Evaluation of the Effectiveness of Power Plans in Kenya

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Abstract

In developed countries, consistent, and accurate power system planning ensures, a secure and reliable operation of existing and future grids. In developing countries, the planning of the power system is not well coordinated leading to improper matching of supply and demand. Kenya has had a share of its challenges in regards to power system planning. It is against this backdrop that this paper seeks to make an in-depth analysis of why developing countries do not seem to move forward towards electric energy security as projected in their energy plans. It is evident that electric energy plans in developing countries do not work very well. Is it because of poor planning or is it due to poor implementation? This research was done with Kenya as the case study. The primary data collection method was structured interviews with electric energy planners in Kenya. The least-cost power development plans and electric energy plans were assessed and compared to what has been actually implemented, according to the plans. The research proposed some solutions aimed at advising energy planners and policymakers, and the relevant stakeholders on the best planning and implementation strategies.

Keywords: Least cost power development plan (LCPDP), planning and implementation strategies, projects, energy planners, and interviews.

1 Introduction

Energy planning is a projection of how the power system should grow over a specific period of time, given certain assumptions and judgments about the future loads and the size of investment in generating capacity additions and transmission facilities expansion and reinforcements [1]. Energy planning seeks to address the energy trilemma i.e. supply power balancing on energy security, economic competitiveness and environmental considerations. However, the plans can become technically and economically obsolete as new inventions in electrical utilization equipment or unforeseen industrial, commercial, or residential projects can change energy plans [1].

In this regard, a key focus is necessary for the development of the integrated energy plan to ensure that it's realistic, accurate, and implementable for the provision of least-cost power for the country. Additionally, a precise implementation of these policies and energy plans will be consequential in the achievement of the country's development goals. Kenya is considering the introduction of nuclear power in the energy mix which requires a proper electrical grid system planning to avoid events that might challenge the safety of the plant, hence the need to get it right the first time. Therefore, it is paramount to ensure that our energy plans are foolproof, realistic, and implementable. The figure below illustrates the power planning process used to generate the country's power plans.

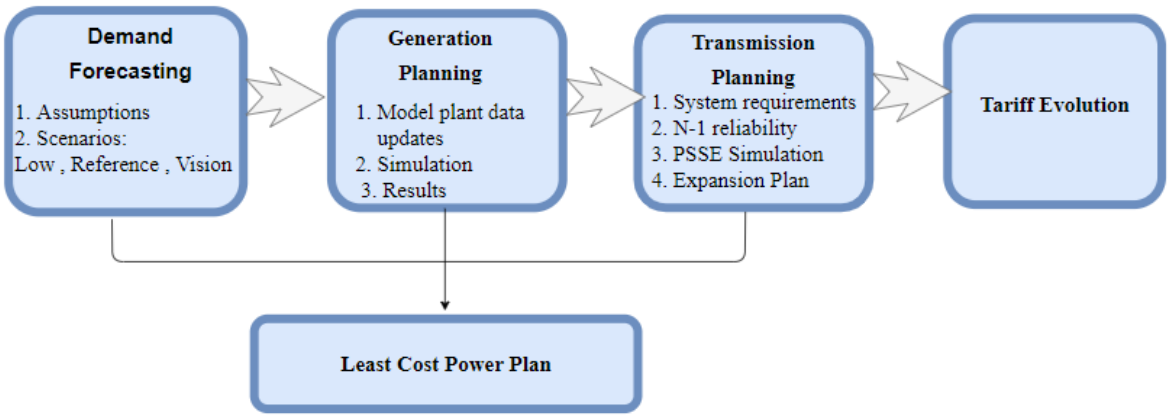

Figure 1 : Power Planning Process

2 Methodology.

The study process involved the collection of data on generation planning projections for the years 2011, 2013, 2015,2017, and 2020. The data obtained was then analyzed to check the accuracy of the power plans. After graphing of the data obtained, the trends were observed to compare with the actual installed generation capacities. Afterwards, conclusions and recommendations were drawn from the results.

3 Results

3.1 Generation Plans

Power plans obtained (for the years 2011, 2013, 2015, 2017 and 2020) were tabulated below for comparisons. These trends are also depicted in the graphs. From the data obtained the generation capacity is expected to increase over the planning periods for the different plans.

