next MWh at a specific node and takes into consideration marginal generation cost, cost of transmission congestion and cost of marginal losses:

\[
LMP = \text{marginal generation cost} + \text{cost of transmission congestion} + \text{cost of marginal losses}
\]

When there are no transmission constraints, transmission congestion component will be zero and hence, all nodal prices will be almost the same. Little variation will exist depending on the network losses at different locations.

As an example, a scenario was simulated to find the LMP at Port Sudan node, under the conditions of limited capacity for power export to remainder of Grid. The simulation considers the Sudanese power system as forecasted for year 2015 by Sudan Long Term Power System Planning Study. The following can be observed:
- Compared to unconstrained network’s market prices, there is a considerable drop in LMP of all buses located in Port Sudan (Snapshots of simulation are shown in Figures (7) and (8)). For example, for Port Sudan 220 kV busbar (bus 2015), price of serving extra MWh is $106 under unconstrained network peak load case. While in the case of constrained network with limited transfer capability to export from Port Sudan the LMP drops to $39.9/MWh.

- For the first case, LMP is equal to the marginal generation price and losses price only. In the second case, taking extra MWh from this bus will contribute in relieving network congestion. The network congestion cost component at this bus is negative and LMP then became $35.9/MWh.

In addition to calculating LMP’s at different operating conditions, the use of OPF with respect to generation dispatch has a particular importance not only in giving information for proper transmission expansion location, but also to quantify the cost of congestion that can be used to finance transmission expansion projects at specific network segments.

4. CONCLUSIONS

(i) After study of the current electricity sector in Sudan, this paper has presented a reform plan that lays-down a set of targets, framework and implementation plan for the reform. The plan includes:

- Identify major Issues in the Power Sector
- Set Key Objectives for reform
- Provide Guidelines and vision for future Sector Structure.
- Provide Guidelines for Legislative and Regulatory Reforms
- Identify the directives for the accepted models for Private sector participation for the generation and distribution businesses

(ii) It is suggested that privatization should not be the driving force for electricity reform. Experience from international experience confirms that industry structure, market design, and effective regulatory frameworks are the main drives for sector efficiency and successful reforms.

(iii) Single buyer Model is suggested as a first stage of Sudan electricity industry reform. Under Single Buyer Model setup that allows for long term transition to proper competition, “competition for the market” can improve efficiency through competitive bidding for new generation facilities. A gradual implementation plan for Sudan is
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recommended. The key step in the new structure is to have the vertically integrated utility (NEC) unbundled to various business entities based on its ability to be competitive or remain a natural monopoly with proper regulation. The step shall be combined with creation of necessary institutions for policy and regulatory functions which are required to ensure successful implementation of the proposed market model and structure.

(iv) The logical step after implementing Single Buyer Model is Generation Wholesale Market. It is proposed as the first implementation of wholesale market to go for a design that is based on mandatory pool with multi-seller single-buyer arrangement. In this case, system operation and market operation can then be assigned to the single buyer company to act as a Poolco and system operator to ensure both market efficiency and system reliability. This structure and market design helps in implementing “competition in the market” while avoiding the complication of markets structures that have multi-buyers and multi-sellers. The decision to move towards wholesale market needs to be taken after conducting all necessary due-diligence. This is needed to ensure readiness to have healthy competition in the market for electricity production. The key and important issue is the market design

(v) Modelling of centralized electricity market operation in Sudan has been made to illustrate the outcome of implementation of wholesale competition. The simulation made is based on the Sudan power system as forecasted for year 2015 by Sudan Long Term Power System Planning Study. This includes Network configuration used for optimal power flow simulation, generation expansion program, and cost data including cost of fuel by plant location, generating unit’s data and heat rates for generating units.

9. References


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Table 1: Summary of proposed reform policy, objectives and strategies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Objectives</th>
<th>STRATEGY</th>
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| Electricity shall be produced and delivered to all classes of consumers in a reliable; efficient and fair manner at reasonable price. | Improve the efficiency, quality and quantity of electricity supply to contribute in improving social and economic development of the country. | - Gradual application of appropriate sector reforms.  
- Improve electricity sector governance, administration and institution.  
- Recognizing that industry structure rather than ownership of assets derives efficiency improvement; public ownership should be maintained while prompting private investment participation.  
- give incentives to encourage use of renewable energy technologies instead of conventional energy, where applicable. |
| Promote efficient utilization of energy resources. | Maximize the benefit of energy, reduce production cost and improve social welfare | - Implement effective performance based regulation.  
- Set long term market structure that maximizes competition.  
- Promote use of renewable resources. |
| Satisfy internal demand of electricity then Maximize power export opportunities to the neighboring. | Increase market size to attract foreign investors, increase efficiency and improve feasibility of utilizing hydro generation potential | - Creation of viable electricity industry structure that accommodates suitable market structure with suitable trading arrangement.  
- Promote for private sector participation in interconnection transmission development. |
| Increase access to affordable electricity. | - Contribute to poverty alleviation.  
- Enhance socio-economic development | - By developing rural electrification programs  
To attract private participation in uncovered area’s, subsidize connection rather than electricity usage. |
| Promote private sector participation in the development of electricity industry. | - To have both public and private sectors participating in electricity industry.  
- To improve industry efficiency, management and viability.  
- To attract private investment and contribute in macro economic growth. | - Improve investment environment by establishing a legal framework that define investors’ rights and obligations and enforcing property rights legislations.  
- Identify the forms and business area’s open for private sector and foreign investors participation.  
- Provide the required grantees and commitment to long term contracts.  
- Prepare and promote package of project for renewable energy generation for private investment. This project shall be attractive through low interest finance, fiscal incentives and flexible loans. |
### Table 2: Electricity business functions privatization options

<table>
<thead>
<tr>
<th>Electricity Business Function</th>
<th>Market entity</th>
<th>privatization</th>
<th>privatization Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>generation companies</td>
<td>Open for private sector participation</td>
<td>project company -60% joint stock company 40% for limited partnership joint venture partners</td>
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<tr>
<td>Power procurement</td>
<td>Sudan Electricity Company SB</td>
<td>Public ownership</td>
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<tr>
<td>Economic dispatch</td>
<td>Sudan Transmission Company</td>
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<td>Technical (real time) dispatch</td>
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<td>Transmission</td>
<td>Sudan Transmission Company</td>
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<td>• Distribution</td>
<td>Distribution companies</td>
<td>Open for private sector participation</td>
<td>concession or lease</td>
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<td>• Sales and service</td>
<td>Distribution companies/Retail companies</td>
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