Table 1 : **Power Plans (Source LCPDP Reports)**

	Total Installed Capacity (MW)				
Year	**2011 Power Plan**	**2013 Power Plan**	**2015 Power Plan**	**2017 Power Plan**	**2020 Power Plan**
2011	**1,363**				
2012	1503				
2013	1,532	**1,805**			
2014	2,000	2,228			
2015	2,888	2,528	**2213**		
2016	3,168	2,493	2,205		
2017	3,868	3,844	2,332	**2,235**	
2018	4,373	4,304	2,496	2,381	
2019	5,113	4,488	3,446	3,237	**2,694**
2020	5,611	5,008	3,570	3,744	2,869
2021	6,451	5,608	3,983	3,848	3,315
2022	7,237	6,548	4,333	4,421	3,856
2023	8,237	7,468	4,622	4,457	4,696
2024	8,857	8,388	4,597	4,537	5,094
2025	9,977	9,428	4,846	4,794	5,793
2026	11,118	10,588	5,168	5,337	6,277
2027	13,138	11,656	5,475	5,584	7,465
2028	13,758	13,266	6,028	6,137	7,491
2029	15,410	15,241	6,303	6,876	7,422
2030	17,220	17,261	6,840	7,368	7,366

2031	19,220	19,561	7,277	7,878	7,255
2032	21,620	22,086	7,764	8,280	7,287
2033		24,673	8,301	8,900	7,319
2034			8,882	9,073	7,131
2035			9,521	9,644	7,005
2036				10,043	7,037
2037				10,490	7,069
2038					6,751
2039					6,441
2040					8186

Table 2 : **Comparison of Power Plans to Actual Installed Capacity.**

	Total Installed Capacity (MW)				
Year	**2011 Power Plan**	**2013 Power Plan**	**2015 Power Plan**	**2017 Power Plan**	**2020 Power Plan**
2011	**1,363**				
2012	1,503				
2013	1,532	**1,805**			
2014	2,000	2,228			
2015	2,888	2,528	**2213**		
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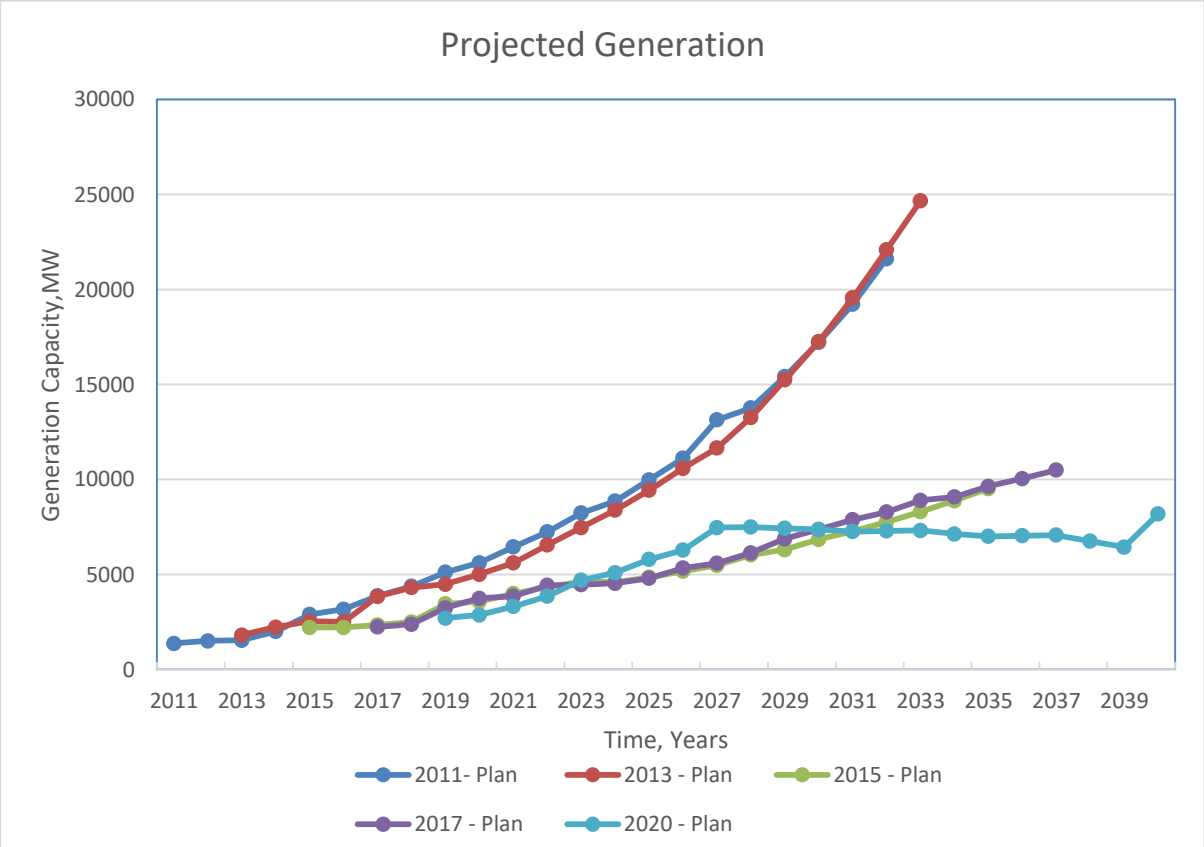

Figure 3 : **Projected Installed Capacity**

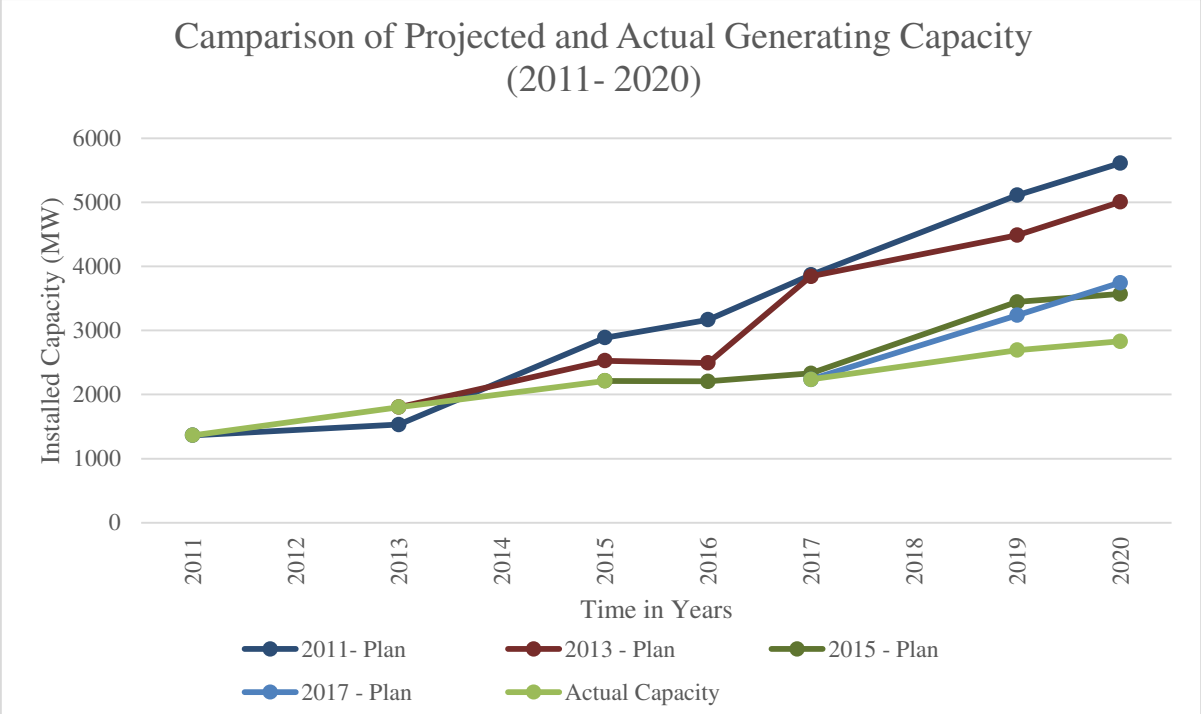

Figure 4 : Comparison of Generations Plans to Actual Capacity, 2011-2020

4 Discussion

An analysis of the planned generation capacity increase shows that there was a consistency of 2011 and 2013 least-cost power development plans. According to these plans, a high increase in generation capacity was projected. The 2011 and 2013 LCPDP plans were very optimistic with projections of a large increases in the total generation capacity. On the contrary, the 2015 and 2017 generation plans were pessimistic as the planned increase in generating capacity is minimal over the planning periods.

According to the 2020 least-cost power development plans, the total installed generation capacity is expected to increase moderately up to the year 2027, with a decrease for the remaining years of the 2020- 2040 planning period. The 2011 and 2013 LCPDP plans appear to be consistent with each other, but detailed scrutiny shows that these plans contradict each other in some years. For example, for the years 2020-2028 in these energy plans, a mismatch of between 500 - 1000MW exists. Such a mismatch is huge as is equivalent to 20-30% of the grid capacity. From the 2015 and 2017 energy plans, consistency in trend is noticed but with a great mismatch in installed capacity for a number of years. For instance, the mismatch between the years 2028-2033 ranges from 500-600MW which is large compared to the installed generation capacity.

A comparison of the actual installed generating capacity and each individual power plan equally shows recognizable inconsistencies as shown in fig 4. The actual installed capacity is below all the plans for most years of the planning periods. The 2011 and 2013 power plans are off by approximately 2000-3000MW. The mismatch for the years 2017-2020 ranges from 2000 - 3000MW signaling errors in either the planning process or project implementation. For the 2015 and 2017 LCPDP plans, the projection is closer to the actual installed capacities but off by at least 500MW. Compared to the size of the Kenyan grid, this difference is equally high as it accounts for approximately 15 - 20% of the grid capacity. In conclusion, the plans for 2011, 2013, 2015, and 2017 predict higher installed capacities than the actual generation. This clear contradiction of the energy plans for the planning periods warrants an explanation as the plans generated are expected to be accurate and consistent.

5 Conclusions

The analysis of 2011, 2013, 2015, 2017, and the 2020 LCPDP, shows that the output of the planners was not consistent. These inconsistencies can be attributed to either a poor planning process, a delayed implementation of power projects, or delayed implementation of flagship projects.

From an analysis of the planning process, the projection in demand growth is optimistic as the GDP growth rate used is above the historical averages. For all the power plans in consideration, the GDP growth rate is higher than the historical average of 5.3% for the years 2010 - 2019. It's worth noting that these optimistic demand projections were carried over to the generation and transmission expansion plans. To be precise, the low scenario projection is realistic as it uses a GDP growth rate close to the actual growth rate. However, the delayed implementation of vision 2030 flagship projects such as the electrification of standard gauge railway, smart cities, etc. could also be the reason for these inconsistencies.

Table 3 : Projected GDP Growth rates [2,3,4,5,6]

Energy Plan	Year	Reference Scenario	Historical Growth Rate
2011 - 2031	2010	4.50%	
	2011	5.20%	
	2012	5.90%	
	2013	6.60%	5.9%
	2014	7.30%	5.3%
	2015 Onwards	8.00%	5.7%
	2016		5.8%
	2017		4.9%
	2018		6.3%
	2019		5.4%
2013 - 2033		10%	
2015 - 2035	2015 - 2035	7.3%	
2017 - 2037	2017 - 2037	6.70%	
2020 - 2040	2020 - 2040	4.84%	

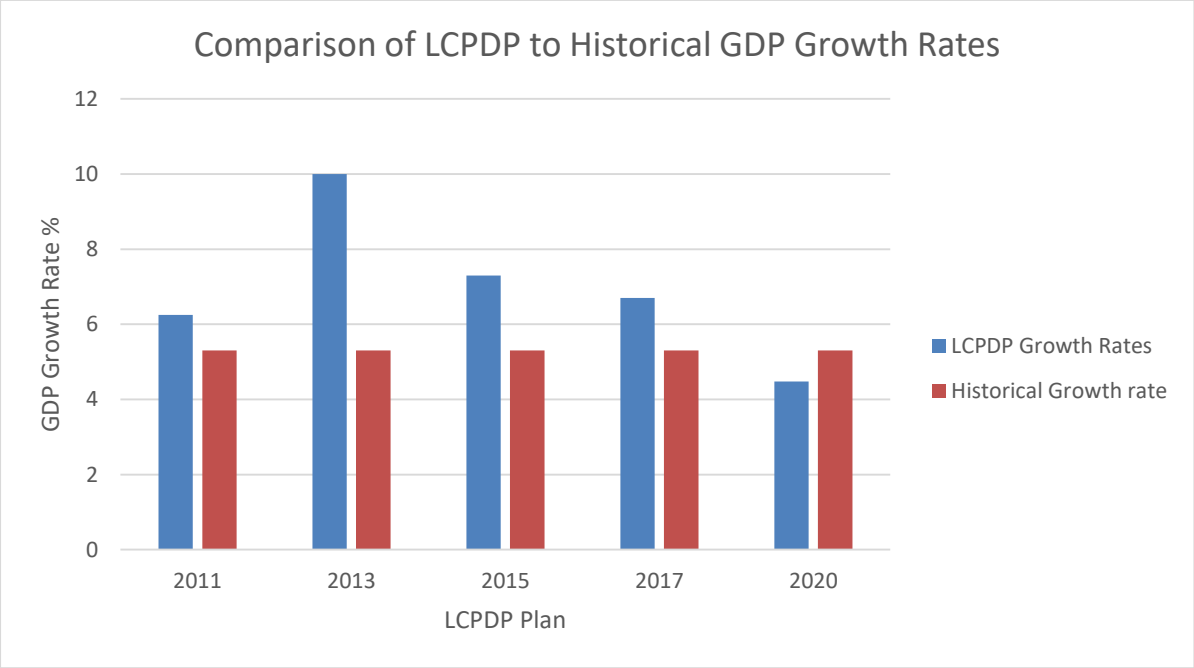

Figure 5: Comparison of LCPDP Growth rate to Historical Average

In the event that the power plans are implemented, with GDP growing at the normal rate, the generation will surpass the demand resulting to excess capacity, more capacity charges and higher power tariffs. A high cost of power would eventually slow down the country's economic growth.

From the findings of this paper, it's recommended that the energy planners should use GDP growth rates as realistic as possible, the Ministry of Industrialization Trade and Enterprise Development to revamp its efforts in fostering industrialization, for demand growth.

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